SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

MASTER CLEANERS
2312 WESTERN AVENUE
GUILDERLAND NEW YORK

Brownfield Cleanup Agreement No. C401072-11-21

PREPARED FOR:

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION
OFFICE OF ENVIRONMENTAL QUALITY REGION 4
1130 NORTH WESTCOTT ROAD
SCHENECTADY, NEW YORK 12306-2014
AND
FOUNDRY VILLAGE LLC.
450 LOUDON ROAD
LOUDONVILLE, NEW YORK 12211
AND
CHARLES BOHL INCORPORATED
2314 WESTERN AVENUE
GUILDERLAND, NEW YORK 12084

PREPARED BY:

NORTHEASTERN ENGINEERING TECHNOLOGIES PLLC
P.O. BOX 2167
BALLSTON SPA, NEW YORK 12020

DATED:

FEBRUARY 18, 2022
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"..... providing integrated geo-environmental, engineering and geotechnical services ....."

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Appendix C Community Air Monitoring Program

Appendix D Health & Safety Plan

LIST OF ACRONYMS

Brownfield Cleanup Agreement	BCA
Brownfield Cleanup Program	BCP
Compound of Concern	COC
Chlorinated Volatile Organic Compound	CVOC
Division of Environmental Remediation	DER
Direct Push	DP
Data User Summary Report	DUSR
Engineering Control	EC
Environmental Conservation Law	ECL
Environmental Laboratory Approval Program	ELAP
Environmental Protection Agency	EPA
Institutional Control	IC
Interim Remedial Measure	IRM
Macro Core	MC
Mean Sea Level	MSL
Northeastern Engineering Technologies	NET
Northeastern Environmental Technologies Corp.	NETC
New York State Department of Environmental Conservation	NYSDEC
Occupational Safety and Health Administration	OSHA
Tetrachloroethylene	PERCPCE
Per & Polyfluoroalkyl Substances	PFAS
Photoionization detector	PID
Personal Protective Equipment	PPE
Quality Assurance Project Plan	QAPP
Remedial Action Work Plan	RAWP
Remedial Investigation Report	RIR
Remedial investigation Work Plan	RIWP
Standards, Criteria & Guidance	SCG
Sampling Quality Assurance	SQA
Supplemental Remedial Investigation	SRI
Supplemental Remedial Investigation Work Plan	SRIWP
Sole Source Aquifer	SSA
Trichloroethylene	TCE
United States Department of Agriculture	USDA
United States Geologic Survey	USGS
Volatile Organic Compound	VOC

ENGINEERING CERTIFICATION

I, Keith D. Rupert, P.E. , certify that I am currently a NYS registered professional engineer and that this Supplemental Remedial Investigation Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-1O).

Keith D. Rupert, P.E. License No. 066843-1

1.0 INTRODUCTION

Charles Bohl Incorporated entered into a Brownfield Cleanup Agreement (BCA) [Index No. C401072-10-16] as a "Volunteer" on December 29, 2016, for the purpose of investigating and remediating a single 0.43 acre parcel of land located in the Town of Guilderland, New York (Tax Id No 40.17-2-12). The 0.43-acre parcel was formerly operated as a Master Cleaners dry-cleaning facility which ultimately resulted in the release of the chlorinated dry-cleaning compound Tetrachloroethylene (PCE) to the subsurface. In October 2017, the New York State Department of Environmental Conservation (NYSDEC) approved a Remedial Investigation Work Plan (RIWP) that was subsequently implemented in 2018 by C.T. Male Associates. A Remedial Investigation Report (RIR) dated January 29, 2019, revised July 12, 2019, detailing the findings of the investigation work was accepted and approved by the NYSDEC.

In July 2021 Charles Bohl Incorporated and Foundry Village LLC submitted a Brownfield Cleanup Program (BCP) application to the NYSDEC for the purpose of amending the existing BCA between Charles Bohl Incorporated and the NYSDEC. The BCP amendment application request was for the purpose of adding Foundry Village LLC as a Volunteer and to modify the boundary of Master Cleaners Site No. C401072 to include an adjacent 3.2-acre parcel (i.e., Tax Map No. 40.17-2-11.1) located at 2314-2316 Western Ave. Guilderland, NY (hereinafter termed the "Site"). The NYSDEC approved this request and a new BCA between Foundry Village LLC and Charles Bohl Incorporated (hereinafter termed "applicants") and the NYSDEC was executed on November 22, 2021 [Index No. C401072-11-21].

On behalf of the BCP applicants; Northeastern Engineering Technologies, PLLC (NET) has prepared this Supplemental Remedial Investigation Work Plan (SRIWP) to further assess the environmental conditions at the adjacent 3.2-acre parcel. The objective of the SRIWP is to characterize the nature and extent of chlorinated volatile organic compounds (CVOC) and other related chemical impacts at the Site and to provide sufficient information for the development of an appropriate Remedial Action Work Plan (RAWP), as required by the BCP.

This SRIWP was developed in accordance with the process and requirements identified in the NYSDEC Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation (May 2010) and addresses technical comments received from the NYSDEC on June 1, 2022. The proposed scope of work includes the installation of soil borings and monitoring wells as well as the collection and analysis of on-site soil and groundwater samples.

2.0 SITE BACKGROUND

2.1 Site Description

The Site is located at the southeast corner of the intersection between NYS Route 20 (aka Western Avenue) and Foundry Road in the Town of Guilderland, Albany County, New York (see **Appendix A**, **Figure 1**). The Site consist of two contiguous parcels of land identified by the Town of Guilderland as Tax Map No.'s 40.17-2-11.1 (3.2 acres) and 40.17-2-12 (0.42 acres), see **Figure 2**. The respective addresses associated with the tax map listings are 2314-2316 Western Avenue and 2312 Western Avenue.

The 2314 - 2316 Western Avenue (Tax Map No. 40.17-2-11.1) portion of the Site is improved by one vacant two-story (5) unit wood framed residential apartment building completed atop of a concrete foundation and full basement; one vacant two-story concrete block and wood framed garage completed at grade with improved concrete floor surfaces and two vacant second floor residential apartments; one vacant single story concrete block and wood framed garage completed at grade with improved concrete floor surfaces; one vacant single-story wood framed storage barn completed at grade, portions of which are improved by concrete floor surfaces; and an approximate 7,000 ft² remnant concrete foundation ruin for a commercial garage.

The 2312 Western Avenue (Tax Map No. 40.17-2-12) portion of the Site is improved by one vacant single-story concrete block and wood framed structure completed with a slab on-grade foundation. The structure was most recently operated as Master Cleaners & Dyers Inc. a commercial dry-cleaning facility.

2.2 Site History

Information received from the Town of Guilderland suggest Hamilton Glass Works & Dowesburgh Glass Works of Foundry Road operated from portions of the site in the early 1800's. The Guilderland Foundry an iron casting business reportedly operated from portions of the Site in the 1860s. Subsequent commercial establishments at the Site which are considered germane to this BCP application include historic automotive repair and fuel storage activities of the Former Bohl Bros Bus Line, Inc. and commercial dry-cleaning operations of Master Cleaners during the period from at least the 1950's – 2000's. Subsurface investigations and tank closure work conducted during the period of May 2015 – November 2015 resulted in the identification petrochemical and chlorinated solvent impacts at the site. As a result, the site was issued (3) NYSDEC Spill No.'s for administration of the documented impacts (1502134, 1507597 & 1508420). Subsequent UST closure and source removal work performed at the site for petrochemical impacts associated with NYSDEC Spill No.'s 1502134 and 1508420 resulted in the Department issuing "No Further Action" letters for each release. Conversely, chlorinated impacts associated with the former Master Cleaners, which operated from the 2312 Western Ave. portion of the site, was initially accepted into the BCP in on December 29, 2016.

2.3 Surrounding Land Use

The Site is bound to the north by Western Avenue beyond which exists the Guilderland Fire District, Lexington Center, Schoolcraft Cultural Center, and Hamilton Union Presbyterian Church; to the west by Foundry Road beyond which exist residential properties; to the east by undeveloped land; and to the south by undeveloped wooded land and residential properties.

2.4 Physical Setting Sources

2.4.1 Topography

According to the contour lines on the 1954 United States Geological Survey (USGS) Voorheesville 7.5-minute series topographic map, the majority of the Site is located at an elevation of approximately 200 feet above mean sea level (msl). The general area appears to be relatively flat

to gently sloping towards the south. The southern portions of the Site contain steeply sloping terrain.

2.4.2 Soils/Geology

Based on Soil Survey map accessed through the United States Department of Agriculture (USDA) Soil Conservation Service web site, at https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm, the Site is mapped with four soil types; as discussed below:

Hudson silt loam, 8-15% slopes (HuC) - This strongly sloping soil is very deep and moderately well drained. It is on knolls and hillsides. Areas of this soil are oblong or irregularly shaped and range from 3 to 50 acres in size. Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsurface layer is brown, mottled silt loam about 3 inches thick. The subsoil extends to a depth of about 31 inches. The upper part is brown silty clay loam. The lower part is brown silty clay. The substratum extends to a depth of 60 inches or more. It is brown, varved silt and clay.

Hudson silt loam, 25-45% slopes (HuE) - This steep soil is very deep and moderately well drained. It is on hillsides and side slopes of streambanks and large gullies. In many areas, evidence of past and present landslides or slumps is apparent along large streams. Areas of this soil are long and narrow and range from 25 to 200 acres in size. Typically, the surface layer is dark brown silt loam about 8 inches thick. The subsurface is brown, mottled silt loam about 3 inches thick. The upper part of the subsoil is brown silty clay loam, and the lower part is brown silty clay. The substratum is brown, varved clay and silt to a depth of 60 inches or more.

Urban land-Udorthents complex, 0-8% slopes (Ut) - This map unit consists of nearly level and gently sloping areas of Urban land and areas of clayey and loamy Udorthents. Areas of this complex are irregularly shaped or oval and range from 5 to 150 acres. Areas of this complex are about 50 percent Urban land, 30 percent Udorthents, and 20 percent other soils. Udorthents are mostly covered by concrete, asphalt, buildings, or other impervious materials. The Urban land and Udorthents in this map unit are so intermingled that separating them in mapping was not practical. Slopes range from 0 to 8 percent. Typically, the surface layer of Udorthents is dark brown silt loam about 5 inches thick. The layers below the surface to a depth of 60 inches or more are brown and yellowish brown silt loam to silty clay that contains as much as 40 percent rock fragments.

Elmridge fine sandy loam, 3-8% slopes (EIB) - This gently sloping soil is very deep and moderately well drained. It is on glacial lake plains. Areas of this soil are irregularly shaped and range from 3 to 35 acres. Typically, the surface layer is dark brown fine sandy loam about 9 inches thick. The subsoil is 19 inches thick. The upper part is yellowish brown fine sandy loam; the middle part is yellowish brown, mottled loamy fine sand; and the lower part is dark yellowish brown and light olive brown, mottled clay loam. The substratum extends to a depth of 60 inches or more. It is reddish brown, brown, and pinkish gray, mottled silty clay or clay that has varves of grayish brown fine sand.

The Site is situated in the Hudson-Mohawk Lowlands physiographic province. The bedrock geology in the immediate vicinity of the Site consists of Paleozoic sedimentary deposits. The bedrock beneath the Site is most likely composed of undivided late Ordovician age shale, siltstones, and sandstones.

Site specific geologic information document the near surface unconsolidated deposits at the Site [as visually classified using the Unified Soil Classification System] as a fining downward sequence of sand, silt and clay that alternates between silt/sand layers and silt/clay layers. A layer of gray clay/silt is reported to be present approximately 13 to 15 feet below grade, followed by a mottled

gray and brown clay/silt confining layer which extends to depths in some cases > 25 feet below grade.

2.4.3 Hydrology

According to the United States Geologic Map (www.water.usgs.gov), the Site is located in the Mid-Atlantic Hydrologic Unit in the Lower Hudson River drainage basin. According to the EPA Designated Sole Source Aquifer (SSA) in Region 2 website (www.epa.maps.arcgis.com), the Site is not located in a sole source aquifer. Groundwater in the vicinity of the Site is not used for drinking water. Properties in the study area are serviced by the Town of Guilderland municipal water supply. Based upon elevation data recorded at the Site groundwater generally flows from the northeast to the southwest toward Hunger Kill.

A network of groundwater monitoring wells exist at the Site. These monitoring wells have been installed as part of the prior BCA between Charles Bohl Incorporated and the NYSDEC for the purpose of evaluating the release of the dry-cleaning compound PCE and its related breakdown daughter components from the Master Cleaners & Dyers Inc. facility. No other on-site water wells, settling ponds, lagoons, or surface impoundments were observed on the Site during this investigation.

Groundwater levels in the network of monitoring wells ranges from approximately 3 – 23 feet below grade; apparent shallow groundwater flow is to the west – southwest.

2.4.4 Surface Water Features

The closest mapped surface water body is the Hunger Kill which is located approximately 150 feet west-southwest of the Site. An unmapped intermittent stream borders the eastern property line. Surface water from the unmapped stream enters the Hunger Kill south of the Site. The Hunger Kill is a tributary to Normans Kill which enters the Hudson River in Bethlehem, New York.

2.4.5 Wetlands

Based on wetland data accessed through the NYSDEC's Environmental Resource Mapping web site, at https://gisservices.dec.ny.gov/gis/erm/, the Site is not depicted to contain any New York State regulated wetlands or to be located in a New York State regulated wetland check zone. However, the National Wetlands Inventory identifies areas of the Site immediately adjacent to the Hunger Kill and its tributary as Riverine wetlands. Freshwater wetland boundaries are subject to amendment; the boundaries depicted are current as of the publication date of the map and/or revision date. The freshwater wetlands for all filed counties are shown on official maps available at the regional offices of the NYSDEC, the county office of the SCS, and at the office of the clerk of each local government. It is recommended that the regulating agencies (Army Corps of Engineers, NYSDEC, and possible local jurisdiction) delineate the location of wetland boundaries prior to (if any) construction projects within designated wetlands, or within adjoining regulated "buffer zones".

2.5 Proposed Redevelopment Plan

The contemplated re-development plan for the proposed Foundry Village project includes developing multi-story, mixed retail commercial, residential use structures which are to be constructed atop of a lower level parking garage on the Site and (3) other contiguous parcels of land (i.e., Tax Map No.s 40.17-2-11.1, 13, 14 and 51.00-1-1). The completion of the proposed Foundry Village project will provide an overall net benefit to all parties (citizens, businesses, services) within the immediate vicinity of the Site and to those within the community of the Town of Guilderland.

2.6 Environmental History

Based upon the investigations conducted to date, the primary contaminants of concern for the Site are the chlorinated volatile organic compound CVOC PCE and its breakdown daughter compounds Trichloroethylene (TCE), cis-1,2-Dichloroethene and Vinyl Chloride. A summary of know contaminants in the on-site soil and groundwater are summarized below.

- Soil – The CVOCs have been detected in subsurface soils at concentrations above the 6 NYCRR Part 375 Restricted Residential SCOs in areas primarily beneath, adjacent to and down gradient of the former Master Cleaners dry-cleaning facility. PCE was detected at concentrations up to 21,000 parts per million (ppm) in shallow soils within a building sump. PCE-related breakdown products are also present in deeper soils (approximately 6 -16 feet below grade) including TCE at concentrations up to 110 ppm, cis-1,2-Dichloroethene (cis-1,2-DCE) up to 70 ppm, trans-1,2-Dichloroethene (trans-1,2-DCE) up to 0.31 ppm, and Vinyl Chloride up to 3.2 ppm.

- Groundwater – The CVOCs have been detected in groundwater samples collected from the network of (21) on site monitoring wells at concentrations above the NYSDEC 6 NYCRR Part 703 groundwater standard. Total CVOC concentrations have been identified within the network of monitoring wells ranging from approximately 1 – 200,000 ug/L. The most significant groundwater exceedances (above 10, 000 ug/L) have been documented to exist beneath the former Master Cleaners dry-cleaning facility and extending approximately500 feet to the south, mimicking the flow groundwater.

- Soil Vapor & Indoor Air – PCE was detected in soil vapor at concentrations up to 3,860 micrograms per cubic meter (ug/m^3), TCE up to 1,140 ug/m^3, cis-1,2-DCE up to 1,050 ug/m^3, trans-1,2-DCE up to 61.5 ug/m^3, and vinyl chloride up to 2.81 ug/m^3.

2.7 Summary of Previous Investigations

Environmental reports identified for the site are listed below;

- Tank Closure Report– 2314 Western Avenue, Town of Guilderland, New York. NYSDEC Spill No.1502134. Prepared by Albany Tank Services, Inc., dated June 29, 2016

- Environmental Activities Report – Former Bohl Bros Bus Line, Inc. 2316 Western Avenue, Town of Guilderland, New York. NYSDEC Spill No. 1508420. Prepared by PS Property Solutions, Inc., dated April 15, 2016.

- Phase 2 Subsurface Investigation Report – 2312 Western Avenue, Town of Guilderland, New York. NYSDEC Spill No. 1507597, Prepared by PS Property Solutions, Inc., dated November 30, 2015.

- Remedial Investigation Report - Master Cleaners Site (BCP#C401072). 2312 Western Avenue, Town of Guilderland, New York. Prepared by C.T. MALE ASSOCIATES, dated January 29, 2019 (Revised July 12, 2019)

- Supplemental Groundwater Investigation Report – Master Cleaners Off-Site. 2312 Western Avenue, Town of Guilderland, New York. Prepared by Precision Environmental Services Inc., dated June 2, 2020

- Supplemental Soil Quality Data –Foundry Village 2298-2316 Western Avenue, Town of Guilderland, New York. May 2020 Soil Boring Logs & Analytical Data developed by Northeastern Environmental Technologies Corp.

3.0 SCOPE OF WORK

3.1 Objective

The objective of this SRIWP is to further delineate the extent of the CVOC release in relationship to the recently amended BCA Site boundary (i.e., the recently added 3.2-acre parcel), per Environmental Conservation Law (ECL) Article 27, Title 14 (Brownfield Cleanup Program). The readily available reports and the most current conceptual Site redevelopment plan were used to develop an investigative approach to further characterize the extent of Site contaminants. The focus of SRIWP is to supplement existing data and where need fill in data gaps to complete an appropriate level of investigation in support of developing an appropriate RAWP to reduce the risk to human health and the environment from Site related contaminants. Potential remedial actions will be based upon the totality of the existing and supplemental information developed during the SRIWP and presented in the alternatives analysis evaluation. The field tasks are discussed in more detail in the following sections.

Existing Monitoring Well Inspection & Replacement

- Inspect and gauge existing onsite monitoring wells for presence of groundwater and light non-aqueous phase liquids (LNAPL).

- Existing onsite monitoring wells that do not have available surveying information (i.e., well location coordinates, top of well elevation and ground elevation), in addition to newly constructed wells/borings, will be located with a global positioning system (GPS) so their location and elevations can be accurately depicted on figures. Longitudinal and latitudinal coordinates will be located to a minimal of 6 decimal places and top of well and ground elevations will be recorded to the nearest 0.01ft.

Soil Borings and Sampling

- Seven (7) soil borings (i.e., NE-46, NE-47, NE-48, NE-49, NE-50, NE-51 & NE-52) will be completed at the Site. To avoid creating a potentially deeper migration pathway for CVOCs soil borings will be completed to depths no greater than 10 feet below the groundwater table or approximately 5 feet below impacts documented in the field whichever occurs first.

- Collect (1) surface soil sample & (3) subsurface soil samples from each of the (7) soil borings, for a total of up to (28) soil samples (plus quality assurance/quality control [QA/QC] samples) to be selected for volatile organic compound (VOC) laboratory analysis via EPA Method 8260. Sample selection will be based in part on field screening, visual and olfactory observations. In absence of impacts VOC subsurface soil samples will be collected at the groundwater table, 5 feet below the groundwater table and at the base of the soil boring.

- Collect (1) surface soil sample and (1) subsurface soil sample from (6) of the soil borings, for a total of up to (12) soil samples (plus quality assurance/quality control [QA/QC] samples) to be selected for laboratory analysis for the following target compound list/target analyte list (TCL/TAL) of compounds; Semi-VOCs (EPA Method 8270), TAL Metals (EPA Method 6010B), Mercury (EPA Method 7471A), Total Cyanide (EPA Method 9012), Hexavalent Chromium (EPA Method 7196A), Pesticides (EPA Method 8081), PCBs (EPA Method 8082), 1,4-Dioxane (EPA Method 8270 SIMS), and EPA Method 1633 . Sample selection will be based in part on field screening, visual and olfactory observations. In the absence of impacts subsurface soil samples will be collected at the groundwater table.

Monitoring Well Installation and Groundwater Sampling

- Install and develop (6) ¾ inch PVC monitoring wells; (1) at each of the following soil boring locations; NE-46, NE-47, NE-48, NE-49, NE-50 & NE-51.

- Collect (1) groundwater sample from each of the (6) newly installed monitoring wells (i.e., NE-46, NE-47, NE-48, NE-49, NE-50, & NE-51) and from existing monitoring well locations MW-19-14, MW-19-16, MW-19-21, MW-19-25, MW-19-26, MW-19-28, MW-19-30, MW-33, MW-34, MW-35, CTMMW-9 and CTMMW-10 (plus QA/QC samples) for VOC laboratory analysis via EPA Method 8260.

- Collect (1) groundwater samples from each of the (6) newly installed monitoring wells and existing monitoring well MW-19-28 (plus QA/QC samples) for laboratory analysis for the following TCL/TAL list of compounds; Semi-VOCs (EPA Method 8270), TAL Metals (EPA Method 6010/200.7 ICP), Mercury (EPA Method 7471A), Total Cyanide (SM 4500 CN-E), Pesticides (EPA Method 8081), PCBs (EPA Method 8082), 1,4-Dioxane (EPA Method 8270 SIMS), and EPA Method 1633 .

Sanitary Sewer Line Evaluation

- Locate and evaluate the position of the sanitary sewer line in the vicinity of MW-19-25, which services the building southwest of the former Master Cleaners, relative to the groundwater table.

3.2 Soil Boring / Monitoring Well Installation Program

To address data gaps on the recently added 3.2-acre parcel (7) soil borings will be installed across the Site (see **Figures 3** & **4**). The soil borings will be advanced using direct push (DP) sampling methods approximately10 feet below the groundwater table or approximately 5 feet below CVOC impacts documented in the field. Proposed soil borings NE-46, NE-47, NE-48, NE-49, NE-50 & NE-51 will be completed with a 3/4 inch flush joint, schedule 40 PVC monitoring well with approximately 10 feet of prepacked slotted well screen.

The monitoring wells will be constructed with approximately 10 feet of well screen positioned to straddle the surface of the groundwater table. If soil impacts are observed deeper than the shallow groundwater table the monitoring well will be constructed to screen the zone of impact. The annular space around and approximately 2 feet above the well screen will be filled with a clean filter pack material graded for the slot size of the well. A bentonite seal will be installed above the sand pack with the remainder of the bore-hole will be filled with a cement grout surface seal. A steel protective manhole cover or protective casing will be installed to prevent unauthorized access and provide protection for the well.

A NYS licensed professional geologist will supervise all aspects of the drilling program and be responsible for detailed logging of all samples. As part of the soil boring / monitoring well installation program, the professional geologist will perform periodic examinations of the ambient air space surrounding the work zone, and the open bore hole to evaluate the presence of VOCs. A MiniRae 3000 or equivalent photoionization detector (PID) or equivalent instrument will be used to facilitate the testing requirements. The information acquired will be used to determine the level of health and safety equipment necessary to accomplish the proposed work. At this time, level "D" conditions are assumed for all drilling services.

3.2.1 Surface Soil Sampling

Surface soil samples are anticipated to be collected from each of the (7) proposed soil boring locations across the Site. The surface soil samples will be collected from approximately 0 – 2.0 inches below grade if the sampling point does not lie within a vegetated location (i.e., exposed surface soils). At locations where there is vegetation, the vegetation will be removed to a point below the root zone and the surficial soil sample will be collected to a depth of approximately 0 – 2.0 inches below the root bearing zone. In areas where asphalt and/or concrete exist, the sample will be collected of soils

immediately beneath the asphalt/concrete to a depth of approximately 0 – 2.0 inches below the improved surface.

It is anticipated that at a minimum (7) surface soil samples will be submitted for TCL/TAL VOC laboratory analysis via EPA Method 8260 and (6) surface soil samples will be submitted for laboratory analysis for the full TCL/TAL, 1,4-Dioxane (EPA Method 8270 SIMS), and EPA Method 1633 . Samples will be maintained at a temperature of 4°C by commercially available (pre-frozen) "ice-packs" and appropriate holding and transportation times will be followed. Per- and Polyfluoroalkyl substances (PFAS) samples will be maintained at a temperature of 4°C by regular ice through the transportation of the samples.

All PFAS samples will be collected in accordance with the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. Formal chain of custody documentation will be maintained throughout the shipment of the samples to a NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory. All samples will be submitted as a Category B data deliverable for the purpose of developing a data usability summary report (DUSR) by a third party laboratory.

3.2.2 Subsurface Soil Sampling

A series of macro-core (MC), large bore and / or split spoon soil samplers, consisting of a drive head, barrel, and drive shoe, will be used to collect the subsurface soil samples during the drilling program. All soil samples will be logged on site as they are extracted, labeled, and retained for additional VOC analysis. All sampling equipment will be pre-cleaned prior to use.

Samples obtained in this manner will be examined and visually described using the Modified Burmister and Unified Soil Classification Systems. Samples will be retained in glass jars sealed with aluminum foil-lined screw top lids. In compliance with ASTM methods, the sample jars will be labeled with the following information: job designation, boring number, sample number, depth of sample, depth penetration record and length of recovery.

It is anticipated that at a minimum (21) subsurface soil sample will be submitted for TCL/TAL VOC laboratory analysis via EPA Method 8260 and (6) subsurface soil samples will be submitted for laboratory analysis for the full TCL/TAL, 1,4-Dioxane (EPA Method 8270 SIMS), and EPA Method 1633 . Samples will be maintained at a temperature of 4°C by commercially available (pre-frozen) "ice-packs" and appropriate holding and transportation times will be followed. Per- and Polyfluoroalkyl substances (PFAS) samples will be maintained at a temperature of 4°C by regular ice through the transportation of the samples.

All PFAS samples will be collected in accordance with the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. Formal chain of custody documentation will be maintained throughout the shipment of the samples to a NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory. All samples will be submitted as a Category B data deliverable for the purpose of developing a data usability summary report (DUSR) by a third party laboratory.

3.2.3 Soil Gas Screening

As part of the subsurface investigative program, the responsible NYS licensed professional geologist will perform examinations for VOCs on all soil samples obtained. A MiniRae 3000 PID or equivalent will be used for the screening work. Photoionization uses ultraviolet light to ionize many trace compounds (especially organic) and the PID employs this principal to measure the concentration of trace gases. In the PID, a chamber adjacent to the ultraviolet light source contains a pair of electrodes. When a positive potential is applied to one electrode, the field created drives any ions in the chamber to the collector electrode where current is measured. Measured current is proportional to the concentration of organic sampled by the instrument's probe. Useful range of the instrument is from 0.1 to 3,000 ppm. The headspace in the half-filled sample bags will be evaluated with the PID probe.

The field PID data will be used to direct the soil sample acquisition work, estimate the areal and vertical extent of chemical impacts to soil.

3.2.4 Decontamination Procedures

Prior to drilling the first boring, the equipment to be used in drilling and sampling will be cleaned to remove possible contaminants encountered during drilling at previous jobs. All equipment, which is to come in contact with the soil or groundwater, will undergo the initial cleaning procedure. While working at the site, the drilling equipment will be decontaminated between soil borings to prevent cross-contamination. The cleaning process will involve the use of high-pressure wash. Uncontaminated water, collected at the site from the municipal water supply of the Town of Guilderland, will be used for all decontamination procedures.

All decontamination activities will be performed within a designated decontamination pad established at the site. Decontamination waters resultant from the proposed work will be containerized in 55 gallon open head salvage drums. All investigation derived waste, including excess soil cuttings, purge water, and decontamination fluids generated during this SRIWP will be properly containerized in DOT shippable containers and characterized prior to disposal at an appropriate disposal facility.

3.3 Groundwater Sampling Program

To evaluate the downgradient extent of the dissolved phase CVOC groundwater impacts and to aid with the development of an appropriate remedial treatment design groundwater samples will be collected each of the proposed monitoring wells (i.e., MW-46, MW-47, MW-48, MW-49, MW-50 and MW-51) installed for this matter and from a subset of the existing network of onsite monitoring wells (i.e., CTMMW-09, CTMMW-10, MW-19-16, MW-19-25, MW-19-26, MW-19-28, MW-19-30, MW-33, MW-34 and MW-35). Prior to any groundwater sample collection services, static water levels will be measured to the nearest one-hundredth of a foot in each monitoring well. The presence of non-aqueous phase liquids (NAPL) will be evaluated in the network of monitoring wells using an interface probe. Concomitant with the development process temperature, pH, specific conductance, dissolved oxygen, and turbidity will be measured until these parameters show little change, indicating that fresh, representative groundwater is entering the well or three well volumes have been removed from the well. Sampling services will occur when a sufficient volume of water has recovered (i.e., fresh aquifer water has entered the well) in the designated wells. Sampling will be performed using low flow sampling methods, when practical.

All samples will be collected in such a manner as to minimize agitation and other disturbing conditions, which may cause physiochemical changes and bring about losses due to volatilization, adsorption, redox changes, or degradation. Samples will be maintained at a temperature of 4°C by commercially available (pre-frozen) "ice-packs" and appropriate holding and transportation times will be followed. Per- and Polyfluoroalkyl substances (PFAS) samples will be maintained at a temperature of 4°C by regular ice through the transportation of the samples. Each of the (16) groundwater samples will be submitted for chemical analysis for the full TCL/TAL for VOCs via EPA Method 8260 testing criteria.

To evaluate for the presence of emerging contaminants and other programmatic parameters groundwater samples from each of the (6) proposed monitoring wells and existing monitoring well MW-19-28 will also be submitted for chemical analysis for the full TCL/TAL for Semi-VOCs (EPA Method 8270), TAL Metals (EPA Method 6010/200.7 ICP), Mercury (EPA Method 7471A), Total Cyanide (SM 4500 CN-E), Pesticides (EPA Method 8081) and PCBs (EPA Method 8082) and for the emerging contaminants 1,4-Dioxane (via EPA Method 8270 SIMS) and PFAS via EPA Method 1633 . All PFAS samples will be collected in accordance with the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. Formal chain of custody documentation will be maintained throughout the shipment of the samples to a NYSDOH ELAP certified laboratory. All volatile and emerging contaminant samples will be submitted as a Category B data deliverable for the purpose of developing a DUSR by a third party laboratory.

3.4 Groundwater Aquifer Characterization

Hydraulic conductivity tests (i.e., slug and / or bail) will be completed in the field at monitoring wells CTMMW-10, MW-19-14, MW-19-26 and MW-19-28. Groundwater levels changes documented at each well will be monitored in real time using down-hole pressure transducer equipment and electronic data-logging field instrumentation (i.e., In-Situ Level Troll or equivalent). A minimum of (3) tests will be conducted at each monitoring well location to demonstrate & support conditions documented at each monitoring well. The hydraulic conductivity information & groundwater gradient data from the network of monitoring wells will be used to estimate groundwater & contaminant flow rates in the shallow groundwater system(s).

3.5 Sanitary Sewer Line Evaluation

A combination of remote sensing and physical inspections services will be completed in the vicinity of MW-19-25 and a vacant building that is located over the western CVOC groundwater plume. The objective of this field work is to document the location and relative elevation [with respect to groundwater] of a sewer line lateral which reportedly connect the vacant building s to the Town of Guilderland sanitary sewer system.

The remote sensing survey will involve the use of a Noggin 250 plus Smart Cart ground penetrating radar (GPR) profiling system. GPR technology uses radio waves to image objects in the subsurface. The subsurface may consist of sands, silts, clays, rock, or a combination thereof. GPR systems emit high frequency radio wave pulses and detect the echoes that return from objects within the subsurface. Echoes are produced when the target material is different from the host material (e.g., PVC pipe in sand). Under favorable conditions the GPR is able to locate buried objects up to 6.0 – 8.0 feet below grade. Profile records will be interpreted in the field and retained for later interpretation as to the presence of a buried sanitary sewer line.

Based on the results of the GPR survey a test pit excavation will be advanced to evaluate the sewer lateral and its relative position to the groundwater table. A geologist will direct the excavation services and be responsible for documenting conditions encountered during the excavation work. As part of the test pit excavation program, NETC will perform periodic examinations of the ambient air space surrounding the work zone, to evaluate the presence of VOC. A Mini Rae 3000 PID or equivalent will be used to facilitate the testing requirements.

The need to pursue additional site characterization measures will be based on conditions documented in the field and input from the NYSDEC and the NYSDOH.

4.0 QULAILTY ASSURANCE PROJECT PLAN

The Quality Assurance Project Plan (QAPP) describes the quality assurance and quality control procedures to be followed from the time media samples are collected to the time they are analyzed by the environmental analytical laboratory and evaluated by a third party according to the NYSDEC DUSR guidelines. The QAPP is presented in **Appendix B** of this SRIWP.

The QAPP will be followed by field personnel during the Site investigation activities and media sampling events. It will also be used by the project management team and Quality Assurance Officer to assure the data collected and generated is representative and accurate.

The laboratory results will be reported with NYSDEC ASP Category B deliverables, which will be subjected to NYSDEC's DUSR guidelines to determine if the data is valid and usable. The QAPP will also identify the requirements for how to report environmental analytical data to NYSDEC. Data submitted to NYSDEC will be stored in the agency's Environmental Information Management System (EIMS). NYSDEC uses EQuIS software, developed by EarthSoft, specifically as the EIMS. The QAPP will set forth the procedural and formatting requirements for creating and submitting electronic data deliverables (EDDs) to NYSDEC.

5.0 COMMUNITY AIR MONITORING & HEALTH AND SAFETY PLAN

Community Air Monitoring will be implemented during all ground intrusive activities. Community Air Monitoring will be completed in accordance with the New York State Department of Health Generic Community Air Monitoring Plan (CAMP) dated May 2010. A copy of the CAMP is provided in **Appendix C** of this SRIWP.

A total of two (2) organic vapor and two (2) particulate (dust) monitors will be used for the CAMP. The locations of the environmental enclosures each containing the two instruments will be selected on a daily basis on the basis of the prevailing wind direction. The prevailing wind direction will be determined based on review of available weather data such as Weatherbug and/or temporary wind direction markers installed in the field such as a wooden stake and light/loose flagging. The location and wind direction shall be recorded daily in the field notes.

The project specific Health and Safety Plan will be used to address all activities (soil boring, monitoring well installation, and sampling work), risks, and controls (see **Appendix D**). Engineering controls, administrative controls, and personal protective equipment (PPE) will be used as required to keep the project workforce safe.

All workers involved with the SRIWP work and working within controlled areas will have 40-hour Occupational Safety and Health Administration (OSHA) hazardous waste worker training as required under 29 CFR 1910.120. The work area around the soil boring locations will be controlled so that only workers and escorted visitors who meet training requirements may enter the area. Contaminant vapors within the soil boring work zone will be monitored throughout the soil boring and monitoring well installation work with a PID to determine the appropriate levels of worker PPE.

The following activities and risk are associated with the proposed supplemental SRIWP work. Mitigation measures are listed in parentheses.

Physical Hazards

- Underground Utilities (use lockout/tag out, locate utility line before digging, UFPO).
- Installation of soil borings and monitoring wells using drilling equipment (requires close oversight to avoid pinch points, hart hats and safety vests).

Chemical Hazards

- Workers exposed to volatile contaminants (monitor using a PID, use respirators if required).

6.0 PROPOSED SCHEDULE & REPORTING

6.1 General

Upon completion of SRIWP activities and receipt of the analytical laboratory data and DUSR, a Draft Supplemental Remedial Investigation (SRI) Report will be prepared and submitted to NYSDEC. The SRI Report will summarize the investigations completed as well as any non-conformance to the approved SRIWP. The report will present the investigations at the Site, analytical results of samples collected and analyzed, interpretations of the data, overall conclusions regarding residual Site contaminants, and recommendations for further investigative work and/or Interim Remedial Measures (IRMs) or Remedial Measures, if any. Upon review and acceptance by the NYSDEC, the final approved RI Report will be submitted in electronic format, as requested by the NYSDEC.

The anticipated project schedule proposed for this matter is as follows:

- Receive NYSDEC Approval of SRIWP — Week of October 24, 2022
- Initiate SRIWP Work — Week of November 28, 2022
- Complete SRIWP Sampling Work — Week of December 26, 2022
- ABD Survey of Sample Locations — Week of December 26, 2022
- Receive Data Validation Packages — Week of January 30, 2023
- Submission of SRI Status Report — Week of February 21, 2023
- Receive NYSDEC Comments on SRI Report — Week of March 27, 2023
- Submit Revised SRI Report — Week of April 24, 2023
- Receive NYSDEC Approval of SRI Report — Week of May 22, 2023

6.2 Remedial Action Work Plan

The development and analysis of remedial alternatives will be based upon the totality of the data developed during the initial RIR submitted for 0.43 acre Master Cleaners BCA and the SRI Report data developed for the existing BCA.

At a minimum, the RAWP will evaluate no action relative to the documented conditions disclosed through the investigation and an action that would reduce/remove all documented media impacts to levels below applicable standards, criteria and guidance values (SCGs). The NYSDEC will ultimately select a remedy that is both protective of human health and the environment from an approved RAWP.

Once developed, a detailed evaluation will be conducted on the alternatives pursuant to factors identified in 6 NYCRR 375-1.10(c). These criteria include:

(1) Overall protection of public health and the environmental;
(2) Compliance with Standards, Criteria, and Guidance Values (SCGs);
(3) Short-term effectiveness;
(4) Long-term effectiveness;
(5) Reduction of toxicity, mobility, and volume;
(6) Implementability;
(7) Land Use;
(8) Cost; and
(9) Community acceptance

The first eight (8) of the preceding nine (9) criteria form the basic components of the detailed analysis of each alternative, whereby each criterion is compared to the others to determine the most cost effective, protective remedy. The NYSDEC will use criterion 9 in their evaluation, once the 45-day public comment period has ended.

The RAWP will be prepared under the guidance of a currently registered New York State Licensed Professional Engineer.

APPENDIX A

FIGURES

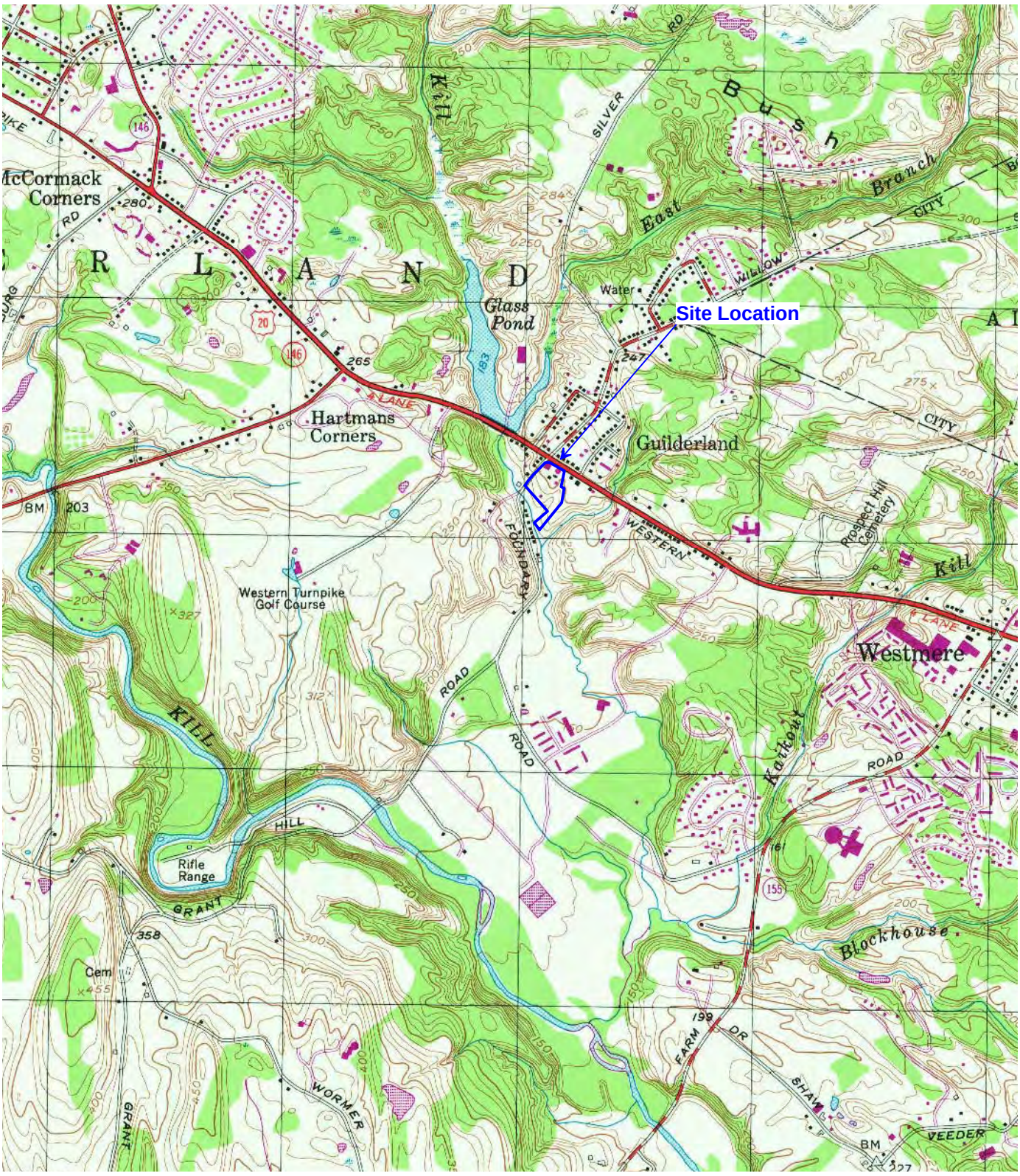


Figure 1: Site Location Map

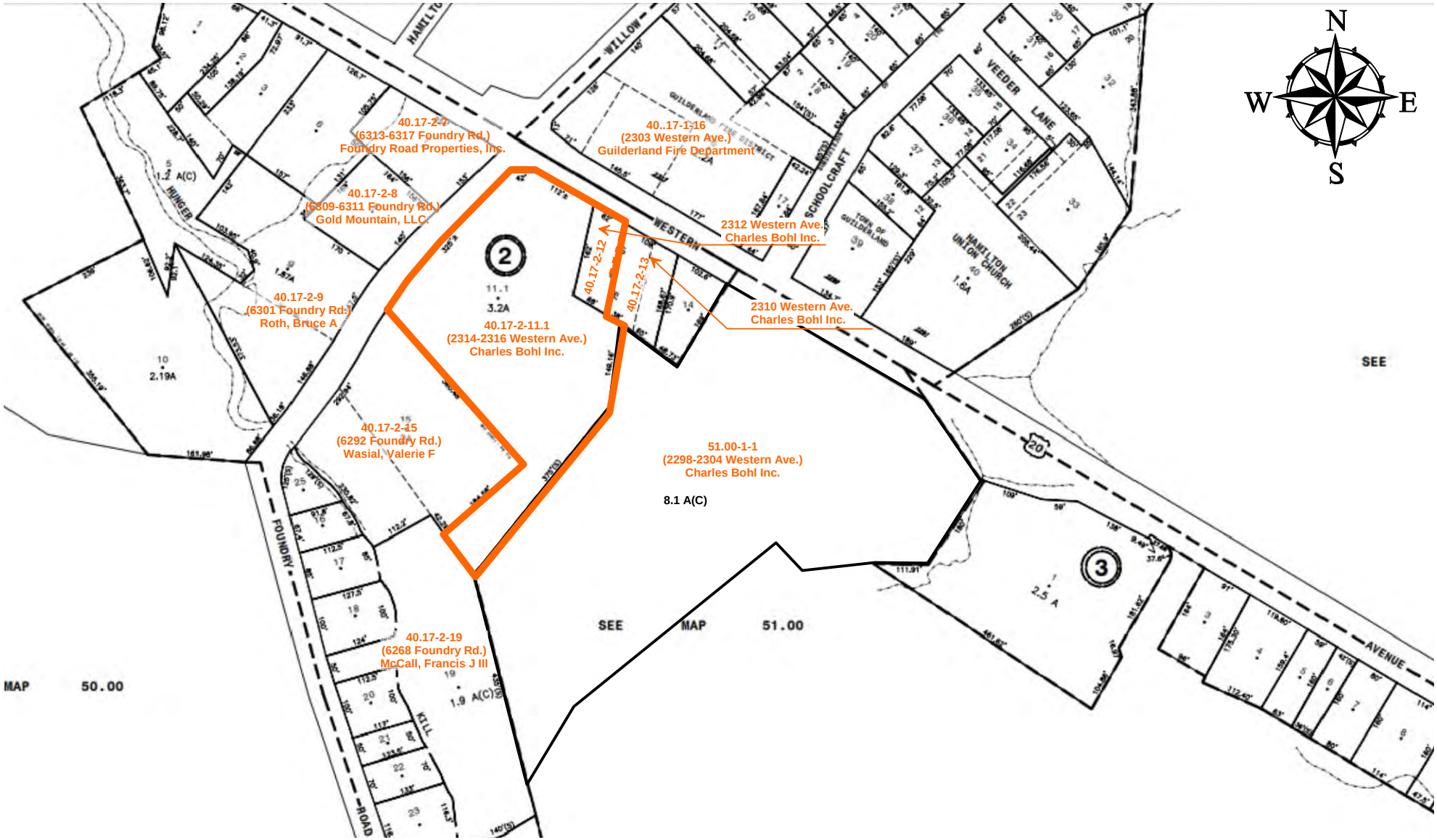
2312-2316 Western Avenue
Guilderland, New York 12084

Project # 19.1120044	August 24, 2022

NORTHEASTERN ENVIRONMENTAL TECHNOLOGIES CORP.

1476 Route 50, P.O. Box 2167, Ballston Spa, NY 12020
Phone: (518) 884-8545 Fax: (518) 884-9710 e-mail: jeffnetc@nycap.rr.com

GEO-ENVIRONMENTAL CONSULTING & PROPERTY MANAGEMENT SERVICES * SITE ASSESSMENTS * GEOTECHNICAL DRILLING & DPT PROBE SERVICES * TANK CLOSURES * EXCAVATION SERVICES * SOIL & GROUNDWATER REMEDIATION * EXPERT TESTIMONY * OSHA FIELD CERTIFIED



NOTES:

This site plan is intended for illustration purpose associated with a July 2022 Supplemental Remedial Investigation Work Plan for the Master Cleaners (BCA Site #C401072).

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1476 Route 50, P.O. Box 2167, Ballston Spa, NY 12020
Phone: (518) 884-8545 Fax: (518) 884-9710 e-mail: jeffnetc@nycap.rr.com

FIGURE 2: Albany County Tax Map

PROJECT: 2312 - 2316 Western Avenue
Guilderland, New York

Project # 19.1120044	Scale: Not to Scale	Date: 08/24/2022

NOTES:
Source Maps

August 2022 Satellite Imagery GoogleEarth

C.T. Male Associates
"Sampling Locations Plan" Dated December 2018

Precision Environmental Services, Inc. Orthoimagery
"CVOC Plume Map" dated December 31, 2019

ABD Engineers, LLP "Existing Condition Base Plan"
Proposed Foundry Village dated February 25, 2022

Legend:

- Proposed boring location - (1) surface soil sample & (3) subsurface soil samples from each boring for EPA 8260
- Proposed boring location - (1) surface soil sample & (1) subsurface soil sample from each boring for full TCL/TAL list, PFAS & 1,4-Dioxane; and (1) surface soil sample & (3) subsurface soil samples from each for EPA Method 8260

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1476 Route 50, P.O. Box 2167, Ballston Spa, NY 12020
Phone: (518) 884-8545 Fax: (518) 884-9710 e-mail: jeffnetc@nycap.rr.com

FIGURE 3: Proposed Soil Sample Locations
PROJECT: 2312 - 2316 Western Avenue
Guilderland, New York

Project # 19.1120044 | Scale: 0 25 50 75 100 | Date: 08/24/2022

NOTES:
Source Maps

August 2022 Satellite Imagery GoogleEarth

C.T. Male Associates
"Sampling Locations Plan" Dated December 2018

Precision Environmental Services, Inc. Orthoimagery
"CVOC Plume Map" dated December 31, 2019

ABD Engineers, LLP "Existing Condition Base Plan"
Proposed Foundry Village dated February 25, 2022

Legend:

- Proposed well location - groundwater to be sampled for full TCL/TAL list, PFAS & 1,4-Dioxane
- Existing monitoring well to be sampled for full TCL/TAL, PFAS & 1,4-Dioxane
- Existing monitoring well to be sampled for EPA 8260

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Phone: (518) 884-8545 Fax: (518) 884-9710 e-mail: jeffnetc@nycap.rr.com

FIGURE 4: Proposed Groundwater Sample Locations
PROJECT: 2312 - 2316 Western Avenue
Guilderland, New York

Project # 19.1120044 | Scale: 0 25 50 75 100 | Date: 08/24/2022

Legend:

- Prior Soil Boring / Monitoring Well Location
- Prior Surface Water Sample Location
- Prior Vapor Sampling Location
- Prior Surface Soil Sample Location
- Prior Geotechnical Boring Location

NOTES:
Source Maps

August 2022 Satellite Imagery GoogleEarth

C.T. Male Associates
"Sampling Locations Plan" Dated December 2018

Precision Environmental Services, Inc. Orthoimagery
"CVOC Plume Map" dated December 31, 2019

ABD Engineers, LLP "Existing Condition Base Plan"
Proposed Foundry Village dated February 25, 2022

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Phone: (518) 884-8545 Fax: (518) 884-9710 e-mail: jeffnetc@nycap.rr.com

FIGURE 5: Prior Sample Locations
PROJECT: 2312 - 2316 Western Avenue
Guilderland, New York

Project # 19.1120044 | Scale: 0 25 50 75 100 | Date: 08/24/2022

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

MASTER CLEANERS
2312 WESTERN AVENUE
GUILDERLAND NEW YORK

Brownfield Cleanup Agreement No. C401072-11-21

PREPARED FOR:

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION
OFFICE OF ENVIRONMENTAL QUALITY REGION 4
1130 NORTH WESTCOTT ROAD
SCHENECTADY, NEW YORK 12306-2014
AND
FOUNDRY VILLAGE LLC.
450 LOUDON ROAD
LOUDONVILLE, NEW YORK 12211
AND
CHARLES BOHL INCORPORATED
2314 WESTERN AVENUE
GUILDERLAND, NEW YORK 12084

PREPARED BY:

NORTHEASTERN ENGINEERING TECHNOLOGIES PLLC
P.O. BOX 2167
BALLSTON SPA, NEW YORK 12020

DATED:

MAY 12, 2022
REVISED September 23, 2022

"..... providing integrated geo-environmental, engineering and geotechnical services ....."

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LIST OF ACRONYMS

Chanin of Custody	COC
Chlorinated Volatile Organic Compound	CVOC
Data User Summary Report	DUSR
Division of Environmental Remediation	DER
Environmental Laboratory Approval Program	ELAP
Environmental Protection Agency	EPA
High Density Polyethylene	HDPE
Matrix Spike / Matrix Spike Duplicate	MS/MSD
New York State Department of Environmental Conservation	NYSDEC
New York State Department of Health	NYSDOH
Non-Aqueous Phase Liquid	NAPL
Northeastern Engineering Technologies	NET
Northeastern Environmental Technologies Corp.	NETC
Per & Polyfluoroalkyl Substances	PFAS
Photoionization detector	PID
Quality Assurance Project Plan	QAPP
Quality Assurance Quality Control	QA/QC
Supplemental Remedial Investigation Work Plan	SRIWP
Target Compound List / Target Analyte List	TCL/TAL
Volatile Organic Compound	VOC

1.0 INTRODUCTION

1.1 Purpose

Northeastern Engineering Technologies PLLC (NET) has prepared this Quality Assurance Project Plan (QAPP) to govern the field activities and sampling work to be completed at the Master Cleaners located at 2312 – 2316 Western Avenue in the Town of Guilderland, Albany County, New York (hereinafter termed the "Site"). This QAPP is a companion document to the supplemental remedial investigation work plan (SRIWP) prepared by NET dated March 22, 2022, revised July 22 12, 2022. A complete description of the Site, available background information, objectives and the supplemental remedial investigation scope of work is presented in detail in the accompanying SRIWP.

This QAPP describes the measures to be taken in the field and in the laboratory to ensure that samples collected during the implementation of the SRIWP are collected, handled, and analyzed in an appropriate manner. This QAPP has been developed to ensure that all environmental data generated during the implementation of the SRIWP are scientifically valid, representative, and of known and acceptable precision and accuracy so that it may be used by the New York State Department of Environmental Conservation (NYSDEC) for decision making purposes.

The QAPP also presents the project scope and goals, organization, objectives, sample handling procedures and Quality Assurance Quality Control (QA/QC) procedures associated with the Site. The QAPP outlines project responsibilities, prescribes guidance and specifications to make certain that:

- Samples are identified and controlled through sample tracking systems and chain-of custody (COC) protocols.
- Field and laboratory analytical results are valid and usable by adherence to established protocols and procedures.
- All aspects of the supplemental remedial investigation, from field to laboratory are documented to provide data that are technically sound and legally defensible.

The QAPP has been prepared in a manner consistent with NYSEDEC's DER-10, Technical Guidance for Site Investigation and Remediation dated May 3, 2010.

1.2 Data Quality Objectives

The data quality objectives (DQOs) for this project are intended to ensure the development of technically valid and defensible data of an acceptable level of confidence such that the data may be used by the NYSDEC for decision making purposes. The data obtained as a result of the implementation of the SRIWP will be used to further document the nature and extent of on-site soil and groundwater contamination such that an appropriate remedy may be selected by the NYSDEC.

DQOs are qualitative and/or quantitative statements that are used to clarify the goals of the project and define the appropriate type of data to collect to support project decisions. DQOs are predicated in accordance with the anticipated end uses of the data that is to be collected. The data to be generated during the implementation of the SRIWP will be completion of supplemental remedial investigation work, and health and safety during implementation of the field activities. Physical data and analytical data from soil, and groundwater will be needed to provide the necessary information to complete the steps in the supplemental remedial investigation. The specific physical and analytical data proposed, and its purposes are presented in the SRIWP.

The objects of the supplemental remedial investigation work are described in detail in the SRIWP and are summarized below:

- Soil Boring / Monitoring Well Installation
- Soil and groundwater sampling and analysis for the target compound list/target analyte list (TCL/TAL) of compounds; VOCs (EPA Method 8260), Semi-VOCs (EPA Method 8270), TAL Metals (EPA Method 6010B), Mercury (EPA Method 7471A), Total Cyanide (EPA Method 9012), Hexavalent Chromium (EPA Method 7196A), Pesticides (EPA Method 8081), PCBs (EPA Method 8082), 1,4-Dioxane (EPA Method 8270 SIMS), and EPA Method 1633
- Groundwater level, well development & groundwater mapping services.

The investigative tasks will include the advancement of test borings; collection and analysis of select surface and sub-surface soil samples, installation of monitoring wells, collection, and analysis of groundwater samples from the network of existing and newly installed monitoring wells.

To achieve these goals/objectives this QAPP has been prepared in a manner consistent with the following guidance documents:

- DER-10 Technical Guidance for Site Investigation and Remediation, NYSDEC, May 2010.
- 6 NYCRR PART 375 "Environmental Remediation Program"; New York Department of Environmental Conservation; Division of Environmental Remediation; December 2006.
- Technical and Operational Guidance Series (TOGs) 1.1.1. "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations;" New York Department of Environmental Conservation; Division of Water; June 1998.

2.0 PROJECT ORGANIZATION & RESPONSIBILITY

This section of the QAPP details the specific roles, activities, and responsibilities of key project participants, as well as the lines of responsibility and communication within and between organizations. NET is responsible for the QA/QC of the supplemental remedial investigation scope of work outlined in the SRIWP. This includes the supervision of contractors, field activities, and the evaluation and interpretation of data. The work tasks that will be performed by contractors are as follows: installation of direct push drilling of borings, installation of monitoring wells, collection of soil and groundwater samples, analytical laboratory testing, and third party data validation.

The project organization, key organizations and personnel are listed in the table below:

Individual	Organization	Job Title
Keith D. Rupert, P.E.	Northeastern Engineering Technologies PLLC (NET)	Project Engineer of Record
Jeffery T. Wink, P.G.	Northeastern Environmental Technologies Corp. (NETC)	Quality Assurance Officer
Robert W. Gray, P.G.	Northeastern Environmental Technologies Corp. (NETC)	Project Manager/ Geologist / Health and Safety Officer
Joseph J. Bianchine, P.E.	ABD Engineers, LLP	Surveyor
Fran Derose	Pace Analytical Services , LLC	Laboratory Manager/Director
Phyllis Shiller	Phoenix Environmental Laboratories, Inc.	Laboratory Manager/Director
Sherri Pullar	Koman Government Solutions, LLC	Data Validator

Professional profiles for the team are provided in Appendix A. Pace Analytical Services, LLC (PACE) is the primary laboratory for this project. Phoenix Environmental Laboratories, Inc. is subcontracted by Pace to complete the 1,4-Dioxane analysis on soil samples, only.

Project Principal/Engineer: is responsible for overseeing all project tasks, responsible for the successful completion of the SRIWP, evaluation of the collected data, report preparation and interaction with Project Manager and Project Team.

Quality Assurance Officer: is responsible for the independent review of the SRIWP documents and reports to check that the appropriate project documentation, of the quality control activities performed, exist, and are maintained; and for conducting field and sampling audits. Analytical data will also be reviewed by this individual for accuracy and completeness.

Project Manager/Geologist: is responsible for the overall coordination and implementation of the project, the management of staff and resources, the implementation of schedules, the conformance by the technical staff and subcontractors to the scope of work, assessing the adequacy of the work being performed, implementing corrective action as necessary, interaction with the client and regulatory agencies, maintaining complete project documentation, and report preparation.

Health and Safety Officer: is responsible for implementation of the project specific Health and Safety Plan, and resolution of safety issues which arise during the completion of the work. The Health and Safety Coordinator or designee will be present during the completion of the field work.

Laboratory Manager/Director: Laboratory analysis will be completed by a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP)-certified laboratories. The Laboratory Director is responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of laboratory staff. The Laboratory Director will ensure

that quality assurance procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Director reports to the Project Principal and Project Manager.

Data Validator: is responsible for review of all analytical data generated for this project. The data validator will review analytical data in accordance with New York State Department of Environmental Conservation Guidance for the Development of Data Usability Summary Reports (DUSR) and prepare a report documenting if the analytical data is valid and usable. The report will also present data rejection and qualification, where necessary, based on laboratory performance.

3.0 SAMPLING PROCEDURES & EQUIPMENT DECONTAMINATION

3.1 Field Sampling Procedures

This Section of the QAPP outlines the following supplemental remedial investigation sampling procedures:

- Installation of soil borings and groundwater monitoring wells
- Collection and analysis of soil samples
- Collection and analysis of groundwater samples

3.1.1 Soil Sampling and Field Screening Procedures

Surface Soil Sampling

Surface soil samples are anticipated to be collected from each of the (7) proposed soil boring locations across the Site (i.e., NE-46, NE-47, NE-48, NE-49, NE-50, NE-51 & NE-52). The surface soil samples will be collected approximately 0 – 2.0 inches below grade if the sampling point does not lie within a vegetated location (i.e., exposed surface soils). At locations where there is vegetation, the vegetation will be removed to a point below the root zone and the surficial soil sample will be collected approximately at the 0 – 2.0 inch horizon below the root bearing zone. In areas where asphalt and/or concrete exist, the soil sample will be collected immediately beneath the asphalt/concrete to a depth 2.0 inches below the improved surface.

The specific soil sampling procedures that will be followed for surface soil samples include the following:

1. Place and secure a new unused approximately 3'x 3' plastic sheeting over the sampling location. An approximately 6"x 6" opening will be removed from the center of the plastic sheeting to allow for sample collection.
2. Where present, removal vegetation and root bearing zones to expose surface soils. If sampling location is within asphalt pavement or concrete surfaces, the pavement/concrete will be removed. All granular subbase, if present, will be removed to expose surface soils.
3. A decontaminated stainless steel shovel, trowel or hand auger will be used by sampling personnel for collection of the surface soil samples. Clean disposable nitrile gloves will be worn while handling the sampling equipment and samples targeted for laboratory characterization.
4. A discrete soil sample will be collected by advancing the shovel, trowel and/or hand auger to the desired sampling depth. New unused nitrile gloves will be worn at each sampling location.
5. For VOCs analysis, immediately upon exposing the sample, a portion of the soil sample for VOC analysis will be collected with a new Terra Core sampler or equivalent and put directly into laboratory provided glass 40-ml vials and the vials sealed in accordance with EPA Method 5035A. The samples for VOC analysis are required to be frozen within 48 hours, which will be identified on the chain of custody record to be performed by the laboratory receiving the samples. For non-VOCs analysis, the soil sample will be transferred to a sealable plastic bag and homogenized with a pre-cleaned stainless steel spoon or by hand wearing new nitrile gloves. An aliquot of the sample will then be transferred to laboratory provided sample containers.
6. For samples collected for laboratory analysis, the sample container label will be completed with the surface soil sample location, sample interval, sampler's initials, date, and time. The client, project name, Site location, matrix, sample type (grab/composite) and laboratory analyses to be performed will also be recorded on the sample label.
7. Immediately upon collecting the lab soil sample for VOCs, a portion of the remaining soil will be placed in a new plastic zip lock bag, not more than one-half full, and sealed. This bag sample will be for head space analysis screening in the field for VOCs using a PID.

8. The recovered soil will be classified and detailed on the corresponding Soil Boring Log.
9. The sampling equipment will be decontaminated between each sampling location per Section 3.2.

Additional necessary precautions, as outlined in Appendix B of the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs, will be taken when sampling for emerging contaminants in soil. The following additional precautions will be taken while sampling for emerging contaminants:

1. Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex and Tyvek);
2. Avoid using bladder pumps and sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene (Teflon®) materials;
3. Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon® and using sharpies, permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
4. Utilizing regular ice for sample preservation and only Alconox for decontamination.

Subsurface Soil Sampling

A series of (7) soil borings (i.e., NE-46, NE-47, NE-48, NE-49, NE-50, NE-51 & NE-52) will be advanced at the Site using a GeoProbe® 6620DT drilling platform. Each soil boring will be advanced approximately 10 feet into the groundwater table or approximately 5 feet below impacts documented in the field during the soil boring installation work. Care will be taken to not advance borings deeper than clean intervals of soil present beneath contaminated intervals to avoid creating a potentially deeper migration pathway for chlorinated volatile organic compounds (CVOCs).

A series of macro-core (MC), large bore and / or split spoon soil samplers, consisting of a drive head, barrel, and drive shoe, equipped with a new unused PVC liner will be used to collect the subsurface soil samples during the drilling program. All sampling equipment will be pre-cleaned prior to use.

Samples obtained in this manner will be examined and visually described using the Modified Burmister and Unified Soil Classification Systems. Samples will be retained in laboratory provided sample containers appropriate for the desired analysis. In compliance with ASTM methods, the sample jars will be labeled with the following information: job designation, boring number, sample number, depth of sample, depth penetration record and length of recovery.

Soil samples will be collected on a continuous basis, logged on site as they are extracted, visually described using the Modified Burmister and Unified Soil Classification Systems, and labeled. A blank copy of the soil boring field log is included as Appendix B. Upon opening of the PVC soil liner approximately 2.5' intervals will be physically inspected for evidence of contamination (e.g., staining, odors, and/or visible chemical impacts) and prescreened with a handheld photoionization detector (PID) for the presence of VOCs. A MiniRae 3000 PID or equivalent will be used for the field VOC screening work. The PID data will be used to direct the soil sample acquisition work, and estimate the areal and vertical extent of chemical impacts to soil Samples for VOC analysis will be placed in a laboratory-supplied jar or encore sampler in accordance with EPA Method 5035A immediately flowing the VOC screening work. Samples will be retained in appropriate containers specific to the desired chemical analysis. In compliance with ASTM methods, the sample containers will be labeled with the following information: job designation, boring number, sample number, depth of sample, depth penetration record and length of recovery.

Soil sampling procedures that will be followed for the collection of soil samples during the drilling program include the following:

1. A cleaned maco-core sampler equipped with a dedicated new unused PVC liner will be given to the driller or driller's assistant who will attach it to the sampling rod. Clean disposable nitrile gloves will be worn when handling the macro-core sampler.
2. Soil samples will be collected continuously by advancing the macro-core sampler employing direct push drilling techniques the desired sampling interval.
3. The recovered macro-core sampler will be placed on clean polyethylene sheeting. The end cap will be unscrewed, and the PVC liner cut open to expose the sample.
4. Immediately upon opening the PVC liner, the soil core will be prescreened for VOCs using a PID to guide VOC sampling in accordance with EPA Method 5035A.
5. For VOCs analysis, upon completion of the boring, a portion of the prescreened soil sample for VOC analysis will be collected with a new Terra Core sampler or equivalent and put directly into laboratory provided glass 40-ml vials and the vials sealed in accordance with EPA Method 5035A. Samples for VOC analysis will be frozen within 48 hours and identified on the chain of custody record to be performed by the laboratory receiving the samples. For non-VOCs analysis, soil samples will be homogenized in a sealed plastic bag while wearing new nitrile gloves. An aliquot of the sample will then be transferred to laboratory provided sample containers.
6. All soil samples will be classified & described on corresponding Soil Boring Logs.
7. The sampling equipment will be decontaminated between each sampling location and sample interval as per Section 3.2.

Additional necessary precautions, as outlined in Appendix B of the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs, will be taken when sampling for emerging contaminants in soil. The following additional precautions will be taken while sampling for emerging contaminants:

1. Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex and Tyvek);
2. Avoid using bladder pumps and sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene (Teflon®) materials;
3. Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon® and using sharpies, permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
4. Utilizing regular ice for sample reservation and only Alconox for decontamination.

It is anticipated that at a minimum (28) soil sample will be submitted for TCL/TAL VOC laboratory analysis via EPA Method 8260. VOC soil samples will be collected and containerized using the purge-and –trap procedures outlined in EPA Method 5035A. It is also anticipated that a minimum (12) soil samples will be submitted for laboratory analysis for the full TCL/TAL and the emerging contaminants 1,4-Dioxane (EPA Method 8270 SIMS) and Per and Polyfluoroalkyl Substances (PFAS) (EPA Method 1633). The specific list of PFAS included in the EPA Method 1633 include the following;

- Perfluorobutanoic acid (PFBA)
- Perfluoropentanoic acid (PFPeA)
- Perfluorohexanoic acid (PFHxA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorooctanoic acid (PFOA)
- Perfluorononanoic acid (PFNA)
- Perfluorodecanoic acid (PFDA)
- Perfluoroundecanoic acid (PFUnA)
- Perfluorododecanoic acid (PFDoA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluorotetradecanoic acid(PFTeDA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluoropentansulfonic acid (PFPeS)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluoroheptanesulfonic acid (PFHpS)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluorononanesulfonic acid (PFNS)
- Perfluorodecanesulfonic acid (PFDS)
- Perfluorododecanesulfonic acid (PFDoS)
- 1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2FTS)
- 1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2FTS)
- 1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2FTS)
- Perfluorooctanesulfonamide (PFOSA)
- N-methyl perfluorooctanesulfonamide (NMeFOSA)
- N-ethyl perfluorooctanesulfonamide (NEtFOSA)
- N-methyl perfluorooctanesulfonamidoethanol (NMeFOSE)
- N-ethyl perfluorooctanesulfonamidoethanol (NEtFOSE)
- N-ethyl perfluorooctanesulfomidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctanesulfomidoacetic acid (NMeFOSAA)
- Hexafluoropropylene oxide dimer acid (HFPO-DA)
- 4,8-Dioxa-3H-perfluorononanoic acid (ADONA)
- Perfluoro-3-methoxypropanoic acid (PFMPA)
- Perfluoro-4-methoxybutanoic acid (PFMBA)
- Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
- 9-Chlorohexadecafluoro-3- oxanonane-1-sulfonic acid (9Cl- PF3ONS)
- 11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)
- Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)
- 3-Perfluoropropyl propanoic acid (3:3FTCA)
- 2H,2H,3H,3H-Perfluorooctanoic acid (5:3FTCA)
- 3-Perfluoroheptyl propanoic acid (7:3FTCA)

All PFAS samples will be collected in accordance with the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl Substances (PFAS) Under

NYSDEC's Part 375 Remedial Programs. Formal chain of custody documentation will be maintained throughout the shipment of the samples to a NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory. All samples will be submitted as a Category B data deliverable for the purpose of developing a data usability summary report (DUSR) by a third party laboratory. Samples will be maintained at a temperature of 4°C by commercially available (pre-frozen) "ice-packs" and appropriate holding and transportation times will be followed. Per- and Polyfluoroalkyl substances (PFAS) samples will be maintained at a temperature of 4°C by regular ice through the transportation of the samples.

A number of factors including but not limited to sample recover, drilling refusal, and zone of impact may limit the amount of soil available for laboratory analysis. Based upon Site specific history sample selection will be prioritized in the following manor VOCs, SVOCs, PCBs, Metals, Pesticides, 1,4-Dioxane, and PFAS.

3.1.2 Monitoring Well Installation & Development

Following soil boring installation, (6) soil borings (i.e.,NE-46, NE-47, NE-48, NE-49, NE-50 & NE-51) will be completed as a permanent monitoring well. Proposed monitoring wells will consist of 3/4 inch flush joint, schedule 40 PVC monitoring well with approximately 10 feet of prepacked slotted well screen. The monitoring wells will be constructed with approximately 10 foot well screen positioned to straddle the surface of the groundwater table. If soil impacts are observed deeper than the shallow groundwater table the monitoring well will be constructed to screen the zone of impact.

The annular space around and approximately 2 feet above the well screen will be filled with a clean filter pack material graded for the slot size of the well. An approximate 2.0' bentonite seal will be installed above the sand pack with the remainder of the bore-hole will be filled with a cement grout surface seal. A steel protective manhole cover or protective casing will be installed to prevent unauthorized access and provide protection for the well. A monitoring well construction log will be completed to document the well materials and screened intervals. A blank copy of the monitoring well construction field log is included as Appendix B.

Following installation each of the newly installed monitoring wells will be developed to remove sediments from the well screen, well bottom, sand pack and formation. Well development will not occur any sooner than 24hrs after the installation of monitoring wells. Well development will occur via surging, bailing and/or pumping. Surge and purge methods will be used to create a back and forth flow within the screened interval to dislodge and remove fine sediments that may have infiltrated the well screen and sand pack. The initial development will occur using approximately 0.375" diameter polyethylene tubing and a stainless steel check valve. The check valve will be rapidly raised and lowered within the screened interval to remove a minimum of (3) well volumes of water and fines from the well. If this technique does not appear to be effective at removing fines from the well or is taking an excessive amount of time removing groundwater a peristaltic pump may be used.

To prevent cross-contamination during well development all disposable well development materials (such as tubing) will be dedicated to each well. The stainless steel check valve will be decontaminated using a two-step process using a detergent (Alconox) and PFAS free water. All investigation derived waste, including purge water, and decontamination fluids generated during this SRIWP will be properly containerized in DOT shippable containers and characterized prior to disposal at an appropriate disposal facility.

3.1.3 Groundwater Sampling

To evaluate the downgradient extent of the dissolved phase CVOC groundwater impacts and to aid with the development of an appropriate remedial treatment design groundwater samples will be collected each of the proposed monitoring wells (i.e., MW-46, MW-47, MW-48, MW-49, MW-50 and MW-51) installed for this matter and from a subset of the existing network of onsite monitoring wells (i.e., CTMMW-09, CTMMW-10, MW-19-16, MW-19-25, MW-19-26, MW-19-28, MW-19-30, MW-33, MW-34 and MW-35).

Prior to any groundwater sample collection services, static water levels will be measured to the nearest one-hundredth of a foot in each monitoring well. The presence of non-aqueous phase liquids (NAPL) will be evaluated in the network of monitoring wells using an interface probe. Concomitant with the development process temperature, pH, specific conductance, dissolved oxygen, and turbidity will measured until these parameters show little change, indicating that fresh, representative groundwater is entering the well or three well volumes have been removed from the well. Sampling services will occur when a sufficient volume of water has recovered (i.e., fresh aquifer water has entered the well) in the designated wells. Sampling will be performed using low flow sampling methods, when practical, using a peristaltic pump, disposable silicon tubing and disposable HDPE tubing. A groundwater sampling filed log will be completed to document the conditions at the time of sampling. A blank copy of the groundwater sampling filed log is included as Appendix B.

The specific groundwater sampling procedures that will be followed for the collection of groundwater samples include the following:

1. Sampling personnel will use new nitrile gloves for the collection of each groundwater sample.
2. Measure the static water level in the well to the nearest 0.01 ft. with a clean electronic water-level indicator.
3. Set up low flow sampling cell, Horiba U-52 Multi Water Quality Checker, and new unused dedicated HDPE sample tubing to collect groundwater approximately midpoint of water column. The disposable tubing will be lowered slowly into the well to minimize the aeration of the samples. Once the well has stabilized groundwater samples will be collected in decreasing order of the volatility of the parameters being analyzed for; VOCs, SVOCs, 1,4-Dioxane, PCBs, Metal, Pesticides, and PFAS.
4. Sample container caps will not be removed until the actual sampling time and only long enough to fill the container.
5. Identify every container by filling out the label with all the required data using a ball point pen.
6. Some sample containers may contain a preservative which should not be rinsed out of the bottle. Read the sample label to determine if a preservative has been added by the laboratory. Be careful not to contact fixatives with skin or clothing. If this should occur, rinse liberally with water.
7. Fill all sample containers completely.
8. After the sample is taken, wipe the container with a paper towel and place the container in a cooler with ice, to maintain the cooler at 4°C.
9. Complete the Groundwater Sampling Field Log and Chain of Custody Record forms.
10. Ship samples to the laboratory within 48 hours.

All samples will be collected in such a manner as to minimize agitation and other disturbing conditions, which may cause physiochemical changes and bring about losses due to volatilization, adsorption, redox changes, or degradation. Samples will be maintained at a temperature of 4°C by commercially available (pre-frozen) "ice-packs" and appropriate holding and transportation times will be followed. Per- and Polyfluoroalkyl substances (PFAS) samples will be maintained at a temperature of 4°C by regular ice through the transportation of the samples. Each of the (16)

groundwater samples will be submitted for chemical analysis for the full TCL/TAL for VOCs via EPA Method 8260 testing criteria.

To evaluate for the presence of emerging contaminants and other programmatic parameters groundwater samples from each of the (6) proposed monitoring wells and existing monitoring well MW-19-28 will also be submitted for chemical analysis for the full TCL/TAL* and for the emerging contaminants 1,4-Dioxane (via EPA Method 8270 SIMS) and PFAS via EPA Method 1633. All PFAS samples will be collected in accordance with the NYSDEC's June 2021 guidance document, titled Analysis, and Assessment of Per and Polyfluoroalkyl substances (PFAS) Under NYSDEC's Part 375 Remedial Programs. Formal chain of custody documentation will be maintained throughout the shipment of the samples to a NYSDOH ELAP certified laboratory. All volatile and emerging contaminant samples will be submitted as a Category B data deliverable for the purpose of developing a DUSR by a third party laboratory.

Additional precautions, as outlined in Appendix C of the NYSDEC's June 2021 guidance document, titled *Analysis, and Assessment of Per and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs*, will be taken when sampling for emerging contaminants in soil. A copy of the June 2021 guidance document is included as Appendix C. The following additional precautions will be taken while sampling for emerging contaminants:

1. Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex and Tyvek);
2. Avoid using bladder pumps and sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene (Teflon®) materials;
3. Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon® and using sharpies, permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
4. Utilizing regular ice for sample reservation and only Alconox for decontamination.

**Note: Hexavalent Chromium groundwater analysis will be collected and analyzed only if Hexavalent Chromium is identified in soil samples at concentrations above restricted residential use soil cleanup objectives.*

3.2 Equipment Decontamination

The objective of equipment decontamination is to ensure that all drilling, soil sampling, and groundwater sampling equipment is decontaminated; prior to being brought onsite; between on-site drilling and sampling; and prior to demobilization of offsite. The following subsections outline the minimum decontamination procedure for drilling, soil sampling, and groundwater sampling equipment.

3.2.1 Drilling and Soil Sampling Equipment Decontamination

Drilling equipment including rods, drive caps, tools, drill unit and any piece of equipment that comes in contact with subsurface Site soils will be cleaned with an alconox and PFAS free tap water (obtained from the municipal system of the Town of Guilderland) solution and tap water rinse prior to the start of work and between each boring to prevent cross-contamination between borings. The equipment will also be cleaned using the same procedure at completion of the work (before leaving the Site) to prevent any contamination from leaving the Site. The sampling equipment including macro-core samplers and stainless steel trowels, bowls, etc., will be cleaned prior to use, in between each boring and at completion of the work by similar process described above. Between each sample interval at the same boring location the sampling equipment will be cleaned using the following procedure:

- Remove any excess soil remaining on the macro-core sampler
- Prepare a solution of tap water and alconox in a HDPE 5 gallon wash bucket, and scrub the equipment with a brush to remove any adhering particles
- Rinse the equipment with tap water
- Reassemble the clean macro-core sampler with a new acetate liner
- New disposable gloves will be worn when cleaning and handling the equipment to avoid contamination
- The water in the wash and rinse buckets will be changed frequently to avoid cross contamination

The decontamination rinse water will be collected and placed in labeled 55-gallon drums and stored at the project Site until laboratory analyses results of the soil and groundwater samples indicates the proper method of treatment or disposal. Disposable protective clothing such as gloves, etc. will be placed in the 55-gallon drum containing excess soil from the project.

For samples undergoing PFAS analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

- Clean with tap water and Alconox® detergent, only, using a brush, if necessary, to remove particulate matter and surface films. No detergents that contain fluoro-surfactants are to be used for PFAS decontamination.
- Rinse thoroughly with PFAS-free water.
- Place on clean plastic sheeting to air-dry. If the equipment is to be stored overnight, it should be covered and secured with clean, unused plastic sheeting.
- Wrap equipment in plastic and label for storage and/or transport prior to use.

3.2.2 Groundwater Sampling Equipment Decontamination

Non dedicated groundwater sampling equipment (e.g., water level meters, aquifer testing equipment, pumps, foot valves, etc..) will be cleaned with an alconox and PFAS free tap water (obtained from the municipal system of the Town of Guilderland) solution and PFAS free tap water rinse prior to the start of work and between each monitoring well to prevent cross-contamination between wells. The equipment will also be cleaned using the same procedure at the completion of the work (before leaving the Site) to prevent any contamination from leaving the Site. New disposable nitrile gloves will be worn when cleaning and handling the equipment to avoid contamination.

The decontamination water and purge waters will be collected and placed in labeled 55-gallon drums and stored at the project Site until laboratory analyses results of the groundwater samples indicates the proper method of treatment or disposal.

For samples undergoing PFAS analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

- Clean with tap water and Alconox® detergent, only, using a brush, if necessary, to remove particulate matter and surface films. No detergents that contain fluoro-surfactants are to be used for PFAS decontamination.
- Rinse thoroughly with PFAS-free water.
- Place on clean plastic sheeting to air-dry. If the equipment is to be stored overnight, it should be covered and secured with clean, unused plastic sheeting.
- Wrap equipment in plastic and label for storage and/or transport prior to use.

4.0 FIELD INSTRUMENT OPERATING PROCEDURS

4.1 Field Instrument Procedures

The field instruments that will be utilized during implementation of the SRIWP include: a PID meter for air monitoring of the total VOCs during drilling, and for headspace analysis of soil samples for total VOCs; a multi parameter water quality measurement capable of measuring temperature, pH, specific conductance, dissolved oxygen and turbidity for field analysis of groundwater; and a vented groundwater data logger for continuous monitoring of water level, water pressure, and temperature for groundwater aquifer characterization. The field instruments used will be calibrated and operated in accordance with the manufacturer's instructions and the procedures identified in the following sections.

4.1.1 Photo-Ionization Detector

A MiniRae 3000 PID meter will be utilized to measure total VOCs. The instrument is calibrated at the factory upon purchase and annually thereafter using certified service shops who utilize standards of benzene and isobutylene. Prior to use in the field, the instrument will be calibrated in accordance with the manufacturer's instructions using a disposable cylinder containing isobutylene obtained from a reputable supplier. During use the PID meter will be calibrated at least once every workday using a two-point calibration consisting of 100ppm isobutylene calibration gas and fresh ambient outdoor air. The calibration procedure is contained in the MiniRae User's Manual.

Care will be taken when handling and using the PID meter to prevent any debris from entering the sample line which will affect the instrument's operation. If this occurs, the field personnel will clean the unit or replace it with a functional PID meter.

4.1.2 Horiba U-52

The Horiba U-52 Multi Water Quality Checker features an integrated control unit and sensors capable of making a maximum of eleven simultaneous measurements for various parameters. The instrument is calibrated at the factory upon purchase and annually thereafter using certified service shops. During use the U-52 meter will be calibrated at least once every workday using a standard solution of pH 4.0 and fresh ambient outdoor. The calibration procedure is contained in the Horiba U-50 Series Instruction Manual.

4.1.3 In-Situ Level Troll 700

The instrument will be calibrated [by the manufacturer and / or the leasing agent] prior to use.. Routine maintenance of the instrument will be completed to sustain the accuracy and longevity of the probes and cables.

5.0 SAMPLE PREPARATION, HANDLING AND QUALITY CONTROL

5.1 Sample Preparation

Certified-clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2005 (Eagle Picher pre-cleaned containers or equivalent) will be supplied by the NYSDOH Environmental Laboratory Accreditation Program (ELAP) certified laboratory. The anticipated sample quantities, analytical parameters, analysis methods, matrix, sample containers, preservation acceptable holding times and required method detection limits are presented in included in the table below:

ANALYTE	ANALYTICAL METHOD	QUANTITY MATRIX	SAMPLE CONTAINER	SAMPLE PRESERVATION	SAMPLE HOLD TIME	LABORATORY QUANTITATION LIMIT
VOCs	EPA Method 8260 + TICS	(7) Surface Soil (21) Subsurface soil (2) Field Duplicates (2) Equipment Blanks (2)MS/MSD (2) Trip Blanks	(4) - 40ml glass VOA Vials	(2) DI Water / On ice (1) Methanol / On Ice (1) As Is / On Ice	48 hours to freeze, 14 days to analysis once unfrozen	5 – 100 ug/Kg
VOCs	EPA Method 8260 + TICs	(16) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(3) - 40ml glass VOA Vials	HCL / On Ice	14 Days Preserved to Analysis	0.5 - 10.0 ug/L
Semi-VOCs	EPA Method 8270 + TICs	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass Jar	As Is / On Ice	14 days to analysis	170 – 670 ug/Kg
Semi-VOCs	EPA Method 8270 + TICs	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1) – 1L glass Amber	As Is / On Ice	7 days to analysis	0.5 - 1.0 ug/L
PCBs	EPA Method 8082	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	14 days to analysis	0.020 mg/Kg
PCBs	EPA Method 8082	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1) – 1L glass Amber	As Is / On Ice	7 days to analysis	0.2 ug/L
Pesticides	EPA Method 8081	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	14 days to analysis	0.0020 – 0.050 mg/Kg
Pesticides	EPA Method 8081	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1) – 1L glass Amber	As Is / On Ice	7 days to analysis	0.020 – 0.5 ug/L
TAL Metals	EPA Methods 6010 & 7471	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	28 days to analysis	0.010 – 5.0 mg/Kg
TAL Metals	EPA Method 6010 / 200.7 ICP	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1) – 500ml plastic Bottle	As Is / On Ice	28 days to analysis	0.0040 – 0.01 mg/L
Mercury	EPA Method 7471A	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	28 days to analysis	0.025 mg/Kg
Mercury	EPA Method 7471A	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1) – 250ml Plastic Bottle	HNO3 / On Ice	28 days to analysis	0.00010 mg/L

Total Cyanide	EPA Method 9012	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	28 days to analysis	0.50 mg/Kg
Total Cyanide	SM 4500 CN-E	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1)– 250ml Plastic Bottle	NaOH / On Ice	14 days to analysis	0.010 ug/L
Hexavalent Chromium	EPA Method 7196A	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	28 days to analysis	0.16 mg/Kg
Hexavalent Chromium	EPA Method 7196A	(To Be Determined) Groundwater	(1) – 250ml Plastic Bottle	As Is / On Ice	24 hours to analysis	0.004 ug/L
Per- & Polyfluoroalkyl Substances	EPA Method 1633	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(2) - 250ml Plastic Bottle	As Is / On Ice	14 days to analysis	0.2 – 5 ug/Kg
Per- & Polyfluoroalkyl Substances	EPA Method 1633	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(2) - 250ml Plastic Bottle	As Is / On Ice	14 days to analysis	1.0 - 25 ng/L
1,4-Dioxane	EPA Method 8270 SIMS	(6) Surface Soil (6) Subsurface Soil (1) Field Duplicate (2) Equipment Blanks (1) MS/MSD	(1) – 4oz glass jar	As Is / On Ice	14 days to analysis	100 ug/Kg
1,4-Dioxane	EPA Method 8270 SIMS	(7) Groundwater (1) Field Duplicates (2) Equipment Blanks (1) MS/MSD	(1) – 8oz Glass Amber	NAHSO4 / On Ice	7 days to analysis	0.2 ug/L

Where matrix interference is noted, analytical clean-ups will be required to be performed by the laboratory following the procedures specified in SW-846 or the most current NYSDEC ASP, as applicable. In general, samples shall not be diluted more than 1 to 5.

Pace Analytical Services, LLC (PACE) will be the primary laboratory for this project. Phoenix Environmental Laboratories, Inc. (PEL) will be subcontracted by Pace to complete the 1,4-Dioxane analysis on soil samples, only. Copies of PACE and PEL's laboratory quality manuals are included as Appendix D. Laboratory quantitation limits for the individual PFAS compounds in soil and water range from 0.2 – 5 ug/kg and 1.0 – 25 ng/L, respectively. Pace's project action limits and laboratory specific detection/quantitation limits for each of the individual PFAS compounds is included in Appendix D. Laboratory quantitation limits for 1,4-Dioxante in soil and groundwater are 100 ug/kg and 0.2 ug/L.

5.2 Chain of Custody Documentation

Prior to sampling and filling the sample containers, the label on the container will be completed with the required information. After filling the sample containers, they will be wiped with a paper towel, and placed in a protective bubble or foam wrap to protect it during transport. The container(s) will be placed in a cooler with double bagged ice packs, to maintain a temperature of 4°C.

A Chain of Custody Record will be completed by the sampler in the field after securing analytical samples. The sampler will be responsible for retaining possession of the samples until they are delivered to the laboratory or until they are delivered to a courier or common carrier for shipment to the laboratory. When the samples are released from the custody of the sampling personnel, the Chain of Custody Record will be signed by both relinquishing and receiving parties with the date and time indicated. A copy of the form will be retained by the sampler for inclusion in the project files and the original form will accompany the shipment. The Chain of Custody Record will then be signed by the relinquishing party and receiving laboratory personnel when the samples are ultimately received at the laboratory.

If samples are shipped, a bill of lading or an air bill will be used and retained in the project files as documentation of sample transportation. Prior to shipment, the cooler will be securely wrapped with clear tape to protect it from tampering. A separate additional Chain of Custody Record will be completed for each cooler of samples, or a copy of the original chain will be placed in the second cooler. This form will be placed in a plastic bag and taped to the underside of the cooler lid. This form will be used by the laboratory personnel as a check to verify that the containers listed on the form are present in the cooler when they are received at the laboratory. A copy of the signed Chain of Custody Record will accompany the laboratory analysis reports.

5.3 Quality Control Samples

Quality control samples will be collected during the field sampling to monitor sampling techniques, sampling equipment cleanliness, sample variability, sample handling and laboratory performance (analytical reproducibility). The quality control samples will include duplicate samples, equipment/field blanks and trip/transport blanks.

5.3.1 Field Duplicate Samples

Field Duplicate samples are samples collected from the same location and interval using the same sampling device. Field Duplicate samples are used as a check and balance on sampling techniques, sampling equipment and on laboratory reproducibility. The field duplicate samples will be coded so that the laboratory is not biased in performing the analyses. The code that is used will be identified in the field notes and on the sampling logs, but not on laboratory correspondence.

One field duplicate soil and groundwater sample will be taken for every twenty (20) samples submitted to the laboratory for analysis. The field duplicate soil samples, except those slated for VOCs analysis, will be collected after the sample is thoroughly mixed in a zip lock bag or stainless steel bowl to achieve a homogeneous sample and then equally split into the various analytical containers. The field duplicate groundwater samples, except for VOC analysis, will be taken by splitting the sample by alternating the outlet of the sampling equipment between each set of containers (sample and field duplicate containers) until the containers are filled. The field duplicate groundwater samples for VOCs analysis will be taken by filling one container completely and then filling the replicate container completely. Groundwater samples for VOCs analysis are typically taken in triplicate, so this procedure will be repeated three times.

The field duplicate samples will be identified as FD-01, FD-02, etc. The sampling interval and location where the field replicates are collected will be identified in the Environmental Services Field Log.

5.3.2 Equipment Field Blank Samples

Equipment/field blanks are samples taken to monitor sampling equipment cleanliness and decontamination procedures during field sampling. One equipment/field blank will be taken during soil and groundwater sampling for every twenty (20) samples submitted to the laboratory for analysis of all of the parameters of concern at a minimum frequency of (1) per day per matrix. The equipment/field blanks will be taken as follows per the environmental media being sampled:

Soil - After the sampling trowel or macro-core sampler has been decontaminated and are ready for sampling, pour deionized water through and/or over the sampling equipment and collect it in the sample container(s).

Groundwater - After the new disposable bailer and/or tubing are removed from its packaging and are ready for sampling, pour deionized water into the bailer and/or tubing and then into the sample container(s).

The equipment/field blanks will be identified as such and by the location to be sampled (i.e., equipment blank before NE-48 (5-10 feet); or before MW-48). The equipment/field blanks will be identified for the lab as EB-01, EB-02, etc.

5.3.3 Trip Blanks

Transport blanks are prepared when VOCs analysis is to be performed, and they are prepared in the laboratory when the sample containers are prepared. Transport blanks will be prepared by filling 40 ml glass containers with deionized water. These containers will travel unopened with the sample containers and be analyzed for the same volatile constituents as the samples being submitted. The transport blanks are taken to monitor whether the samples have been contaminated during transport, as a result of handling in the field, during shipment or during storage in the laboratory. One transport blank will accompany each set of samples (groundwater) that are shipped/delivered to the laboratory for VOCs analysis. Transport banks will not accompany soil samples.

5.3.3 Matrix Spikes & Matrix Spike Duplicates

Matrix spike and matrix spike duplicate (MS/MSD) samples are used to check on sample matrix effect and laboratory accuracy and precision. One MS/MSD soil sample each and one MS/MSD groundwater sample each will be collected for every twenty (20) samples submitted to the laboratory for analysis. The MS/MSD samples for VOC analysis will be collected by equally splitting the sample into the various analytical containers. MS/MSD samples that will not undergo VOC analysis will be homogenized and transferred into the various sample containers. The MS/MSD samples will be labeled as required for the sample location except that in the comment section of the chain of custody records it shall read “use this sample for the MS/MSD” or equal.

6.0 DATA REDUCTION, VALIDATION & REPORTING

6.1 General

The field measurement data and the laboratory analyses results of detected parameters will be compiled and tabulated to facilitate comparison and evaluation and will be included in the Supplemental Remedial Investigation Report. The tabulated data will include at a minimum:

- surface and sub-surface soil analysis results,
- groundwater analysis results, and
- quality control results (equipment/field blanks, replicates/duplicates, matrix spike/matrix spike duplicates, and transport blanks).

Field logs will also be compiled and included, in part, in the text and appendices of the Supplemental Remedial Investigation Report, and will consist of:

- soil boring logs,
- monitoring well construction logs,
- groundwater sampling & field data logs,

Any observations or problems encountered during field activities which could affect the quality of the data, or its validity will be noted on the appropriate field log.

6.2 Data Validation

Internal data validation will be performed by the laboratory QA/QC officer to ensure that the data package is complete and meets the criteria for Category B data deliverable. Any problems encountered in performing the analyses by the laboratory such as out of limits surrogate recoveries, and comments on the quality and limitations of specific data and the validity of the data will be described in the case narrative of the laboratory report.

External third party data validation will be performed by a contracted data validator who will utilize the USEPA National and Regional Validation Guidelines/Procedures and the NYSDEC Guidance in the Development of Data Usability Summary Reports to determine the applicable qualifications of the data. The validator will then prepare a NYSDEC Data Usability Summary Report (DUSR) in accordance with NYSDEC guidelines. The data validator will not be involved in any other portions of the project.

6.3 Reporting

The laboratory will generate NYSDEC ASP Category B Data Deliverable Package(s) for analytical data generated. The data deliverables will be provided to the third party data validator for DUSR generation. The data packages will also be presented as part of the Supplemental Remedial Investigation Report, but due to the volume of material, it will be presented on a CD, not in hardcopy. The data package will include analytical results and quality control data deliverables as required by the most recent NYSDEC ASP used by the laboratory of record.

Analytical data is also required to be electronically submitted to NYSDEC. This data submitted to NYSDEC will be stored in the agency's Environmental Information Management System (EIMS). NYSDEC uses EQuIS software, developed by EarthSoft, specifically as the EIMS. The laboratory of record will be required to provide electronic data deliverables (EDDs) in NYSDEC EDD Format Version 4.00.16 or equal. NETC will be responsible for updating the sample locations with coordinate information (latitude/longitude) and sample depths. The edited EDD will be checked in NYSDEC EQuIS Data Processor (EDP). When successfully meeting the requirements of the EDP (i.e., no errors), the EDD will be electronically signed and sealed through the EDP and submitted to the NYSDEC.

APPENDIX A

PROFESSIONAL RESUME

NORTHEASTERN
ENGINEERING
TECHNOLOGIES PLLC

KEITH D. RUPERT, P.E

1476 Route 50 - P.O. Box 2167 Ballston Spa, NY 12020
Phone: (518) 884-8545 - Fax: (518) 884-9710

EDUCATION :

May 1994 Clarkson University Potsdam, NY
Masters of Science – Managerial Systems

May 1983 Syracuse University Syracuse, NY
Bachelors of Science – Mechanical Engineering

PROFESSIONAL EXPERIENCE:

Various Professional Engineering Services
1983 - Present
8 Years experience w/ Northeastern Engineering Technologies PLLC
15 Years experience w/ Northeastern Environmnetal Technologies Corporation
18 Years experience w/ CRK Engineering
26 Years experience with *New York State*
DOCS - Division of Facilities Planning and Development
OGS - Design and Construction

REGULATORY EXPERIENCE:

Develop and maintain Federal and State Environmental Compliance Programs in accordance with the Code of Federal Regulations and the New York State Environmental Conservation Law (ECL) as indicated in Title 6 of the New York Code, Rules and Regulations. Some of the areas of expertise include;

Water Regulations

- U.S. Clean Water Act
- NYS Water Pollution Control Revolving Fund
- Waste water treatment plant permitting, operation and licensing
- Fresh water wetland disturbance and remediation projects
- Surface water and groundwater quality standards and effluent limitations, water treatment Facilities, pump stations, etc.
- NYC water shed regulations

Air Regulations

- Federal Title V Facility air permitting regulations, State permits and minor facility registrations
- NO_x, SO_x, CO_2, Particulate and Hazardous Air Pollutants
- Motor vehicle and stationary combustion source emissions compliance
- New Source Review in Non-attainment and Ozone Transport Region

Environmental Quality and Resource Management

- Brownfields Cleanup Program
- Integrated Pest Management systems
- Management of Solid Waste, Hazardous Waste, Medical Waste, Industrial Waste, Universal Waste and Construction and Debris Waste
- Compost operations and facility development
- Petroleum and Chemical Bulk Storage, remediation projects, new facilities, liquid handling and detection systems
- SPCC – Spill Prevention, Control and Compensation Plans
- State Environmental Quality Review programs
- Combined Sewer Overflows
- Storm Water Management Plans, BMPs, MS-4s, General Construction Permits, Erosion and Sediment Control, SPDES

Environmental Management System

- Perform building and site assessment and physical inspections
- Identification and prioritizing of significant environmental aspects of physical plant operations and issues
- Develop and install environmental compliance programs as they relate to on going operations and occupied facilities
- Formulate remedial measures and options along with cost estimates and project schedules for mitigation of hazards
- Consent Order and Stipulation Agreement negotiation and experience
- Work with legal consultants, providing technical expertise and support in dealing with open litigation, hearings, or settlement negotiations
- Develop environmental training programs for facility staff to assist in compliance with all applicable regulatory requirements and programs

NORTHEASTERN
ENVIRONMENTAL
TECHNOLOGIES CORP.

Jeffrey T. Wink, PG
President

1476 Route 50 - P.O. Box 2167 Ballston Spa, NY 12020
Phone: (518) 884-8545 - Fax: (518) 884-9710

EDUCATION & TRAINING:

STATE UNIVERSITY OF NEW YORK, POTSDAM - BA Geology 1983
UNIVERSITY OF WISCONSIN, MADISON; Water Well Hydraulics & Hydrology 1985
PRINCETON UNIVERSITY; Groundwater Pollution & Hydrology 1986
NGWA ENVIRONMENTAL SITE ASSESSMENT FOR GROUNDWATER PROFESSIONALS 1989
BUTLER UNIVERSITY - Holcomb Research Institute 1990
OSHA 29 CFR 1920.120(E)(4) H&S Training

PROFESSIONAL EXPERIENCE:

NYS Professional Geologist License No. 000566-1

1991-Present, Northeastern Environmental Technologies Corporation
1987-1992, Environmental Hydrogeology Corporation
1983-1987, Dunn Geoscience Corporation

PROFESSIONAL EXPERTISE:

Mr. Wink has been a practicing geologist for over 35 years. Since founding Northeastern Environmental Technologies Corporation (NETC) NETC in 1991, Mr. Wink has been responsible for the execution and oversight of a wide range of consulting, invasive testing and remediation work completed by his firm. Prior to founding NETC, Mr. Wink obtained valuable experience as a consulting geologist for Dunn Geoscience Corporation and later as the principal director of site assessment and remediation services at Environmental Hydrogeology Corporation. With the assistance of the NETC staff, Mr. Wink continues to draw on his experience in geo-environmental consulting and corrective action matters when pursuing work objectives for his clients. An abbreviated list project work completed by Mr. Wink include:

- Investigation of soil and groundwater impacts caused by underground utilities and surface impoundment at manufacturing facilities and chemical storage sites. Work including the study of on and off site impacts of organic and heavy metal compounds of concern; risk assessment and remedy selection to achieve programmatic regulatory closure goals.

- NYSDEC Brownfields Cleanup Agreement project work; responsibilities including initial site characterization of impacts, interim remedial measures deemed necessary for buried vessels and the associated soil, and groundwater impacts, final remedy selection to achieve certificate of completion (COC) as well as implementation of post COC site management plan / building engineering controls during and after end use construction activities.

- Delineation of contamination due to releases at petroleum and chemical bulk storage facilities involving contamination of the vadose zone and underlying aquifer systems. Design, install, operate and maintain soil, vapor and groundwater treatment systems, post remedy monitoring of air, surface water and groundwater to meet Federal and State regulatory agency requirements.

PROFESSIONAL EXPERTISE (Cont.):

- Preparation of environmental assessments, audits and property divestiture certification reports for commercial lenders, attorney / bankruptcy plan administrators, equity investors, owner / operators and developers. Work involving pre and post acquisition ASTM Phase I, II & III Environmental Site Assessments, chemical and petroleum bulk storage permit administration, Spill Prevention, Control and Countermeasure and the Facility Response Plan compliance, waste management and waste brokerage services.

- Investigations of groundwater contamination by organic and inorganic compounds at landfill and surface land spreading waste disposal sites. Work incorporating study of on and off site environmental impact.

- Investigation of the available groundwater resource potential of unconsolidated glacial and carbonate bedrock aquifers at private, industrial and municipal sites. Work involving geologic and hydrologic evaluation of the unconsolidated deposits and bedrock formations for water supply purposes and subsequent well field development.

PROFESSIONAL AFFILIATIONS:

American Water Works Association
Emergency Medical Technician (1983-1989)
National Ground Water Association - Association of Groundwater Scientists and Engineers
National Ski Patrol 1987 - Present, (S&T Examiner 1989 -2004)
NYS Professional Geologist - License No. 000566-1
Saratoga County Chamber of Commerce
Schenectady County Chamber of Commerce
US EPA Asbestos Handler & Inspector (1987-1991)

PROFESSIONAL PUBLICATIONS:

Carl, J.O., Liptak, A.R. Savitz, S.L., Schmidt, D.T., Scott, S.G., Tom, J.V. & Wink, J.T.,1984; Geochemical Characteristics of Granitoid Plutons in the Penobscot Bay Area, Maine. Northeastern Geology, V.6, No. 1, pp.12-24.

Hanson, E.L. & Wink, J.T., Groundwater Occurrences in Southern Dutchess County, In Field Trip Guidebook Natural Association of Geology Teachers, 1987.

NORTHEASTERN
ENVIRONMENTAL
TECHNOLOGIES CORP.

Robert Gray III
Project Geologist PG

1476 Route 50 - P.O. Box 2167 Ballston Spa, NY 12020
Phone: (518) 884-8545 - Fax: (518) 884-9710

Education

State University of New York, Cortland
BS Degree, Geology - May 2003

Adirondack Community College
Associates Degree, Math and Science - December 2000

OSHA 29 CFR 1920.120(E)(4) Health & Safety Training

OSHA 29 CFR 1910.146(g) Confined Space Awareness Training

NYS Professional Geologist License No. 001091-1

Professional Experience

February 2005 - Present

Project Geologist
Northeastern Environmental Technologies Corporation
1476 Route 50 Ballston Spa, New York

Environmental Professional Experience

- Responsible for project specific environmental consulting
- Responsible for technical report writing (i.e., ESA, TSP, SI, RI, CAP, etc.)
- Project manager for implementation of subsurface investigations, UST and AST closure services, and on site remediation
- Experienced in permit application and compliance for SPCC, SPEDS, and Brownfields
- Experienced in conducting geophysical investigations using EM-31, EM-61MK2 and GPR
- Experienced in various drilling and well installation techniques including hollow stem auger, direct push technology (Geoprobe), hand auger, and Shelby tube
- Experienced in groundwater sampling techniques including field pH, turbidity, Conductivity, and low flow sampling
- Experienced in NYSDOH indoor air sampling techniques via TO-15 including ambient air and sub slab testing
- Experienced in design, cost analysis and project management of various remediation techniques including UST and AST removal, soil removal, SVE and AS systems installation, and ORC and HRC application
- Proficient with Microsoft and Apple operating systems as well as small office networks (server installation and maintenance)
- Proficient with various programs including Surfer, Auto CAD Light, Lotus, Excel, Word, Air Flow SVE, Adobe, FirstSearch, etc.
- Proficient in converting text and graphic documents into PDF formats to electronically transmit via the internet

Notable Projects

Project Geologist with NETC:

- College Park Redevelopment Site Schenectady, New York -
  Future Home of Golub Corporation (Price Chopper) Headquarters - Brownfields Redevelopment Site
- Union Graduate College Schenectady, New York
  Site Assessment, Soil and Groundwater Construction Management, Groundwater treatment services

Notable Projects (cont.)

- Union College - College Park Hall and Soccer Field Schenectady, New York
  Site Assessment, Geophysical Survey, Soil Removal, Soil Management, Groundwater Monitoring
- Greene County - Various Sites
  Site Assessment, Soil Remediation, Soil and Groundwater Monitoring, In *situ* Soil Remediation
- Cranesville Block - Kingston, New York
  Site Assessment, Design and Construction of Soil Vapor Extraction System
- Town of Ballston - Charlton Road Site
  Site Assessment, Soil Remediation, Groundwater Monitoring
- K.C. Canary (4) Sites - Clifton Park, Gloversville, Plattsburgh, Gouverneur, NY
  Site Assessment, Soil and Groundwater Assessment, Geophysical Survey, Groundwater Monitoring
- Friendly's (11) Sites - Rotterdam, Binghamton, Dewitt, Lockport, Olean, Oneonta, Vestal, Watertown, NY
  Site Assessment, Soil and Groundwater Assessment, Geophysical Survey, Groundwater Monitoring

Other Professional Experience

- Review and writing of contracts, purchase orders, and change orders
- Budget variances, analysis and accounting
- Site and building plan take-offs for budget and bid purposes
- Supervision and coordination of field personnel and contractors
- Liaison with local, town and state officials
- Earthwork construction involving density testing of compaction with nuclear density gauge and verification of back fill placement and compaction methods
- Large scale disposal bed construction involving percolation tests on blended and in situ soils and placement of infiltrating systems
- Laboratory testing responsibilities include compressive strength tests on concrete, mortar and grout samples, proctor tests, gradations and moisture contents of soil samples
- Heavy equipment operator experience including, direct push, backhoe, excavator and roller

RESUME OF JOSEPH J. BIANCHINE, P.E. PARTNER

EDUCATION:

Union College, BS in Civil Engineering, 1972
Mohawk Valley Community College, A.A.S. in Civil Technology, 1965

EXPERIENCE:

Mr. Bianchine is the founding partner in the firm, of ABD Engineers, LLP which began in January 1987. Mr. Bianchine's experience covers a wide variety of projects within the civil and environmental fields, from conception to ultimate construction and start-up. He has successfully completed several hundred projects involving site evaluation and planning; S.E.Q.R.A.; public participation; water, sewer and septic systems, gas and electric utilities, drainage and Hydraulics, Stormwater management and Stormwater pollution prevention plans, water and sewage treatment facilities; sidewalks; streets; roads and highways and also solid waste facilities.

Mr. Bianchine has been responsible for the design of industrial, construction and demolition debris landfills and closures, he has prepared several Part 360 Solid waste reports, and has designed three transfer stations and two resource recovery facilities.

Mr. Bianchine was the responsible professional for such projects as Heritage Park, the Albany County Civic Center Environmental Impact Statement, The Washington County Sewer District No. 2 Sewage Treatment Plant; Interceptor and Collection Sewers, The Mid-State Correctional Facility, The Maywood Drainage Project, The Marriott Hotel, Capital Plaza, and Corporate Woods. In addition, Mr. Bianchine has provided engineering services to the municipalities of Clifton Park, Halfmoon, Waterford, Malta, Hadley, Colonie, Saratoga Springs, East Greenbush, Menands, Green Island, Rotterdam, Schenectady, Niskayuna and Voorheesville.

Mr. Bianchine has been the responsible professional for the construction quality control of many of the projects he has designed. Additionally, has served as the responsible professional for the construction quality control of projects designed by others. These projects involve soils, concrete, water lines, sewer lines, storm facilities, pavements and landscaping.

Mr. Bianchine has served as an expert witness on issues regarding accidents, construction methods and techniques and environmental issues.

PROFESSIONAL REGISTRATIONS & AFFILIATIONS

- New York 50226
- Massachusetts 32495
- New Hampshire 6343
- American Public Works Association
- American Society of Civil Engineers
- National Society of Professional Engineers
- Water Environment Federation

Sherri Pullar

Senior Project Scientist

EDUCATION

B.S., State University of New York, New Paltz, NY

TRAINING / CERTIFICATIONS

EPA Guidance on QAPP/eQAPP

Training in ADR and EDMS

DOD database training

WORK HISTORY

Years with firm: 13 years

Years Experience: 28 years

Sherri specializes in data validation of inorganic, organic, and wet chemistry data including PFAS and 1,4-dioxane (including ADR and EDMS). Sherri has extensive experience preparing, supporting, and developing numerous quality assurance project plans, sampling analysis plans, quality assurance sampling plans, precision, accuracy, reproducibility, completeness, and comparability reports, and standard operating procedures for field sampling, work plans, remedial investigations, feasibility studies, remedial actions, health and safety plans, and reviewing data packages for quality control and acceptability. Sherri has extensive experience with database entry for DOD and NJDEP.

BACKGROUND / EXPERIENCE

Haley & Aldrich of New York, Two Projects, NY, NY Senior Project Scientist. Worked on two sites with Haley & Aldrich to perform EPA Region II, level II, III, and IV inorganic data validation, including metals and wet chemistry and organic data validation including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, PCBs, 1,4-dioxane, and PFOS in soil, sediment, groundwater, and air samples.

Environmental Business Consultants (EBC), Numerous Projects, Ridge, NY Senior Project Scientist. Worked on numerous sites with EBC to perform EPA Region II, level IV inorganic data validation, including metals, hex chromium, and wet chemistry and organic data validation including VOCs, SVOCs, PAHs, pesticides, herbicides, PCBs, 1,4-dioxane, and PFOS in soil, sediment, groundwater, and air samples.

U.S. Navy, Numerous LTM Projects, Northeast, Southeast and Washington Districts, Senior Project Scientist. Performed inorganic data validation, including metals and wet chemistry and organic data validation including VOCs, SVOCs, PAHs, pesticides, herbicides, PCBs, 1,4-dioxane, and PFOS in groundwater, soil and air samples. Responsible for data tasks.

USACE New England District, Numerous LTM Projects, Senior Project Scientist. Performed inorganic, wet chemistry, and organic data validation, including explosives and perchlorate using automated data validation (ADR) for groundwater and soil.

Northeastern Environmental Technologies (NEET), Numerous Projects, Ballston Spa, NY Senior Project Scientist. Worked on two sites with NEET to perform EPA Region II, level IV inorganic data validation, including metals and wet chemistry and organic data validation including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), in soil, groundwater, and air samples.

APPENDIX B

FIELD LOGS

NORTHEASTERN ENVIRONMENTAL TECHNOLOGIES

TEST BORING LOG					Boring No.
PROJECT:					**SHEET NO.:** 1 of -----
CLIENT:					**JOB NO.:**
DRILLING CONTRACTOR: Northeastern Environmental Technologies Corporation					**M.P. ELEV.:** -----
PURPOSE: Subsurface Investigation					**GR. ELEV.:** -----
DRILLING METHOD: Direct Push		Soil Sample	GW Sample	Sample Method	**DATUM:** -----
DRILL RIG: Geoprobe 6620DT	**TYPE**	Macro			**DATE START:**
GROUND WATER LEVEL: -----	**DIAM.**	2.0"			**DATE FINISH:**
MEASURING PT.: -----	**Sample**	Yes			**DRILLER:**
DATE: -----	**Screen**	-----			**INSPECTOR:**

Depth (feet)	Sample ID	Peak PID (ppm) bkg=0.0	Unified Soil Class. System	GEOLOGIC DESCRIPTION	REMARKS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Groundwater sample collected @ ____ feet

Soil Boring Completed @ ____ feet

Shipping Address: 1476 Route 50 Ballston Spa, NY 12020 (518) 884-8545 - Phone
Mailing Address: P.O. Box 2167 Ballston Spa, NY 12020 (518) 884-9710 - Fax

NORTHEASTERN ENVIRONMENTAL TECHNOLOGIES CORP.

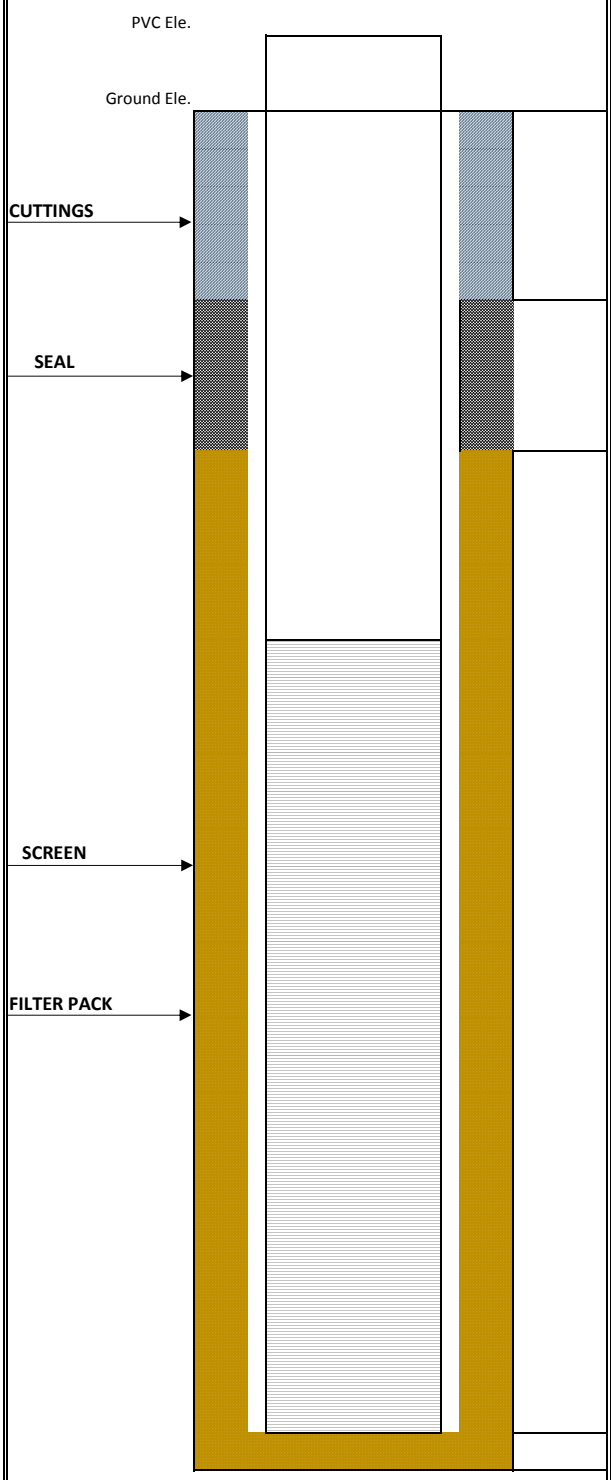
MONITORING WELL COMPLETION LOG | WELL NO.

PROJECT: **DATE DRILLED:**

CLIENT: **DATE DEVELOPED:**

PROJECT NO.:

WELL CONSTRUCTION DETAIL



NOT TO SCALE

INSPECTOR:

DRILLING CONTRACTOR:

WELL TYPE:

WATER LEVEL: DATE:

MEASURING POINT:

WELL DEPTH:

BORING DEPTH:

DRILLING METHOD:

TYPE: DIAMETER:

CASING:

SAMPLING METHOD:

TYPE: DIAMETER:

WEIGHT: FALL:

INTERVAL:

RISER PIPE LEFT IN PLACE:

MATERIAL: DIAMETER:

LENGTH: JOINT TYPE:

SCREEN:

MATERIAL: DIAMETER:

SLOT SIZE: INTERVAL:

STRAEGIC UNIT SCREENED:

FILTER PACK:

TYPE: INTERVAL:

GRADE:

AMOUNT:

SEALS:

TYPE: INTERVAL:

TYPE: INTERVAL:

TYPE: INTERVAL:

NOTES:

NEENVIRONMENTALTECH.COM

Shipping Address: 1476 Route 50 Ballston Spa, NY 12020

Mailing Address: P.O. Box 2167 Ballston Spa, NY 12020

WATER LEVEL MEASUREMENTS

Sheet ___ of ___

PROJECT:_____ SAMPLER:_____

CLIENT:_____ DATE:_____

WEATHER / TEMP:_____ TIME OF ARRIVAL:_____

MEASURING DEVICE:_____ TIME OF DEPARTURE:_____

Well Id	Depth to Product	Depth to Water	pH	Volume Bailed	Color/ Odor	Temp. - C	ORP	Conductivity MS/CM	Turbidity NTU	Dissolved Oxygen MG/L	TDS G/L	Salinity PPT	Spec.Gravity Seawater OT	Recovery Time	Sample Time	Sampling Depth*

* Groundwater samples should be allowed to recover to original elevation prior to sampling

Comments:

APPENDIX C

ANALYSIS, AND ASSESSMENT OF PER AND POLYFLUOROALKYL SUBSTANCES (PFAS) UNDER NYSDEC'S PART 375 REMEDIAL PROGRAMS JUNE 2021

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

June 2021

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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

Citation and Page Number	Current Text	Corrected Text	Date
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 part of the remedy selection process in accordance with Part 375 and DER-10.	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
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. " [Interim SCO 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

Citation and Page Number	Current Text	Corrected Text	Date
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. 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.	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.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
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
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"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"	Deleted	6/15/2021

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 (Lloyd Kahn), 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.

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.

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

[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 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).

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.

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 certified 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 EPA Method 537, 537.1, 533, or 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. **The Bureau of Ecosystem Health will supply the bags.** 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. **The Bureau of Ecosystem Health will supply the larger bags.** 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.

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.

APPENDIX D

LABORATORY QUALITY MANUALS

TITLE PAGE

LABORATORY QUALITY MANUAL

Prepared for:

Pace Analytical Services, LLC
39 Spruce Street
East Longmeadow, MA 01028
Phone: 413-525-2332
DBA: Contest, A Pace Analytical Laboratory

Approved:

Tod Kopyscinski	Katherine F. Allen
Laboratory Director	QA Manager

Revision Number: 0

NON-CONTROLLED COPY

Quality Manual Approval Signatories

Approval of this quality manual by managerial personnel is recorded on the Signature Manifest located before the Title Page of this manual.

The individuals listed below represent the management team that was in place on the effective date of this version of the manual for the following location:

Pace Analytical Services, LLC
39 Spruce Street
East Longmeadow, MA 01028
Phone: 413-525-2332
DBA: Contest, A Pace Analytical Laboratory

Each of the following individuals is a signatory for the quality manual for the location listed above. The application of their signature to the manual signifies their commitment to communicate, implement, and uphold the requirements, policies and procedures specified in this manual and their commitment to continuously improve the effectiveness of the quality management system based on customer feedback and internal assessment.

Name[1]	Title	Address[2]	Phone[2]
Jonathan Waldorf	Corporate Quality Program Manager	Arvada, Colorado	720-660-5317
Jeffrey Graham	Regional Vice-President - Operations	Ormond Beach, Florida	704-589-0230
Thomas Veratti Jr.	General Manager		
Katherine Allen	Quality Manager		
Charles Balicki	Health & Safety, however named.		
Jakub Matusik	IT Manager		
Tod Kopyscinski	Operations Manager		
Francis Derose	Laboratory Manager		
Daren Damboragian	PFAS Manager		

[1] Members of the local management team are subject to change during the lifecycle of this document version.
[2] Include if different from the physical address and phone number of the facility.
[3]This individual serves as an Acting Technical Manager for TNI for one or more fields of accreditation.

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1.0 PURPOSE AND SCOPE

1.1 Purpose

This quality manual (manual) outlines the quality management system (QMS) and management structure of the laboratories and service centers affiliated with the environmental sciences (ENV) division of Pace Analytical Services, LLC (PAS). A laboratory is defined by ENV as any facility, however named, that provides testing, sampling, or field measurement services. When the term 'laboratory" is used in this manual, the term refers to all locations listed on the Title Page of this manual and in Section 4.1.3 unless otherwise specified.

The ENV quality management system is also referred to as the quality program throughout this document. In this context, the phrase "quality management system" and "quality program" are synonymous and may be referred to by the acronym QMS.

The quality management system is the collection of policies and processes established by ENV management to consistently meet customer requirements and expectations, and to achieve the goals of providing PAS customers with high quality, cost-effective, analytical measurements and services.

The quality management system is also intended to establish conformance[1] and compliance with the current versions of the following international and national quality system standards:

- ISO/IEC 17025: *General requirements for the competence of testing and calibration laboratories*
- NELAC/TNI Standard Volume 1: *Management and Technical Requirements for Laboratories Performing Environmental Analysis*

[1]The statement of conformity to these Standards pertains only to testing and sampling activities carried out by the laboratory at its physical address, in temporary or mobile facilities, in-network, or by laboratory personnel at a customer's facility.

In addition to the international and national standards, the quality management system is designed to achieve regulatory compliance with the various federal and state programs for which the laboratory provides compliance testing and/or holds certification or accreditation. When federal or state requirements do not apply to all ENV locations, the requirements for compliance to those specifications are provided in addendum to this manual or in other documents that supplement the manual. Customer-specific project and program requirements are not included in the manual in order to maintain client confidentiality.

- A list of accreditation and certifications held by each laboratory associated with this manual is provided in Appendix A.
- A list of analytical testing capabilities offered by each laboratory associated with this manual is provided in Appendix B.

1.2 Scope and Application

This manual applies to each of the PAS locations listed on the Title Page.

The manual was prepared from the quality manual template (template) created by ENV corporate quality personnel. The template outlines the minimum requirements ENV management considers necessary for every ENV location, regardless of scope of services or number of personnel, to establish in order to maintain a quality management system that achieves the objectives of the Quality Policy

(See 4.2.2). In this regard, the template is the mechanism used by the corporate officers (a.k.a. 'top management') to communicate their expectations and commitment for the quality program to ENV personnel.

Each location also has the responsibility to comply with federal and state regulatory and program requirements for which it provides analytical services and holds certification or accreditation. When those requirements are more stringent than the template, the requirements for compliance are provided in addendum to this manual or in other documents that supplement the manual. This document structure maintains consistency in the presentation of the quality management system across the network while providing the location a mechanism to describe and achieve compliance requirements on a program basis.

1.2.1 Quality Manual Template

The quality manual template is developed by the Corporate Quality Director with contribution and input from corporate quality personnel and the corporate officers. Approval of the template by the corporate officers (aka "top management") confirms their commitment to develop and maintain a quality management system appropriate for the analytical services offered by the organization and to communicate their expectations of the quality program to all personnel.

The template and instructions for use of the template are released by corporate quality personnel to the quality assurance manager responsible for each location (Local QM). The local QM uses the template to prepare the laboratory's manual by following the instructions provided. Since the template provides the minimum requirements by which ENV locations must abide, the laboratory may not alter the font, structure or content of the template except where specified by instruction to do so. As previously stated, program specific requirements are provided in addendum or in documents that supplement this manual.

The template is reviewed by corporate quality personnel annually and updated if needed. More frequent review and revision may be necessary to manage change, to maintain conformance and compliance to relevant standards, or to meet customer expectations.

See standard operating procedure (SOP) ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.2 Laboratory Quality Manual

The manual is approved and released to personnel under the authority of local management whose signatures are identified on the Manual Signatory Page of this manual. The manual is reviewed annually, and location specific information is updated, if needed. More frequent review and revision may be necessary when there are significant changes to the organizational structure, capabilities, and resources of the laboratory. Review and revision of the manual is managed by the local QM. If review indicates changes to the main body of the manual are necessary to maintain conformance and compliance to relevant standards, or to meet customer expectations, the local QM will notify corporate quality personnel to initiate review and/or revision of the template.

See SOP ENV-SOP-CORQ-00015 *Document Management and Control* for more information.

1.2.3 References to Supporting Documents

The template and the manual include references to other laboratory documents that support the quality management system such as policies and standard operating procedures (SOPs). These references include the document's document control number and may include the document title.

This information is subject to change. For example, an SOP may be converted to a policy or the document's title may change. For these types of administrative changes, the manual and template are updated to reflect the editorial change during the manual's next scheduled review/revision cycle or the next time a new version of the manual is released, whichever is sooner.

The local QM maintains a current list of controlled documents used at each location that support the quality management system. This list, known as the "Master List", lists each document used by document control number, title, version, effective date, and reference to any document(s) that the current version supersedes. When there is a difference between the manual and the Master List, the document information in the Master List takes precedence. The current Master List is readily available to personnel for their use and cross-reference. Parties external to the laboratory should contact the laboratory for the most current version.

2.0 REFERENCES

References used to prepare this manual include:

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, most current version.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, current version.
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, current version.
- "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- "NIOSH Manual of Analytical Methods", U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, most current version.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (Sep 1986).
- Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987.

- Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C.
- Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.
- Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, most current version.
- National Environmental Laboratory Accreditation Conference (NELAC) Standard- most current version.
- ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories, 2nd Edition 2005-05-15; 3rd Edition 2017-11

  The following are implemented by normative reference to ISO/IEC 17025:

  - ISO/IEC Guide 99, *International vocabulary of metrology –Basic and general concepts and associated terms*
  - ISO/IEC 17000, *Conformity assessment – Vocabulary and general principles*
- Department of Defense Quality Systems Manual (QSM), most current version.
- TNI (The NELAC Institute) Standard, 2009 and 2016 versions.
- UCMR Laboratory Approval Requirements and Information Document, most current version.
- US EPA Drinking Water Manual, most current version.

3.0 TERMS AND DEFINITIONS

Refer to Appendix C for terms, acronyms, and definitions used in this manual and in other documents used by the laboratory to support the quality management system.

4.0 MANAGEMENT REQUIREMENTS

4.1 Organization

4.1.1 Legal Identity

Pace Analytical Services, LLC is authorized under the State of Minnesota to do business as a limited liability company.

4.1.1.1 Change of Ownership

If there is a change of ownership, if a location goes out of business, or if the entire organization ceases to exist, Pace Analytical Services, LLC ensures that regulatory authorities are notified of the change within the time-frame required by each state agency for which the location is certified or accredited.

Requirements for records and other business information are addressed in the ownership transfer agreement or in accordance with appropriate regulatory requirements, whichever takes precedence.

4.1.2 Compliance Responsibility

Laboratory management has the responsibility and authority to establish and implement procedures and to maintain sufficient resources necessary to assure its activities are carried out in such a way to meet the compliance requirements of the quality management system.

4.1.3 Scope of the Quality Management System

The quality management system applies to work carried out at each location covered by this manual including permanent facilities, at sites away from its permanent facilities, or in associated temporary or mobile facilities.

The permanent and mobile facilities to which this manual applies are listed on the Title Page of this manual.

4.1.4 Organization History and Information

Founded in 1978, Pace Analytical Services, LLC (PAS) is a privately held scientific services firm operating one of the largest full-service contract laboratory and service center networks in the United States. The company's network offers inorganic, organic and radiochemistry testing capabilities; specializing in the analysis of trace level contamination in air, drinking water, groundwater, wastewater, soil, biota, and waste.

With over 90 laboratories and services centers in the contiguous US and in Puerto Rico, the network provides project support for thousands of industry, consulting, engineering and government professionals.

PAS delivers the highest standard of testing and scientific services in the market. We offer the most advanced solutions in the industry, backed by truly transparent data, a highly trained team, and the service and support that comes from four decades of experience.

4.1.4.1 Organization Structure

Each location maintains a local management structure under the oversight and guidance of corporate personnel. Local management is responsible for making day-to-day decisions regarding the operations of the facility, implementing the quality management system, upholding the requirements of the quality program, and for supervision of personnel.

Local management is provided by the Regional Vice-President - Operations (RVPO), Corporate Quality Program Manager (QPM), General Manager (GM), Quality Manager (QM), and department specific management and supervisory personnel.

The GM reports to a Vice-President of Operations (RVPO), who is responsible for the management of multiple laboratories and service centers across the division. The RVPO reports directly to the Chief Operating Officer (COO).

The QM reports to a Quality Program Manager (QPM), who is responsible for managing quality personnel for multiple locations across the division. The QPM reports directly to the Corporate Quality Director (CQD). The QM also maintains an indirect reporting relationship to the GM of each location that the QM manages.

Technical oversight for each location is provided by corporate personnel, RVPO, QPM, GM, QM, and department-specific management.

Refer to the organization charts provided in Appendix D to view the management structure, reporting relationships, and the interrelationships between positions.

4.1.5 Management Requirements

4.1.5.1 Personnel

The laboratory is staffed with administrative and technical personnel who perform and verify work under the supervision of managerial personnel.

- Technical personnel include analysts and technicians that generate or contribute to the generation of analytical data and managerial personnel that oversee day to day supervision of laboratory operations. Including the reporting of analytical data and results, monitoring QA/QC performance, and monitoring the validity of analysis to maintain data integrity and reliability.
- Administrative personnel support the day-to-day activities of the laboratory.
- IT personnel maintain the information technology systems and software used at the laboratory.
- Client services personnel include project managers and support staff that manage projects.
- Managerial personnel make day-to-day and long-term decisions regarding the operations of the facility, supervise personnel, implement the quality management system and uphold the requirements of the quality program.

All personnel regardless of responsibilities are expected to carry out their duties in accordance with the policies and processes outlined in this manual and in accordance with standard operating procedures (SOPs) and other quality system documents. The laboratory's policies and procedures are designed for impartiality and integrity. When these procedures are fully implemented, personnel remain free from undue pressure and other influences that adversely impact the quality of their work or data.

4.1.5.1.1 Key Personnel

Key personnel include the management positions that have the authority and responsibility to plan, direct, and control, activities of the division (corporate) or the laboratory.

The following tables list key personnel positions by PAS job title and the position's primary deputy:

Key Personnel: Corporate

Key Personnel	Primary Deputy
Chief Executive Officer	Chief Operating Officer
Chief Operating Officer	Chief Executive Officer
Chief Compliance Officer	Quality Director

Corporate Quality Director	Chief Compliance Officer
Health and Safety Director	Chief Compliance Officer
IT Director	LIMS Administrator, however named.

Key Personnel: Laboratory

Key Personnel	Primary Deputy
Regional Vice President - Operations	Chief Operating Officer or as designated.
Quality Program Manager	A different QPM or Corporate Quality Director
General Manager	Regional Vice President of Operations
Quality Manager	Quality Program Manager
Manager – Client Services	General Manager or as designated.
Local IT	Corporate IT Director or as designated.
Department Manager	General Manager
Technical Director[1]/Manager[1] Acting Technical Manager TNI	Another qualified employee
Operations Manager[1]	General Manager

[1] *Position may not be staffed at each location.*

Some state certification programs require the agency to be notified when there has been a change in key personnel. Program-specific requirements and timeframes for notification by agency, are tracked and upheld by the local QM, when these requirements apply.

4.1.5.2 Roles and Responsibilities

The qualifications, duties, and responsibilities for each position are detailed in job descriptions maintained by PAS's corporate Human Resource's Department (HR).

The following summaries briefly identify the responsibility of key personnel positions in relation to the ENV quality management system.

Chief Executive Officer (CEO): The CEO has overall responsibility for performance of the organization and endorses the quality program. Working with corporate and laboratory management, the CEO provides the leadership and resources necessary for ENV locations to achieve the goals and objectives of the quality management system and quality policy statement.

Chief Operating Officer (COO): The COO oversees all aspects of operations management including, strategic planning, budget, capital expenditure, and management of senior management personnel for ENV In this capacity, the COO provides leadership and resources necessary to help top management at each ENV location achieve the goals and objectives of the quality management system and quality policy statement.

Chief Compliance Officer (CCO): The CCO oversees the quality assurance and environmental health and safety programs (EHS) for each business unit. The CCO is responsible for planning and policy development for these groups to ensure regulatory compliance and to manage risk. The position provides leadership and

guidance necessary for all PAS locations to achieve the goals and objectives of the quality and EHS programs.

The CCO also serves as the Ethics Officer (ECO). The ECO develops the Ethics and Data Integrity Policy and Training Program and provides oversight for reporting and investigation of ethical misconduct to maintain employee confidentiality during the process. The ECO provides guidance and instruction for follow-up actions necessary to remedy the situation and deter future recurrence.

Corporate Director of Quality (CQD): The Corporate Director of Quality is responsible for developing and maintaining the ENV quality program under guidance and assistance from the CEO, COO, and CCO. This position develops corporate quality policy and procedure and analyzes metric data and other performance indicators to assess and communicate the effectiveness of the quality program to top management. The position provides leadership and guidance for implementation of the quality program across all ENV locations.

Corporate Quality Program Manager (QPM): The Quality Program Manager is responsible for managing the implementation of the ENV quality program for one or more locations in the network. Working with the CQD and local laboratory management to which they are assigned, the QPM provides leadership, guidance and resources, including allocation of personnel, necessary to achieve the goals of ENV quality program.

Corporate Director of Information Technology: The Corporate Director of IT oversees the systems and processes of information technology used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

Regional Vice-President of Operations): The RVPO has full responsibility for administrative and operations management and performance of a group of ENV laboratories and service centers. Working with the COO and local laboratory management, the RVPO provides leadership, guidance and resources, including allocation of personnel, necessary to achieve the goals of ENV quality program.

General Manager (GM): The GM is responsible for the overall performance and administrative and operations management of a ENV location and associated service center(s). This position is responsible to provide leadership and resources, including allocation and supervision of personnel, necessary for the location to implement and achieve the goals of the PAS quality program. In this capacity, the position assures laboratory personnel are trained on and understand the structure and components of the quality program defined in this manual as well as the policies and procedures in place to implement the quality management system.

The GM of NELAC/TNI Accredited laboratories is also responsible for the designation of technical personnel to serve as acting technical managers for TNI for the fields of accreditation held by the laboratory (See Section 4.1.5.2.1) and for

notifying the accreditation body (AB) of any extended absence or reassignment of these designations.

Quality Manager (QM): The QM oversees and monitors implementation of the quality management system for each ENV location assigned and communicates deviations to laboratory management. The QM is independent of the operation activities for which they provide oversight and has the authority to carry out the roles and responsibilities of their position without outside influence.

Additionally, in accordance with the TNI Standard, the QM:

- serves as the focal point for QA/QC and oversees review of QC data for trend analysis;
- evaluates data objectively and perform assessments without outside influence;
- has documented training and experience in QA/QC procedures and the laboratory's quality system;
- has a general knowledge of the analytical methods offered by the laboratory;
- coordinates and conducts internal systems and technical audits;
- notifies laboratory management of deficiencies in the quality system;
- monitors corrective actions;
- provides support to technical personnel and may serve as the primary deputy for the acting TNI Technical Manager(s).

Manager-Client Services (CSM): This position is responsible for training and management of client facing staff that serve as the liaison between PAS and the customer to ensure that projects are successfully managed to meet the expectations and needs of PAS customers. This position is also responsible for sharing positive and negative customer feedback with laboratory management so that this information may be used to improve the quality program.

Local IT Manager, however named: Local IT managers are responsible for maintaining the IT systems used to support the quality program. These systems include Laboratory Information Management Systems (LIMS); data acquisition, reduction, and reporting software; virus-protection, communication tools, and ensuring the integrity and security of electronic data.

Department Manager (DM): The DM is responsible for administrative and operations management and implementation of the quality management system in the work area he/she oversees. These responsibilities include but are not limited to: training and supervision of personnel, monitoring work activity to maintain compliance with this manual, SOPs, policies and other instructional documents that support the quality management system; method development, validation and the establishment and implementation of SOPs to assure regulatory compliance and

suitability for intended purpose; monitoring QA/QC performance, proper handling and reporting of nonconforming work, purchasing of supplies and equipment adequate for use, maintaining instrumentation and equipment in proper working order and calibration, and general maintenance of administrative and technical processes and procedures established by the laboratory.

Operations Manager (OM): The OM is responsible for management of production and/or other duties assigned by the GM.

4.1.5.2.1 Acting Technical Manager (TNI Accreditation):

For ENV locations that are NELAC/TNI accredited:

The TNI Standard specifies requirements for the qualification and duties of technical personnel with managerial responsibility. These requirements are associated in the Standard to the designation 'technical manager(s), however named'. These responsibilities may be assigned to multiple individuals and are not associated with any specific job title.

The TNI requirements for personnel that provide technical oversight correlate with ENV job descriptions for Department Manager or Supervisor. However, the duties may be assigned to any PAS employee that meets the TNI specified qualifications.

Personnel assigned this designation retain their assigned job title. The job title may be appended with *"acting as technical manager for TNI"* and the technology or field of accreditation for which the employee is approved, if necessary.

When TNI Accreditation Bodies (AB) refer to these employees as 'technical manager' or 'technical director' on the official certificate or the scope of accreditation, this reference is referring to their approval to carry out duties of the 'technical manager, however named' as specified in the TNI Standard.

In accordance with the TNI Standard, the acting Technical Manager(s) for TNI are responsible for monitoring the performance of QC/QA in the work areas they oversee.

If the absence of any employee that is approved as acting technical manager for TNI exceeds 15 calendar days, the duties and responsibilities specified in the TNI Standard are temporarily reassigned to another employee that meets the qualifications for the technology or field of accreditation. If the employee's absence exceeds 35 calendar days, the QM will formally notify the TNI primary AB of the absence and the details of reassignment of duties in writing.

Refer to the applicable TNI Standard for requirements for technical oversight and required qualifications of the acting Technical Manager(s) for each discipline (chemical, limited inorganic chemistry, and microbiology).

4.1.5.3 Conflict of Interest

A conflict of interest is a situation where a person has competing interests. Laboratory management looks for potential conflict of interest and undue pressures that might arise in work activities and then includes countermeasures in policies and procedures to mitigate or eliminate the conflict.

See policy COR-POL-0004 *Ethics Policy* for more information.

4.1.5.4 Confidentiality

Laboratory management is committed to preserving the confidentiality of PAS customers and confidentiality of business information.

Procedures used by the laboratory to maintain confidentiality include:

- A Confidentiality Agreement which all employees are required to sign at the time of employment and abide by the conditions of throughout employment;
- Record retention and disposal procedures that assure confidentiality is maintained;
- Physical access controls and encryption of electronic data; and
- Protocol for handling Confidential Business Information (CBI).

Client information obtained or created during work activities is considered confidential and is protected from intentional release to any person or entity other than the client or the client's authorized representative, except when the laboratory is required by law to release confidential information to another party, such as a regulatory agency or for litigation purposes. In which case, the laboratory will notify the client of the release of information and the information provided.

The terms of client confidentiality are included in ENV Standard Terms and Conditions (T&C). With the acceptance of ENV Terms and Conditions and/or the implicit contract for analytical services that occurs when the client sends samples to the laboratory for testing, the client authorizes PAS to release confidential information when required.

See policy COR-POL-0004 *Ethics Policy* for more information.

4.1.5.5 Communication

Communication is defined as the imparting or exchanging of news and information. Effective (good) communication occurs when the person(s) you are exchanging information with actively gets the point and understands it.

4.1.5.5.1 Workplace Communication

Good communication in the workplace is necessary to assure work is done correctly, efficiently, and in accordance with client expectations.

Instructions for how to carry out work activities are communicated to personnel via written policy, standard operating procedures, and standard work instructions.

Information about laboratory performance (positive and negative) and ideas for improvement are communicated using various communication channels such as face to face meetings, video conferencing, conference calls, email, memoranda, written reports, and posters.

4.1.5.5.2 External Communication

Communication with external parties such as customers, vendors, business partners, and regulatory agencies takes place every day.

Laboratory management ensure personnel learn to communicate in professional and respectful ways in order to build strong relationships and learn to communicate effectively to avoid misunderstanding.

4.2 Quality Management System

4.2.1 Quality Management System Objectives

The objectives of the laboratory's quality management system are to provide clients with consistent, exemplary professional service, and objective work product that is of known and documented quality that meets their requirements for data usability and regulatory compliance.

Objective work product is analytical services, data, test results, and information that is not influenced by personal feeling or opinions. The quality of being objective is also known as 'impartiality'.

4.2.1.1 Impartiality

The laboratory achieves and maintains impartiality by implementing and adhering to the policies and processes of the quality management system, which are based on industry accepted standards and methodologies.

The laboratory's procedures for handling nonconforming work (See 4.9), corrective and preventive actions (See 4.11, 4.12) and management review (See 4.15) are the primary mechanisms used to identify risk to impartiality and to prompt actions necessary to eliminate or reduce the threat when risk to impartiality is suspected or confirmed.

4.2.1.2 Risk and Opportunity Assessment

Risks are variables that make achieving the goals and objectives of the quality management system uncertain. An opportunity is something that has potential positive consequences for the laboratory.

Laboratory personnel manage risks and opportunities daily by carrying out the processes that make up the quality management system. Some of the ways in which the quality management system is designed to identify, minimize, or eliminate risk daily include but are not limited to:

- Capability and capacity reviews of each analytical service request to assure the laboratory can meet the customer's requirements;
- Maintenance of accreditation and certification for test methods in multiple states and programs to cover a broad range of jurisdiction for regulatory compliance;
- SOPs and other controlled instructional documents are provided to personnel to eliminate variability in process. These documents include actions to counter risk factors inherent in the process and are reviewed on a regular basis for on-going suitability and relevancy;
- Participation in proficiency testing programs and auditing activities to verify on-going competency and comparability in performance;
- Provision of on-the-job training and established protocol for quality control (QC) corrective action for nonconforming events;
- An established program for ethics, and data integrity;
- Tiered data review process;
- Culture of continuous improvement;
- Monitoring activities to assess daily and long-term performance; and
- Annual critical review of the effectiveness of the quality management system.

ENV also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team-based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction. ENV's lean programs and activities help to mitigate risk because they generate a collective understanding of vulnerabilities and utilize group-effort to develop and implement solutions at all levels.

Risk and opportunities may also be formally identified using specific risk and opportunity assessment methods such as SWOT Analysis (Strength, Weakness, Opportunity, Threats) and 3-Stage Impact/Probability Grids.

4.2.1.3 Communication of the Quality Management System

This manual is the primary mechanism used by laboratory management to communicate the quality management system to laboratory personnel.

To assure personnel understand and implement the quality program outlined in the manual:

- All laboratory personnel are required to sign a Read and Acknowledgement Statement to confirm the employee has: 1) been informed of the manual by laboratory management, 2) has access to the manual, 3) has read the manual 4) understands the content of the manual, and 5) agrees to abide by the requirements, policies and procedures therein.
- Personnel are informed that the manual provides the "what" of the quality management system. The "how to" implementation of the quality management system is provided in policy, SOPs, standard work instructions, and other controlled instructional documents.

4.2.2 Quality Policy Statement

The quality policy of the laboratory is to provide customers with data of known and documented quality fit for their intended purpose. The laboratory achieves this policy by implementing the quality management system defined in this manual, by following industry accepted protocol for analytical testing and quality assurance and quality control (QA/QC) activities, by conformance with published and industry accepted testing methodologies, and by compliance with international and national standards for the competency and/or accreditation of testing laboratories.

Intrinsic to this policy statement is each of the following principles:

- The laboratory will provide customers with reliable, consistent, and professional service. This is accomplished by making sure the laboratory has the resources necessary to maintain capability and capacity; that staff are trained and competent to perform the tasks they are assigned; that client-facing staff are trained and prepared to find solutions to problems and to assist customers with their needs for analytical services. Customer feedback, both positive and negative, is shared with personnel and used to identify opportunities for improvement.
- The laboratory maintains a quality program that complies with applicable state, federal, and industry standards for analytical testing and competency.

  ISO/IEC 17025 and the TNI (The NELAC Institute) Standard is used by ENV to establish the minimum requirements of the ENV quality program.

  ISO/IEC 17025 is a competency standard that outlines the general requirements for the management system for calibration and testing laboratories. It is the primary quality system standard from which other quality system standards, such as the TNI Standard, are based. The TNI Standards are consensus standards that provides management and technical requirements for laboratories performing environmental analysis.

- Laboratory management provides training to personnel so that all personnel are familiar with the quality management system outlined in this manual and that they understand that implementation of the quality management system is achieved by adherence to the organization's policies and procedures.
- Laboratory management continuously evaluates and improves the effectiveness of the quality management system by responding to customer feedback, and other measures of performance, such as but not limited to: the results of internal/external audits, proficiency testing, metrics, trend reports, and annual and periodic management reviews.

4.2.2.1 Ethics Policy / Data Integrity Program

PAS has established a comprehensive ethics and data integrity program that is communicated to all PAS employees in order that they understand what is expected of them. The program is designed to promote a mindset of ethical behavior and professional conduct that is applied to all work activities.

The key elements of the PAS Ethics / Data Integrity Program include:

- Ethics Policy (COR-POL-0004);
- Ethics Officer;
- Standardized data integrity training course taken by all new employees on hire and a yearly refresher data integrity training course for all existing employees;
- Policy Acknowledgement Statements that all PAS personnel, including contract and temporary, are required to sign at the time of employment and again during annual refresher training to document the employee's commitment and obligation to abide by the company's standards for ethics, data integrity and confidentiality;
- SOPs that provide instructions for how to carry out a test method or process to assure tasks are done correctly and consistently by each employee;
- On the Job Training;
- Data integrity monitoring activities which include, but are not limited to, primary, secondary and completeness data reviews, internal technical and system audits, data audits, data surveillance, and proficiency testing; and
- Confidential reporting process for alleged ethics and data integrity issues.

All laboratory managers are expected to provide a work environment where personnel feel safe and can report unethical or improper behavior in complete confidence without fear of retaliation. Retaliation against any employee that reports a concern is not tolerated.

PAS has engaged Lighthouse Services, Inc. to provide personnel with an anonymous reporting process available to them 24 hours a day/7 days per week. The alert line may be used by any employee to report possible violations of the company's ethics

and data integrity program. When using the reporting process, the employee does need to specify the location of concern and when reporting by email, also include the company name. Messages are collected, documented, reviewed, and will be followed up on by the Ethics Compliance Officer to resolve the matter. Investigations concerning data integrity are kept confidential.

Lighthouse Compliance Alert Lines:

English Speaking US & Canada	(844) 940-0003
Spanish Speaking North America	(800) 216-1288
Internet	www/lighthouse-services.com/pacelabs
Email	reports@lighthouse-services.com

4.2.3 Management Commitment: Quality Management System

Evidence of management's commitment for the development, maintenance, and on-going improvement of the quality management system is provided by the application of their signature of approval to this manual. Their signature confirms they understand their responsibility to implement the quality management system outlined in this manual, to communicate the quality program to personnel, and to uphold requirements of the program during work activities.

4.2.4 Management Commitment: Customer Service

Management communicates the importance of meeting customer and regulatory requirements to personnel by training personnel on the quality management system outlined in this manual, implementing the quality management system outlined in this manual, and upholding these requirements for all work activities.

4.2.5 Supporting Procedures

Documents that support this manual and quality management system are referenced throughout this manual. The structure of the document management system is outlined in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and summarized in the following subsections.

4.2.5.1 Quality Management System Document Structure

Documents associated with the quality management system are classified into document types that identify the purpose of the document and establish how the document is managed and /or controlled.

Document types are ranked to establish which documents takes precedence when there is an actual or perceived conflict between documents and to establish the hierarchal relationships between documents. The ranking system also provides information to document writers and reviewers to assure downline documents agree with documents of higher rank. Project specific documents are not ranked because client specific requirements are not incorporated into general use documents in order to maintain client confidentiality.

Examples: ENV QMS Documents: Internal

Document Type	Purpose
Quality Manual	Outlines the laboratory's quality management system and structure and how it works for a system including policy, goals, objectives and detailed explanation of the system and the requirements for implementation of system. Includes roles and responsibilities, relationships, procedures, systems and other information necessary to meet the objectives of the system described.
Policy	Provide requirements and rules for a PAS process and is used to set course of actions and to guide and influence decisions. Policy describes the "what", not the "how".
Standard Operating Procedure	Provide written and consistent set of instructions or steps for execution of a routine process, method, or set of tasks performed by PAS. Includes both fundamental and operational elements for implementation of the systems described in PAS manual(s). Assures that activities are performed properly in accordance with applicable requirements. Designed to ensure consistency, protect EHS of employees and environment, prevent failure in the process and ensure compliance with company and regulatory requirements. SOPs describes the "how" based on policy.
Standard Work Instruction	Provide step by step visual and/or written instruction to carry out a specific task to improve competency, minimize variability, reduce work injury and strain, or to boost efficiency and quality of work (performance). SWI are associated with an SOP unless the task described is unrelated to generation of or contribution to environmental data or analytical results.
Template	Pre-formatted document that serves as a starting point for a new document.
Guide	Provide assistance to carry out a task.
Form	Used for a variety of purposes such as to provide a standardized format to record observations, to provide information to supplement an SOP.
Guidance	Non-binding advice used to explain internal policies, procedures, or practices.

Example: ENV QMS Documents: External

Certificate	Lists parameters, methods, and matrices for which the laboratory is certified/accredited to perform within the jurisdiction of the issuing regulatory agency or accreditation body.
Reference Document	Provide information, protocol, instructions, and/or requirements. Issued by the specifier. Examples include quality system standards such as ISO/IEC, TNI, DoD and published referenced methods such as Standard Methods, ASTM, SW846, EPA, and federal and state regulatory bodies.
Project Document	Provides requirements necessary to meet individual client expectations for intended use of data. Examples include project quality assurance plans (QAPP), client-program technical specifications, contracts, and other agreements.

Document Hierarchy

Rank	Document
1	Reference Documents
2	Corporate Manual
3	Corporate Policy
4	Corporate SOP
5	Corporate SWI, Templates, Guides, Forms, Guidance
6	Laboratory Manual
7	Laboratory SOP
8	Laboratory SWI, Templates, Guide, Forms, Guidance
NA	Project Documents

4.2.6 Roles and Responsibilities

The roles and responsibilities for technical management and the quality manager is provided in section 4.1.5.2.

4.2.7 Change Management

When significant changes to the ENV quality management system are planned, these changes are managed by corporate quality personnel to assure that the integrity of the quality management system is maintained.

4.3 Document Control

4.3.1 General

The laboratory's procedures for document control are provided in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

The laboratory uses electronic document management software (eDMS) to carry out the document control procedures of the SOP. eDMS automates the process for unique document identification, version control, approval, access, and archival. The eDMS software used by ENV restricts access to archived documents except to authorized users to prevent the use of obsolete documents.

The local QM maintains a master list of controlled documents used at the laboratory. The master list includes the document control number, document title, and current revision status and is made available to personnel for their reference.

See SOP ENV-SOP-CORQ-0015 *Document Management and Control* for more information.

4.3.2 Document Approval and Issue

Documents that support the quality management system are reviewed by qualified personnel and approved by laboratory management prior to release for general use.

Only the approved versions of documents are available to personnel for use unless use of a draft document is authorized by management.

See SOP ENV-SOP-CORQ-0015 *Document Management and Control* for more information.

4.3.3 Document Review and Change

Unless a more frequent review is required by regulatory, certification or accreditation program the laboratory formally reviews documents at least every two years to ensure the document remains current, appropriate, and relevant.

Documents are also informally reviewed every time the document is used. Personnel are expected to refer to and follow instructions in controlled documents when they carry out their work activities. Consequently, any concerns or problems with the document should be caught and brought to the attention of laboratory management on an on-going basis.

Documents are revised whenever necessary to ensure the document remains usable and correct. Older document versions and documents no longer needed are made obsolete and archived for historical purposes.

ENV does not allow hand-edits to documents. If an interim change is needed pending re-issue of the document, the interim change is communicated to those that use the document using a formal communication channel, such as SOP Change in Progress form, email, or memorandum.

The document review, revision, and archival process is managed by quality personnel at the location from which the document was released using the procedures established in SOP ENV-SOP-CORQ-0015 *Document Management and Control.*

4.4 Analytical Service Request, Tender, and Contract Review

The laboratory's management and/or client service personnel perform thorough reviews of requests and contracts for analytical services to verify the laboratory has the capability, capacity, and resources necessary to successfully meet the customer's needs. These review procedures are described in laboratory SOP Review of Requests, Tenders, and Contracts Doc #290.

The procedures in this SOP(s) are established to ensure that:

- The laboratory understands the purpose of data collection in order to ensure the test methods requested are appropriate for the intended use of the data and capable of meeting the client's data quality objectives;
- The laboratory and any subcontractor have the capability, capacity, and resources to meet the project requirements and expectations within the requested time frame for delivery of work product;
- Any concerns that arise from review are discussed and resolved with the client; and
- The results of review and any correspondence with the client related to this process and/or any changes made to the contract are recorded and retained for historical purposes.

Capability review confirms that the in-network laboratories and any potential subcontractors hold required certification/accreditation for the test method, matrix, and analyte and verifies the laboratory can achieve the client's target compound list and data quality objectives (DQOs) for analytical sensitivity and reporting limits, QA/QC protocol, and hardcopy test report and electronic data deliverable (EDD) formats.

Capacity review verifies that the in-network laboratories and any potential subcontractors can handle the sample load and deliver work production within the delivery timeframe requested.

Resource review verifies that the laboratory and any potential subcontractors have adequate qualified personnel with the skills and competency to perform the test methods and services requested and sufficient and proper equipment and instrumentation needed to perform the services requested.

4.5 Subcontracting and In-Network Work Transfer

The terms 'subcontract' and "subcontracting" refers to work sent to a business external to Pace Analytical Services, LLC (PAS) and the term 'subcontractor' refers to these external businesses, which are also called vendors.

Work transferred within the ENV network is referred to as interregional work orders (IRWO) and network laboratories are referred to as IRWO, IR, or a network laboratory.

The network of ENV laboratories offers comprehensive analytical capability and capacity to ensure PAS can meet a diverse range of client needs for any type of project. If the laboratory receives a request for analytical services and it cannot fulfill the project specifications, the laboratory's client services team will work with the client to place the work within the ENV network. When it is not possible to place the work within network, the laboratory will, with documented client approval, subcontract the work to a subcontractor that has the capabilities to meet the project specifications and can meet the same commitment agreed on between the laboratory and the client. Some client programs require client consent even for in-network work transfer, and when this applies, the client services team obtains consent as required. The laboratory retains the record of client notification and their consent in the project record for historical purposes.

Whenever work is transferred to a subcontractor or an in network laboratory, the laboratory responsible for management of the project verifies each of these qualifications:

- The subcontractor or in network laboratory has the proper accreditation/certifications required for the project and these are current; and
- The use of the subcontractor or in network laboratory is approved by the client and/or regulatory agency, when approval is required. Record of approval is retained in the project record.

All subcontractor laboratories must maintain a quality management system like ENV and that complies with ISO/IEC 17025 and the TNI Standard(s).

ENV also evaluates and pre-qualifies subcontractors as part of the company's vendor qualification program. The complete list of approved vendors is maintained by the corporate procurement department and is made available to all ENV locations. Pre-qualification of a subcontractor does not negate the requirement for the placing laboratory to verify the capability, capacity, and resources of any selected subcontractor on a project-specific basis to confirm the subcontractor can meet the client's needs.

For both subcontracting and in-network work transfer, the project specifications are always communicated to the subcontractor or the in network laboratory by the project manager so that the laboratory performing the work is aware of and understands these requirements.

The procedures for subcontracting are outlined in laboratory SOP Subcontracting Doc#239.

4.6 Purchasing Services and Supplies

Vendors that provide services and supplies to the laboratory are prequalified to verify the vendor's capability to meet the needs of PAS. These needs include but are not limited to competitive pricing, capacity to fill purchase orders, quality of product, customer service, and business reputation and stability. The records of vendor evaluation and the list of approved vendors is maintained by the corporate procurement department.

The procedures for vendor qualification are specified in the corporate process for vendor qualification, however named.

The laboratory may purchase goods and services from any supplier on the approved vendor list.

The specifications (type, class, grade, tolerance, purity, etc.) of supplies, equipment, reagents, standard reference materials and other consumables used in the testing process are specified in SOPs. The SOP specifications are based on the governing requirements of the approved reference methods and any additional program driven regulatory specification, such as drinking water compliance. All requisitions for materials and consumables are approved by the department supervisor to confirm the purchase conforms with specified requirements. After approval the requisition is handled by the laboratory's designated purchasing agent. On receipt, the product is inspected and verified before use, when applicable.

The laboratory's procedure for the purchase of services and supplies is specified in laboratory SOP Evaluation of Vendors for Supplies Doc#231.

4.7 Customer Service

Project details and management is handled by the laboratory's customer service team. Each customer is assigned a Project Manager (PM) that is responsible for review of contract requirements and handling laboratory to customer communication about the project status.

4.7.1 Commitment to Meet Customer Expectations

The laboratory cooperates and works closely with our customers to ensure their needs are met and to establish their confidence in the laboratory's capability to meet their needs for analytical services and expectations for service.

The PM is the customer's primary point of contact for each analytical service request. The PM gathers information from the customer to ensure the details of their request are understood. After samples are received, the PM monitors the progress of the project and alerts the customer of any delays or excursions that may adversely impact data usability. Laboratory supervisors are expected to keep the PM informed of project status and any delays or major issues, so that the PM can keep the client informed.

The laboratory encourages customers to visit the laboratory to learn more about the laboratory's capabilities, observe performance and to meet laboratory personnel.

ENV customers expect confidentiality. Laboratory personnel will not divulge or release information to a third party without proper authorization unless the information is required for litigation purposes. See Section 4.1.5.4 of this manual and policy COR-POL-0004 *Ethics Policy* for more information on the laboratory's policy for client confidentiality.

4.7.2 Customer Feedback

The laboratory actively seeks positive and negative feedback from customers through surveys and direct communication. Information from the client about their experience working with the laboratory and their satisfaction with work product is used to enhance processes and practices and to improve decision making. Customer feedback is communicated to laboratory management and corporate personnel in management reports and analyzed yearly during management review (See 4.15) to identify risk and opportunity. Corrective, preventive, or continuous improvement actions are taken based on nature of and/or feedback trends.

Also see sections 4.9, 4.10, 4.11, 4.12, 4.14, and 4.15 for more information about how customer feedback is managed by the laboratory and used to enhance the quality management system.

4.8 Complaints

Complaints provide opportunities to improve processes and build stronger working relationships with our clients.

The laboratory's complaint resolution process includes three steps. First, handle and resolve the complaint to mutual satisfaction. Second, perform corrective action to prevent recurrence (See 4.11). Third, record and track the complaint and use these records for risk and opportunity assessment and preventive action (See 4.12).

4.9 Nonconforming Work

4.9.1 Definition of Nonconforming Work

Nonconforming work is work that does not conform to customer requirements, standard specifications, laboratory policies and procedures, or that does not meet acceptance criteria.

The discovery of non-conforming work comes from various sources which include, but are not limited to:

- results of quality control samples and instrument calibrations;
- quality checks on consumables and materials;
- general observations of laboratory personnel;
- data review;
- proficiency testing;
- internal and external audits;
- complaints and feedback;
- management review and reports; and
- regulatory and certification and accreditation actions.

The way in which the laboratory handles nonconforming work depends on the significance and impact (risk) of the issue. Some issues may simply require correction, others may require investigation, corrective action (See 4.11) and/or data recall (See 4.16). When the laboratory releases data and test results associated with nonconforming QC and acceptance criteria, test

results are qualified, or non-conformances are noted in the final analytical report to apprise the data user of the situation. (See 5.10)

Nonconforming work also includes unauthorized departure from laboratory policies, procedures and test methods. Authorized departures are explained in the following subsections. Situations that do not conform to these conditions are considered unauthorized departure(s).

4.9.1.1 Authorized Departure from SOP

An authorized departure from a test method SOP is one that has been reviewed and approved by the Department Manager, designated Acting Technical Manager for TNI for the discipline the SOP pertains to (Chemistry, Inorganic Chemistry, Microbiology), Quality Manager, or the General Manager. Management review is conducted to confirm the departure does not conflict with regulatory compliance requirements for which the data will be used or does not adversely affect data integrity. The departure may originate from client request or may be necessary to overcome a problem.

An authorized departure from administrative or process-oriented SOP is typically necessary to correct an error in the SOP. These departure requests are reviewed and pre-approved by the QA Manager.

Documentation of SOP departures and approval decisions are retained by the laboratory as evidence that the departure was authorized. When necessary, approved departures from test method SOPs are noted in the final test report to advise the data user of any ramification to data quality.

4.9.1.2 Authorized Departure from Test Methods (Method Modifications)

When test results are associated to a published reference test method, the laboratory's test method SOP must be consistent with the test method. If the test method is mandated for use by a specific regulatory program such as drinking water or wastewater or a certification or accreditation program, such as TNI/NELAC, the SOP must also comply with or include these requirements. If the procedures in the SOP are modified from the test method, these modifications must be clearly identified in the SOP. The conditions under which the laboratory may establish an SOP that is modified from these reference documents, and what is considered a modification are specified in ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification*.

Modifications that do not meet the requirements of this SOP (ENV-SOP-CORQ-0011) are unauthorized. Client requests to deviate from the test method are handled as client requests to depart from the test method SOP since it is the SOP that the laboratory follows when performing work.

4.9.1.3 Stop Work Authority

Stop Work Authority provides laboratory personnel with the responsibility and obligation to stop work when there is a perceived unsafe condition or behavior that may result in an unwanted event.

All laboratory and corporate personnel have the authority to stop work when needed to preserve data integrity or safety of workers.

Once a stop work order has been initiated and the reason for doing so is confirmed valid; laboratory management is responsible for immediate correction and corrective action (see section 4.11) before resumption of work.

4.10 Continuous Improvement

The laboratory's quality management system is designed to achieve continuous improvement through the implementation of the quality policy and objectives outlined in this manual. Information about the laboratory's activities and performance is gained from many sources such as customer feedback, audits, QC, trend analysis, business analytics, management reports, proficiency testing, and management systems review. This information is subsequently used during the laboratory's corrective action (see section 4.11) and preventive action (see section 4.12) processes and during annual review of the management system (see section 4.15) to establish goals and objectives for improvement.

ENV also promotes a continuous improvement culture based on the principles of lean manufacturing. These principles include 3P (Process, Productivity, Performance) and Kaizen. 3P is a platform used by Pace to share best practices and standardization across the network to achieve operational excellence. Kaizen is a team-based process used to implement tools and philosophies of lean to reduce waste and achieve flow with the purpose of improving both external and internal customer satisfaction.

4.11 Corrective Action

Corrective action is a process used to eliminate the cause of a detected nonconformity. It is not the same as a correction. A correction is an action taken to fix an immediate problem. The goal of the corrective action process is to find the underlying cause(s) of the problem and to put in place fixes to prevent the problem from happening again. The corrective action process, referred to as CAPA by ENV, is one of the most effective tools used by the laboratory to prevent nonconforming work, identify risk and opportunity, and improve service to our customers.

The laboratory has two general processes for corrective action:

The process used for actions taken in response to day to day quality control (QC) and acceptance criteria exceptions (nonconformance) that occur during the day to day testing process are called corrections. These events do not usually include formal methods for cause analysis; instead the reason for the failure is investigated through troubleshooting or other measures. Required actions for correction of routine nonconformance is specified in laboratory SOPs. When corrective action is not taken, cannot be taken, or is not successful, test results associated with the nonconforming work are qualified in the final test report. Documentation of the nonconformance and corrective action taken is documented in the analytical record.

A 7-stage corrective action process is used when there is a problem or departure from the quality management system, technical activities, or when the extent of a single problem has significant impact on data, regulatory compliance or customer needs. These problems are identified through various activities such as but not limited to quality control trends, internal and external audits, management review, customer feedback, and general observation.

The laboratory's 7 Stage CAPA Process includes:

1) Identification and Containment
2) Evaluation
3) Investigation
4) Cause Analysis
5) Action Plan
6) Implementation
7) Follow Up and Effectiveness Review

The 7 stage CAPA process may be initiated by any employee. Once the process is initiated it is overseen and coordinated by laboratory management. The CAPA process is documented using a software-based workflow process called Qualtrax. The Qualtrax CAPA record includes tracking information, dates, individuals involved, those responsible for action plan implementation and follow-up, and timelines and due dates.

ENV's procedures for corrective action, are specified in corporate SOP ENV-SOP-CORQ-0018, *Procedure for Corrective and Preventive Action.* Additional explanation about certain aspects of the laboratory's corrective action process are outlined in the next three subsections.

4.11.1 Cause Analysis

Cause analysis is the process of investigation used by the laboratory to identify the underlying cause(s) of the problem. Once causal factors are identified, ways to mitigate the causal factors are reviewed and corrective action(s) most likely to eliminate the problem are selected.

The laboratory uses different methods to conduct this analysis. The most common approach is 5-Why, but fishbone diagrams, or even brainstorming may be appropriate depending on the situation. The method used is documented in the CAPA record.

4.11.2 Effectiveness Review

Monitoring corrective actions for effectiveness is an activity shared by laboratory supervisors and quality assurance personnel. Effectiveness means the actions taken were sustainable and appropriate. Sustainable means the change is still in place. Appropriate means the action(s) taken prevented recurrence of the problem since the time corrective action was taken.

The timeframe in which effectiveness review takes place depends on the event and is recorded in the CAPA record with any addition actions that need to be taken.

Corrective action trends are also monitored by laboratory management and used to identify opportunities for preventive action or to gain lessons learned when actions taken were not adequate to solve the problem. See Section 4.12 (Preventive Action) and 4.15 (Management Review) for more information.

4.11.3 Additional Audits

When non-conformities or other problems cast doubt on compliance with the laboratory's policies, procedures, or compliance to regulatory requirements; the quality manager schedules a special audit of the area of activity in accordance with Section 4.14.1 as soon as possible. These special audits are used to determine the scope of the problem and to provide information for the CAPA process. Additional full-scale audits are done when a serious issue or risk to the laboratory's business is identified.

4.12 Preventive Action

Preventive action is an action taken to eliminate the cause of a potential nonconformity and to achieve improvement. Preventive action is a forward-thinking process designed to prevent problems opposed to reacting to them (corrective action).

Some examples of preventative action include, but are not limited to:

- Scheduled instrument maintenance (Preventative maintenance)
- Addition of Staff and Equipment
- Professional Development Activities
- Implementation of New Technology

The laboratory looks for opportunities for preventive action from a variety of sources including but not limited to: employee idea's, customer feedback, business partners input, trend analysis, business analytics, management reviews, proficiency testing results, lean management events, and risk-benefit analysis.

Laboratory management evaluates the success of preventive actions taken in any given year during annual management review. See Section 4.15 for more information.

4.12.1 Change Management

Preventive actions may sometimes result in significant changes to processes and procedures used by the laboratory. Laboratory management evaluates the risks and benefits of change and includes in its implementation of change process, actions to minimize or eliminate any risk. The types of changes for which risk are considered and managed include infrastructure change, change in analytical service offerings, certification or accreditation status, instrumentation, LIMS changes, and changes in key personnel.

4.13 Control of Records

A record is a piece of evidence about the past, especially an account of an act or occurrence kept in writing or some other permanent form. Laboratory records document laboratory activities and provide evidence of conformity to the requirements established in the quality management system. These records may be hardcopy or electronic on any form of media.

4.13.1 General Requirements

4.13.1.1 Procedure

The requirements for control of records is specified in corporate policy ENV-POL-CORQ-0013 *Record Management*. The procedure used to implement the policy is described in laboratory SOP Controlled Documents Doc #83.

The policy is established to assure quality and technical records are identified, retained, indexed, and filed to allow for retrieval during the entire retention time frame. During storage, records are kept secure and protected from deterioration. At the end of the retention time, the records are disposed of properly in order to maintain client confidentiality and to protect the interests of the company.

In general, laboratory records fall into three categories: quality, technical, and administrative.

Examples of each are provided in the following table:

Record Type	Includes Records of:
Quality	Document Types listed in SOP ENV-SOP-CORQ-0015 Audits: Internal and External Certificates and Scopes of Accreditation Corrective & Preventive Action Management Review Data Investigations Method Validation Instrument Verification Training Records
Technical	Raw Data Logbooks Certificates of Traceability Analytical Record Test Reports & Project Information Technical Training Records & Demonstration of Capability
Administrative	Personnel Records Finance/Business

4.13.1.2 Record Legibility and Storage

Records are designed to be legible and to clearly identify the information recorded. Manual entries are made in indelible ink; automated entries are in a typeface and of sufficient resolution to be read. The records identify laboratory personnel that performed the activity or entered the information. Records are archived and stored in a way that they are retrievable. Access to archived records is controlled and managed.

For records stored electronically, the capability to restore or retrieve the electronic record is maintained for the entire retention period. Hardcopy records are filed and stored in a suitable environment to protect from damage, deterioration, or loss. Hardcopy records may be scanned to PDF for retention. Scanned records must be checked against the hardcopy to verify the scan is complete and legible.

Administrative records are kept for a minimum of 5 years and technical and quality records are kept for 10 years unless otherwise specified by the client or regulatory program.

The date from which retention time is calculated depends on the record. In general, the retention time of technical records of original observation and measurement is calculated from the date the record is created. If the technical record is kept in a chronological logbook, the date of retention may be calculated from the date the logbook is archived. The retention time of test reports and project records, which are considered technical records, is calculated from the date the test report was issued. The retention time of quality records is usually calculated from the date the record is archived.

Refer to the record management policy and the laboratory SOP for more information.

4.13.1.3 Security

The laboratory is a secure facility and access to records is restricted to laboratory personnel.

4.13.1.4 Electronic Records

The data systems used to store electronic records is backed up in accordance with laboratory SOP Data Systems and Storage of Electronic Records and Use of Computer Doc #603. Access to archived records stored electronically is maintained by personnel responsible for management of the electronic system.

4.13.1.5 Electronic Signature Policy

Work done by ENV locations include activities that require the application of a signature. Some of this work product is in electronic format and signatures are applied electronically.

The Electronic Signatures in Global and National Commerce Act (E-Sign Act) clarifies that electronic signatures are legally valid and enforceable under United States law.

ENV's policy for use and application of electronic signatures is specified in corporate policy ENV-POL-CORQ-0014 *Electronic Signature Policy*.

All employees of ENV, including temporary and contract personnel, must sign an Electronic Signature Agreement to acknowledge that they understand and accept that work activities performed by them may be authenticated with application of an electronic signature and that electronic signature has the same validity as a handwritten signature. Their signed agreement also confirms the individual has read and understands the policy and agrees to abide by the requirements for use of electronic signature stated in the policy.

4.13.2 Technical Records

In addition to the requirements specified in subsections 4.13.1.1 through 4.13.1.5, the requirements in the following subsections also apply to technical records.

4.13.2.1 Description

Technical records are the accumulation of data and information generated from the analytical process. These records may include forms, worksheets, workbooks, checklists, notes, raw data, calibration records, final test reports, and project record. The accumulated record essentially needs to provide adequate detail to historically reconstruct the process and identify the personnel that performed the tasks associated with a test result.

4.13.2.2 Real Time Recordkeeping

Personnel are instructed and expected to always record observations, data, and calculations at the time they are made. Laboratory managers are responsible to assure that data entries, whether made electronically or on hardcopy, are identifiable to the task.

4.13.2.3 Error Correction

Errors in records must never be erased, deleted or made illegible. Use of correction fluid, such as white-out is prohibited. In hardcopy records, the error is corrected by a single strike through the original entry and the new entry recorded alongside or footnoted to allow for readability. Corrections are initialed and dated by the person making the correction. If the correction is not self-explanatory, a reason for the correction is recorded.

For electronic records, equivalent measures of error correction or traceability of changes made is kept. For example, audit trails provide records of change.

Maintenance of proper practices for error correction is monitored through the tiered data review process described in Section 5.9.3. Laboratory records are reviewed throughout the data review process. Individuals performing these reviews flag errors that are not properly corrected and bring these to the attention of the department manager or supervisor of the work area in which the record was generated so that the problem may be addressed and corrected with the individual(s) that did not make the correction properly.

4.14 Audits

The laboratory performs internal systems and technical audits to assess implementation of the QMS and compliance to this manual and to procedures, such as policy, SOP and SWI. Since the processes in this manual are based on the relevant quality system standards and regulatory and accreditation/certification program requirements the laboratory provides services for, the internal audits also assess on-going compliance to these programs.

The laboratory is also audited by external parties such as regulatory agencies, customers, consultants and non-government assessment bodies (NGAB).

Information from internal and external audits is used by laboratory management to address compliance concerns and opportunities where improvement will increase the reliability of data.

Deficiencies, observations and recommendations from audits are managed by the local QM using the laboratory's formal CAPA process. See Section 4.11 for more information.

4.14.1 Internal Audit

The laboratory's internal audit program is managed by the local QM in accordance with an audit plan established at the beginning of each calendar year. The schedule is prepared to assure that all areas of the laboratory are reviewed over the course of the year. Conformance to the schedule is reported to both laboratory management and corporate quality personnel in a monthly QA report prepared by the quality manager.

Although the local QM creates the audit schedule, it is the shared responsibility of local management to assure the schedule is maintained. Laboratory supervisors cooperate with the quality personnel to provide the auditors with complete access to the work area, personnel, and records needed.

Internal audits are performed by personnel approved by the quality manager. In general, personnel may not audit their own activities unless it can be demonstrated that an effective and objective audit will be carried out. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation.

The laboratory's internal audit program ensures daily practice is consistent with laboratory's SOPs and to verify SOPs are compliant with policy and procedures. Test reports are audited to verify the final product is consistent with customer/project requirements, the work was carried out in accordance with policy and SOPs, the SOP complies with the cited reference method, test results are accurate, and of known and documented quality and properly qualified, when necessary.

Special audits are performed ad hoc to follow up on a specific issue such as a client complaint, negative feedback, concerns of data integrity or ethics, or a problem identified through other audits. Special audits may be scheduled or unscheduled. Unscheduled internal audits are conducted whenever doubts are cast on the laboratory's compliance with regulatory requirements or its own policies and procedures. These unscheduled internal audits may be conducted at any time and may be performed without an announcement to laboratory personnel.

When observations and findings from any audit (internal or external) cast doubt on the validity of the laboratory's testing results, the laboratory takes immediate action to initiate investigate the problem and take corrective action. (Also see 4.11 and 4.16)

The laboratory's internal audit program and auditing procedures are further described in laboratory SOP Internal Audits Doc#605.

4.14.1.1 Corporate Compliance Audit

ENV locations are also periodically audited by corporate quality personnel to assess the location's compliance to ENV's quality management program and to evaluate the effectiveness of implementation of the policies and procedures that make up the quality management system. The purpose of the compliance audit is to identify risks and opportunities and to assist laboratory management achieve the goals and objectives of the company's quality program.

4.15 Management Review

The management team formally reviews the management system of each location under their purview on an annual basis to assess for on-going suitability and effectiveness and to establish goals, objectives, and action plans for the upcoming year.

The process and procedures used to conduct this review are outlined in corporate SOP ENV-SOP-CORQ-0005 *Management Review*.

At a minimum, the following topics are reviewed and discussed:

- The on-going suitability of policies and procedures including EHS and waste management;
- Reports from managerial and supervisory personnel including topics discussed at regular management meetings held throughout the year;
- The outcome of recent internal audits;
- Corrective and preventive actions;
- Assessments by external bodies;
- The results of interlaboratory comparisons or proficiency tests;
- Changes in the volume and type of the work;
- Customer and personnel feedback, including complaints;
- Effectiveness of improvements / preventive actions made since last review;
- Internal and external issues of relevance and risk identification;
- A review of the status of actions from prior management reviews; and
- Other relevant factors, such as quality control activities, resources, and staff training.

The discussion and results of this review are documented in a formal report prepared by laboratory management. This report includes a determination of the effectiveness of the management system and its processes; goals and objectives for improvements in the coming year with timelines and responsibilities, and any other need for change.

Goals and action items from annual management systems review are shared with local employees and with corporate management to highlight focus areas for improvement in addition to areas in which the laboratory has excelled.

4.16 Data Integrity

ENV's procedures for the investigation and response to events that may affect data integrity are described in the corporate SOPs for data inquiries and data recall and corrective and preventive action, however named.

Customers whose data are affected by these events are notified in a timely manner, usually within 30 days after the impact of the problem is understood. Some accreditation programs also require notification to the accreditation body (AB) within a certain timeframe from date of discovery when the underlying cause of the issue impacts accreditation. The laboratory follows any program or project specific client notification requirements for notification, when applicable.

5.0 TECHNICAL REQUIREMENTS

5.1 General

Many factors contribute to the correctness and reliability of the technical work performed by the laboratory. These factors fall under these general categories:

- Human Performance
- Facility and Environmental Conditions
- Test Method Performance and Validation
- Measurement Traceability
- Handling of Samples

The impact of each of these factors varies based on the type of work performed. To minimize negative effects from each of these factors, the laboratory accounts for the contribution from each of these categories when developing test method and process (administrative) SOPs, evaluating personnel qualifications and competence, and in the selection of equipment and supplies used.

5.2 Personnel

5.2.1 Personnel Qualifications

The laboratory's program for personnel management is structured to ensure personnel are selected, qualified, and competent to perform the roles and responsibilities of their position based on education, experience, and training.

Qualifications, duties, responsibilities, and authorities of each position are specified in job descriptions maintained by corporate HR (See Section 5.2.4). These job descriptions provide the general basis for the selection of personnel for hire and are used by the laboratory to communicate to personnel the duties, responsibilities, and authorities of their position.

The term "personnel" refers to individuals employed by the laboratory directly as full-time, part-time, or temporary, and individuals employed by the laboratory by contract, such as through an employment agency. The term "personnel" is used interchangeably with the term "employee" throughout this manual. For purposes of this manual, these terms are equivalent.

The personnel management program is structured to establish and maintain records for each of the following:

- Selection of personnel;
- Training of personnel;
- Supervision of personnel;
- Authorization of personnel; and
- Monitoring Competence of personnel.

5.2.1.1 Competence

Competence is the ability to apply a skill or series of skills to complete a task or series of tasks correctly within defined expectations.

Competence for technical personnel authorized by ENV to provide opinion and interpretation of data to customers also includes the demonstrated ability to:

- Apply knowledge, experience, and skills needed to safely and properly use equipment, instrumentation, and materials required to carry out testing and other work activities in accordance with manufacturer specifications and laboratory SOPs;
- Understand and apply knowledge of general regulatory requirements necessary to achieve regulatory compliance in work product; and
- Understand the significance of departures and deviations from procedure that may occur during the analytical testing process and the capability and initiative to troubleshoot and correct the problem, document the situation and decision-making process, and to properly qualify the data and analytical results.

The laboratory's requirements for the competence of personnel (education, qualification, work experience, technical skills, and responsibilities) are specified in job descriptions created by management and kept by human resources (HR). The job description provides the basis for the selection of personnel for each position.

An employee is considered competent when he/she has completed required training.

The policies and standard operating procedures (SOPs) for the following topics are established by management as minimum required training for all personnel:

- Ethics and Data Integrity
- Quality Manual
- Safety Manual
- Quality Management System
- Technical Process and Procedure relevant to their job tasks

- Successful Demonstration of Capability (DOC) – Analytical Personnel Only

Personnel are initially authorized competent to independently carry out their assigned duties when required training is complete and documented.

Records of required training and qualification provide the record of competence for the individual. Qualification records may include but are not limited to diploma, transcripts, and curriculum vitae (CV).

The on-going competence of each employee is monitored by laboratory management through on-the-job performance. Analytical employees are also required to successfully complete another demonstration of capability for each test method performed on an annual basis.

5.2.2 Training (Required)

ENV's training requirements are outlined in policies COR-POL-0023 *Mandatory Training Policy,* COR-POL-0004 *Ethics Policy*, and laboratory SOP Training requirements Doc#608.

5.2.2.1 Required Training

The laboratory's training program includes these elements:

- Scheduling of Required Training
- Execution of Required Training
- Documentation and Tracking of Required Training
- Evaluation of Training Effectiveness

Required training is delivered using various methods that incorporate techniques that appeal to the main learning styles: visual, aural, linguistic, and kinesthetic. Techniques include, on-the-job, instructor-led, self-study, eLearning, and blended.

The employee's direct supervisor is responsible for oversight of completion of the employee's required training and for providing adequate time to the employee to complete training assignments. Both the supervisor and employee are responsible to make sure the employee's training status and training records for required training are current and complete.

The status of completion of required training is monitored by the local QM, who provides the status to the GM at least monthly or more frequently, if necessary, to ensure required training for personnel is complete and up to date.

The following subsections describe the elements of ENV's required training program.

5.2.2.1.1 New Hire Training

New hire training requirements apply to new personnel and to existing employees starting in a new position or different work area.

Required new hire training includes each of the following:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Manual and any training requirements specified in the manual.
- Policies & SOPs relevant to their job tasks
- Technical personnel that test samples must also successfully complete an initial demonstration of capability (IDOC) for the test methods performed before independently testing customer samples. (See 5.2.2.1.5). Independent testing means handling of client samples without direct supervision of the work activity by the supervisor or a qualified trainer.

All required training must be current and complete before the employee is authorized to work independently. Until then, the employee's direct supervisor is responsible for review and acceptance of the employee's work product.

5.2.2.1.2 On-Going Training

Personnel receive on-going training in each of the following topics:

- Ethics and Data Integrity (See 5.2.2.1.3)
- Quality Manual / Quality Management System (See 5.2.2.1.4)
- Safety Training
- Changes to Policies & SOPs
- Technical employees that carry out testing must also successfully complete on-going demonstration of capability (CDOC) for all test methods performed on an annual basis. (See 5.2.2.1.5)

Personnel are expected to maintain their DOCs current and complete and to complete training assignments in a timely manner.

5.2.2.1.3 Ethics and Data Integrity Training

Data integrity training is provided to all new personnel and refresher data integrity training is provided to all employees on an annual basis. Personnel are required to acknowledge they understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment, or civil/criminal prosecution.

Completion of data integrity training is documented by employee signature to provide evidence that the employee has participated in

training on this topic and understand their obligations related to data integrity.

The following topics and activities are covered:

- Policy for honesty and full disclosure in all analytical reporting;
- Prohibited Practices;
- How and when to report data integrity issues;
- Record keeping. The training emphasizes the importance of proper written documentation on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially nonconforming;
- Training Program, including discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth procedures for data monitoring; and
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

All PAS personnel, including contract and temporary, are required to sign an "Attestation of Ethics and Confidentiality" at the time of employment and during annual refresher training. This document clearly identifies inappropriate and questionable behavior. Violations of this document result in serious consequences, including prosecution and termination, if necessary.

Also see SOP-ENV-COR-POL-0004 *Ethics Policy* for more information.

5.2.2.1.4 Management System Document Training

The Quality Manual and ENV manuals, policies, and SOPs are the documents used by regulatory bodies and PAS customers to verify the laboratory's capability, competency, and compliance with their requirements and expectations.

In addition to on-the-job training, employees must have a signed Read and Acknowledgement Statement (R&A) on record for the laboratory quality manual, and the policies and SOPs relating to his/her job responsibilities. This statement, whether signed by the employee electronically or by wet signature, confirms that the employee has received, read, and understands the content of the document, that the employee agrees to follow the document when

carrying out their work tasks; and the employee understands that unauthorized change to procedures in an SOP is not allowed except in accordance with the SOP departure policy (See 4. 9.1).

See SOP ENV-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions* for more information.

5.2.2.1.5 Demonstration of Capability (DOC)

Demonstration of capability is based on the employee's capability to achieve acceptable precision and accuracy for each analyte reported by the laboratory for the test method using the laboratory's test method SOP.

Technical employees must complete an initial demonstration of capability (IDOC) prior to independent work on client samples analyzed by the test methods they perform. After successful IDOC, the employee must demonstrate continued proficiency (CDOC) for the test method on an annual basis. If more than a year has passed since the employee last performed the method; then capability must be re-established with an IDOC.

Records of IDOC and CDOC are kept in the employee's training file.

5.2.2.2 Effectiveness of Training

The results of the performance measures used to identify training needs are the same measures used by the laboratory to measure effectiveness of the training program. Improvement in key performance measures suggest the training program is successful (See 5.2.2.1).

Effectiveness of individual employee training is measured by their demonstrated ability to comprehend the training material and apply knowledge and skills gained to their job task. Measurements include but are not limited to:

- Testing of the employee's knowledge of the quality management system, policies, and technical and administrative procedures through various mechanisms, such as quizzes, observation, and interviews.
- Demonstrated ability to convey information correctly and factually in written and verbal communication to internal and external parties.
- Demonstrated ability to carry out tasks in accordance with SOPs and other work instructions.
- Demonstrated ability to make sound decisions based on guidance and information available.
- Demonstrated initiative to seek help or guidance when the employee is unsure of how to proceed.

5.2.2.3 Supplemental Learning

Supplemental learning objectives are established for newly hired personnel to aid in their development of administrative and technical skills. These learning objectives and materials, referred to as Learning Plans (LP), are created and maintained by ENV's 3P program and managed by the employee's direct supervisor.

In addition to LPs, PAS maintains a wide variety of supplemental learning courses that are made available to all PAS employees for professional development. These learning materials, maintained by PAS's corporate training personnel, are accessed via the company's employee portal, PaceConnect. The learning may be self-initiated based on an employee's interest or may be assigned to the employee at the discretion of management as professional development as part of an employee's annual goals. Supplemental learning courses and learning plan activities are not prerequisites for competency (Section 5.2.1.1) and are not part of the required QMS training specified in Section 5.2.2.1.

5.2.3 Personnel Supervision

Every employee is assigned a direct supervisor, however named, who is responsible for their supervision. Supervision is the set of activities carried out by the supervisor to oversee the progress and productivity of the employees that report to them.

General supervisory responsibilities may include but are not limited to:

- Hiring Employees
- Training Employees
- Performance Management
- Development, oversight, and execution of personnel training plans
- Monitoring personnel work product to assure the work is carried out in accordance with this quality manual, policies, SOPs, and other documents that support the quality management system.

5.2.4 Job Descriptions

Job Descriptions that define the required education, qualifications, experience, skills, roles and responsibilities, and reporting relationships for each PAS position are established by top management and kept by corporate HR. PAS laboratories use these job descriptions as the source of positions and job titles for the laboratory. The job descriptions apply to employees who are directly employed by PAS, part-time, temporary, technical and administrative and by those that are under contract with PAS through other means.

The job descriptions include the education, expertise, and experience required for the position and the responsibilities and duties, including any supervisory or managerial duties assigned to the position.

5.2.5 Authorization of Technical Personnel

Laboratory management authorizes technical personnel to perform the technical aspects of their position after it has been verified that the employee meets the qualifications for the position, has successfully completed required training (Section 5.2.2.1), and the employee has completed initial demonstrated capability (Section 5.2.2.1.5). After initial authorization, technical personnel are expected to maintain a current and complete training record, demonstrate on-going capability at least annually for each test method performed, and produce reliable results through accurate analysis of certified reference materials, proficiency testing samples, and/or routine quality control samples in order to remain authorized to continue to perform their duties.

Records to support authorization including, education, experience, training, and other evaluations are kept by the laboratory.

5.3 Accommodations and Facilities

5.3.1 Facilities

The laboratory is designed to support the correct performance of procedures and to not adversely affect measurement integrity or safety. Access to the laboratory is controlled by various measures, such as card access, locked doors, main entry. Visitors to the laboratory are required to sign-in and to be escorted by laboratory personnel during their visit. A visitor is any person that is not an employee of the laboratory.

5.3.2 Environmental Conditions

The laboratory is equipped with energy sources, lighting, heating, and ventilation necessary to facilitate proper performance of calibrations and tests. The laboratory ensures that housekeeping, electromagnetic interference, humidity, line voltage, temperature, sound and vibration levels are appropriately controlled to ensure the integrity of specific measurement results and to prevent adverse effects on accuracy or increases in the uncertainty of each measurement.

Environmental conditions are monitored, controlled, and recorded as required by the relevant specifications, methods, and procedures. Laboratory operations are stopped if it is discovered that the laboratory's environmental conditions jeopardize the analytical results.

5.3.3 Separation of Incompatible Activities

The layout and infrastructure of each work area including air handling systems, power supplies, and gas supplies of each laboratory work area is specifically designed for the type of analytical activity performed. Effective separation between incompatible work activities is maintained. For example, sample storage, preparation, and chemical handling for volatile organic analysis (VOA) is kept separate from semi-volatile organic (SVOA).

The laboratory separates samples known or suspected to contain high concentration of analytes from other samples to avoid the possibility for cross-contamination. If contamination is found, the source of contamination is investigated and resolved in accordance with laboratory SOPs.

5.3.4 Laboratory Security

Security is maintained by controlled access to the building and by surveillance of work areas by authorized personnel. Access is controlled to each area depending on the required personnel, the sensitivity of the operations performed, and possible safety concerns. The main entrance is kept unlocked during normal business hours for visitors and is continuously monitored by laboratory staff. All visitors must sign a visitor's log, and a staff member must accompany them during the duration of their stay.

5.3.5 Good Housekeeping

The laboratory ensures good housekeeping practices in work areas to maintain a standard of cleanliness necessary for analytical integrity and personnel health and safety. Minimally, these measures include regular cleaning of the work area. Where necessary, areas are periodically monitored to detect and resolve specific contamination and/or possible safety issues.

5.4 Test Methods

5.4.1 General Requirements

The laboratory uses test methods and procedures that are appropriate for the scope of analytical services the laboratory offers.

Instructions on the use and operation of equipment and sample handling, preparation, and analysis of samples are provided in SOPs. The instructions in SOPs may be supplemented with other documents including but not limited to, standard work instructions (SWI), manuals, guides, project documents and reference documents.

These documents are managed using the procedures described in SOP ENV-SOP-CORQ-0015 *Document Management and Control* and SOP ENV-SOP-CORQ-0016 *Standard Operating Procedures and Standard Work Instructions.*

5.4.2 Method Selection

The test methods and protocols used by the laboratory are selected to meet the needs of the customer, are appropriate for the item tested and intended use of the data, and to conform with regulatory requirements when regulatory requirements apply.

In general, the test methods offered are industry accepted methods published by international, regional, or national standards. The laboratory bases its procedure on the latest approved edition of a method unless it is not appropriate or possible to do so, or unless regulatory requirements specify otherwise.

The laboratory confirms that it can perform the test method and achieve desired outcome before analyzing samples (see section 5.4.5). If there is a change in the published analytical method, then the confirmation is repeated.

When a customer does not specify the test method(s) to be used, the laboratory may suggest test methods that are appropriate for the intended use of the data and the type of samples to be tested. The laboratory will also inform customers when test methods requested are considered inappropriate for their purpose and/or out of date. This discourse takes place during review of analytical service requests (See Section 4.4).

5.4.3 Laboratory Developed Methods

A laboratory developed method is a method developed from scratch (no published source method), a procedure that modifies the chemistry from the source method, or a procedure that exceeds the scope and application of the source method.

Laboratory developed methods must be validated prior to use (see section 5.4.5) and the procedure documented in a test method SOP.

The requirements for non-standard methods (Section 5.4.4) also apply to laboratory developed methods.

5.4.4 Non-standard Methods

A non-standard method is a method that is not published or approved for use by conventional industry standards for the intended purpose of the data. Non-standard methods must be validated prior to use (see section 5.4.5) and the procedure developed and documented in a test method SOP.

At a minimum, the following information must be included in the procedure:

- Title / Identification of Method;
- Scope and Application;
- Description of the type of item to be analyzed;
- Parameters or quantities and ranges to be determined;
- Apparatus and equipment, including technical performance requirements;
- Reference standards and reference materials required;
- Environmental conditions required and any stabilization period needed; and
- Description of the procedure, including:
    - Affixing identification marks, handling, transporting, storing and preparing of items;
    - Checks to be made before the work is started;
    - Verifying equipment function and, where required, calibrating and/or adjusting the equipment before each use;
    - Method of recording the observations and results;
    - Any safety measures to be observed;
    - Criteria and/or requirements for approval/rejection;
    - Data to be recorded and method of analysis and presentation; and
    - Uncertainty or procedure for estimating uncertainty.

Use of a non-standard method for testing must be agreed upon with the customer. The agreement, which is retained by the laboratory in the project record, must include the

specifications of the client's requirements, the purpose of testing, and their authorization for use of the non-standard method.

5.4.5 Method Validation

5.4.5.1 Validation Description

Validation is the process of conformation and the provision of objective evidence that the stated requirements for a specific method/procedure are fulfilled.

The laboratory's requirements and procedures for method validation are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

5.4.5.2 Validation Summary

All test methods offered by the laboratory are validated before use to confirm the procedure works and the data and results achieved meet the goals for the method and repeated when there are major changes to the laboratory procedure.

Results of validation are retained are kept in accordance with method validation SOP and the corporate policy ENV-CORQ-POL-0013 *Record Management.*

5.4.5.3 Validation of Customer Need

The validation process includes review of accuracy, precision, sensitivity, selectivity, linearity, repeatability, reproducibility, robustness, and cross-sensitivity of the procedure against general customer needs to ensure the laboratory's procedure will meet those needs.

The following subsections highlight some of these concepts:

5.4.5.3.1 Accuracy

Accuracy is the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard. When the result recovers within a range from the known value (control limit); the result generated using the laboratory's test method SOP is considered accurate.

5.4.5.3.2 Precision

Precision refers to the closeness of two or more measurements to each other. It is generally measured by calculating the relative percent difference (RPD) or relative standard deviation (RSD) from results of separate analysis of the same sample. Precision provides information about repeatability, reproducibility, and robustness of the laboratory's procedure.

5.4.5.3.3 Limits of Detection (LOD) (Chemistry)

The LOD is the minimum result which can be reliably discriminated from a blank with a predetermined confidence level. The LOD

establishes the limit of method sensitivity and is also known as the detection limit (DL) or the method detection limit (MDL).

Values below the LOD cannot be reliably measured and are not reported by the laboratory unless otherwise specified by regulatory program or test method.

The LOD is established during method validation and after major changes to the analytical system or procedure that affect sensitivity are made.

5.4.5.3.4 Limits of Quantitation (LOQ) and Reporting Limit (RL)

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence. The LOQ is established at the same time as the LOD.

The LLOQ is the value of the lowest calibration standard included in the calibration curve. The LLOQ establishes the lower limit of quantitation.

The LOQ and LLOQ represent quantitative sensitivity of the test method.

- The LOQ must always be equal to or greater than the LLOQ and the LLOQ must always be greater than the LOD.
- Any reported value (detect or non-detect) less than the LLOQ is a qualitative value.

The RL is the value to which the presence of a target analyte is reported as detected or not detected. The RL is project-defined based on project data quality objectives (DQO). In the absence of project specific requirements, the RL is usually set to the LOQ or the LLOQ.

The laboratory's procedures for LOD/LOQ determination is detailed in laboratory SOP LOQ_LOD_MDL Determination Doc#606.

The local SOP is based on guidance provided by corporate quality and must comply with 40CFR 136 Appendix B and the TNI Standard.

5.4.5.3.5 Linearity

Linearity is a mathematical concept applied to calibration models that employ multiple points to establish a calibration range used for quantitative analysis. Linearity is measured differently based on the calibration model. In general, if linearity is demonstrated then the slope of the response of standards are sufficiently close to one

another. The accuracy of the linear regression and non-linear curves is verified by checking percent error or relative standard error (RSE), which is the process of refitting calibration data back to the model to determine if the results are accurate. For linear curves that use average calibration or response factor, error is measured by relative standard difference (RSD).

Linearity also establishes the range of quantitation for the test method used which directly impacts the sensitivity of the test method and uncertainty in measurement results. As previously noted, the LLOQ establishes the lower limit of quantitation. Similarly, the upper range of linearity establishes the upper limit of quantitation. In general, results outside of this range are considered qualitative values. However, some inorganic methods allow for extension of the linear range above the upper limit of quantitation when accuracy at this value is verified.

Linearity can also be used to establish repeatability, reproducibility, and robustness of the laboratory's test method. When linearity is demonstrated using a specific calibration model during method validation, then use of this same calibration model to achieve linearity on a day to day basis confirms the laboratory's method is repeatable, reproducible, and robust.

5.4.5.3.6 Demonstration of Capability (DOC)

The DOC performed during method validation confirms that the procedure demonstrated acceptable precision and accuracy. The procedure used for DOC for method validation is the same as described in section 5.2.2.1.5 for demonstration of analyst capability.

5.4.6 Measurement Uncertainty

The laboratory provides an estimate of uncertainty in testing measurements when required or on client request. In general, the uncertainty of the test method is reflected in the control limits used to evaluate QC performance. (See 5.9.1.1.9). ISO/IEC supports this concept with language that reads when a well-recognized test method specifies limits to the values of the major source of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory has satisfied the requirements on analytical uncertainty by following the test method and reporting instructions.

When measurement uncertainty cannot be satisfied through control limits, the laboratory will provide a reasonable estimation of uncertainty. A reasonable estimation is based on knowledge of method performance and previous experience. When estimating the analytical uncertainty, all uncertainty components which are of importance in the given situation are considered.

5.4.7 Control of Data

The laboratory has policies and processes in place to assure that reported data is free from calculation and transcription errors, that quality control is reviewed and evaluated before data is reported, and to address manual calculation and integration.

5.4.7.1 Calculations, Data Transfer, Reduction and Review

Whenever possible, calculations, transfer of data, and data reduction are performed using validated software programs (See 5.4.7.2).

If manual calculations are performed, the results of these calculations are verified during the data review process outlined in section 5.9.3.

5.4.7.1.1 Manual Integration

The laboratory's policy and procedures for manual integration are provided in corporate SOP ENV-SOP-CORQ-0006 *Manual Integration*.

This SOP includes the conditions under which manual integration is allowed and the requirements for documentation.

Required documentation of manual integration includes:

- complete audit trail to permit reconstruction of before and after results;
- identification of the analyst that performed the integration and the reason the integration was performed; and
- identification of the individual(s) that reviewed the integration and verified the integration was done and documented in compliance with the SOP.

5.4.7.2 Use of Computers and Automated Acquisition

Whenever possible the laboratory uses software and automation for the acquisition, processing, recording, reporting, storage, and/or retrieval of data.

Software applications developed by PAS are validated by corporate IT for adequacy before release for general use. Commercial off the shelf software is considered sufficiently validated when the laboratory follows the manufacturer or vendor's manual for set-up and use. Records of validation are kept by the corporate information technology (IT) group or by the local laboratory, whichever group performed the validation.

The laboratory's process for the protection of data stored in electronic systems include:

- Individual usernames and passwords for Laboratory Information Management Systems (LIMS) and auxiliary systems used to store or process data.

- Employee Training in Computer Security Awareness
- Validation of spreadsheets used for calculations to verify formulas and logic yield correct results and protection of these cells to prevent unauthorized change.
- Operating system and file access safeguards
- Protection from Computer Viruses
- Regular system backup; and testing of retrieved data

The laboratory's process for software development and testing process includes:

- Verification the software application works as expected and is adequate for use and fulfills compliance requirements, such as the need to record date/time of data generation.
- Change control to assure requests for changes are reviewed and approved by management before the change is made.
- Communication channels to assure all staff are aware of changes made.
- Version Control and maintenance of historical records.

These procedures are detailed in laboratory SOP Data Systems and Storage of Electronic Records and Use of Computers Doc#603.

5.5 Equipment

5.5.1 Availability of Equipment

The laboratory is furnished with all equipment and instrumentation necessary to correctly perform the tests offered in compliance with the specifications of the test method and to achieve the accuracy and sensitivity required.

5.5.2 Calibration

Equipment and instrumentation are checked prior to use to verify it performs within tolerance for its intended application.

Laboratory management is made aware of the status of equipment and instrumentation and any needs for either daily. This information is obtained during laboratory walkthroughs (LDM) that are conducted as part of the laboratory's lean program.

5.5.2.1 Support Equipment

The laboratory confirms support equipment is in proper working order and meets the specifications for general laboratory use prior to placement in service with intermediate checks thereafter. Equipment that does not meet specifications is removed from service until repaired or replaced. Records of repair and maintenance activities are maintained.

Procedures used to carry out and record these checks are outlined laboratory in SOP Calibration of Support Equipment and Ref Standards Doc#601.

5.5.2.2 Analytical Instruments

Analytical instruments are checked prior to placement in service in accordance with SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.* After the initial service date, the calibration of instruments and verification calibration is performed in accordance with local test method SOPs.

The calibration procedures in the test method SOPs comply with the requirements for acceptable calibration practices outlined in corporate policy ENV-POL-CORQ-0005 *Acceptable Calibration Practices*, the reference methods, and any applicable regulatory or program requirements.

5.5.3 Equipment Use and Operation

Equipment is operated and maintained by laboratory personnel that are trained on the test method SOP. Up-to-date instructions and procedures for the use and maintenance of analytical equipment are included in SOPs and/or supplemental documents such as standard work instructions (SWI) or instrument manuals which are made readily accessible in the work area to all laboratory personnel.

5.5.4 Equipment Identification

The laboratory uniquely identifies equipment by serial number or any other unique ID system, when practical. The identifier is included in the equipment list maintained by the quality department.

5.5.5 Equipment Lists and Records

5.5.5.1 Equipment List

The laboratory maintains a master list of equipment that includes information about the equipment including a description, manufacturer, serial number, date placed in service, condition when received, identity, and the current location in the laboratory. The date of purchase is tracked by the procurement record. The equipment list(s) for each location covered by this manual is provided in Appendix E.

5.5.5.2 Equipment Records

In addition to the equipment list, the laboratory maintains records of equipment that include:

- Verification that equipment conforms with specifications.
- Calibration records including dates, results, acceptance criteria, and next calibration dates.
- Maintenance plan and records
- Records of damage, malfunction, or repair

The laboratory follows an equipment maintenance program designed to optimize performance and to prevent instrument failure which is described in laboratory SOP Equipment Doc#604 or in individual test method SOPs.

The maintenance program includes routine maintenance activities which are performed as recommended by the manufacturer at the frequency recommended and non-routine maintenance, which is performed to resolve a specific problem such as degradation of peak resolution, shift in calibration relationship, loss of sensitivity, or repeat failure of instrument performance checks and quality control samples.

Maintenance is performed by laboratory personnel or by outside service providers.

All maintenance activities performed by laboratory personnel are recorded by the individual(s) that performed the activity at the time the maintenance was performed in an instrument maintenance log.

The maintenance record minimally includes the date of maintenance, the initials of the person(s) performing maintenance, a description of the activity performed, why (when the maintenance is non-routine), and the return to analytical control. When maintenance is performed by an external vendor, the laboratory staples the service record into hardcopy maintenance logs or scans the record for easy retrieval. The laboratory provides unrestricted access to instrument maintenance logs in order to promote good instrument maintenance and recordkeeping practices.

If an instrument must be moved, the laboratory will use safe practices for handling and transport to minimize damage and contamination.

5.5.6 Out of Service Protocol

Equipment that has been subjected to overloading, mishandling, gives suspect results, has been shown to be defective, or is performing outside of specified limits is taken out of service and either removed from the work area or labeled to prevent accidental use until it has been repaired and verified to perform correctly.

When analytical equipment is taken out of service, the laboratory examines the potential effect it may have had on previous analytical results to identify any non-conforming work. (See section 4.9).

5.5.7 Calibration Status

The laboratory labels support equipment to indicate calibration status, whenever practicable or otherwise maintains the calibration status in a visible location in the work area. These procedures are described in laboratory SOP Calibration of Support Equipment and Reference Standard Doc #601 and SOP Equipment Doc# 604.

The calibration status of analytical instruments is documented in the analytical record. Analysts verify on-going acceptability of calibration status prior to use and with instrument performance check standards. These procedures are described in test method SOPs.

5.5.8 Returned Equipment Checks

When equipment or an instrument is sent out of the laboratory for service, the laboratory ensures that the function and calibration status of the equipment is checked and shown to be satisfactory before the equipment is returned to service. These procedures are outlined in SOP ENV-SOP-CORQ-0011 *Method Validation and Instrument Verification.*

5.5.9 Intermediate Equipment Checks

The laboratory performs intermediate checks on equipment to verify the on-going calibration status. For example, most test methods require some form of continuing calibration verification check and these procedures are included in the test method SOP. Periodic checks of support equipment are also performed; see laboratory SOP Calibration of Support Equipment and Reference Standards Doc #601 and SOP Equipment Doc# 604 for more information.

5.5.10 Safeguarding Equipment Integrity

The laboratory safeguards equipment integrity using a variety of mechanisms that include but are not limited to:

- Adherence to manufacturer's specification for instrument use so that settings do not exceed manufacturer's recommendation or stress the performance of the equipment.
- Established maintenance programs.
- Transparent maintenance records and unrestricted access to maintenance logs.
- Validation and approval of software before use.
- Audits to confirm instrument settings are consistent with SOPs.
- On-the-job training for safe and proper use of laboratory equipment.

5.6 Measurement Traceability

5.6.1 General

Measurement traceability refers to a property of a measurement result whereby the result can be related to a reference through an unbroken chain of calibration, each contributing to the measurement uncertainty. Traceability requires an established calibration hierarchy of equipment (instruments) used during testing including equipment used for subsidiary measurements. The laboratory assures this equipment is calibrated prior to being put into service and that the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard.

When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

5.6.2 Equipment Correction Factors

When correction factors are used to adjust results the laboratory will assure that results in computer software are also updated. For example, if the direct instrument or reading output must be corrected based on preparation factor or concentration factors, laboratory management will assure the corrected result is also updated in the software.

5.6.3 Specific Requirements

5.6.3.1 Requirements for Calibration Laboratories

The laboratory does not offer calibration services to customers.

5.6.3.2 Requirements for Testing Laboratories

The laboratory has procedures in place to verify equipment is calibrated prior to being put into service (See 5.5.2) and ensures the reference standard and materials used for calibration are traceable to the international standard of units (SI) or national measurement standard. When strict traceability to SI units cannot be made, the laboratory establishes traceability with the use of reference standards and equipment obtained from competent suppliers that provide calibration certificates and/or certificates of analysis (COA).

5.6.4 Reference Standards and Reference Materials

5.6.4.1 Reference Standards

The laboratory uses reference standards of measurement to verify adequacy of working weights and thermometers. The working weight is the weight(s) used for daily balance calibration checks and the working thermometers are used for temperature measurements daily.

Intermediate checks of the working reference measurement standards are performed to verify adequacy between calibration from an external calibration laboratory. The measurements from working weights and thermometers are compared to measurements taken by the reference standard which is traceable to SI or a national standard. The reference weights and thermometers are used solely for verification purposes unless the laboratory can prove that daily use does not adversely affect performance of the reference standard.

The laboratory performs intermediate checks of the working weights at least annually.

Working thermometers (glass and digital) are checked against the reference thermometer prior to placement in service to establish a correction factor and then rechecked annually (glass) or quarterly (digital) thereafter.

The calibration of liquid in glass reference thermometers is verified every 5 years and the calibration of digital reference thermometers is verified annually by an ISO/IEC 17025 accredited calibration laboratory or service provider that provides traceability to a national standard.

The calibration of the reference weight(s) is verified every 5 years by an ISO/IEC 17025 accredited calibration laboratory.

If criteria for the intermediate checks or recertification is not acceptable, the impact on previously reported results is evaluated using the process for evaluation of nonconforming work (See 4.9).

See laboratory SOP Calibration of Support Equipment and Reference Standards Doc #601 for more information about this process.

5.6.4.2 Reference Materials

The laboratory purchases chemical reference materials (also known as stock standards) from vendors that are accredited to ISO 17034 or Guide 34. Purchased reference materials must be received with a Certificate of Analysis (COA) where available. If a reference material cannot be purchased with a COA, it must be verified by analysis and comparison to a certified reference material and/or there must be a demonstration of capability for characterization. COA are reviewed for adequacy and retained by the laboratory for future reference.

All prepared standards, reference materials, and reagents are verified to meet the requirements of the test method through routine analyses of quality control samples.

The laboratory procedure for traceability and use of these materials is provided in laboratory SOP Chemical/Reagent Purchase, Receipt and Storage Doc#114.

This SOP includes each of the following requirements:

- Procedures for documentation of receipt and tracking. The record of entry includes name of the material, the lot number, receipt date, and expiration date.
- Storage conditions and requirements. Reference materials must be stored separately from samples, extracts, and digestates.
- Requirements to assure that preparations of intermediate or working solutions are recorded and assigned a unique identification number for tracking. Records of preparation include the lot number of the stock standard(s) used, the type and lot number of the solvent, the formulation, date, expiration date, and the preparer's initials. The lot number of the working standards is recorded in the analytical record to provide traceability to the standard preparation record. The preparation record provides traceability to the COA, which is traceable to SI or the national measurement standard.
- A requirement that the expiration dates of prepared standards may not exceed the expiration date of the parent standard. Standards, reference materials, and reagents are not used after their expiration dates unless it is not possible to procure a new standard and the reliability of the expired material is verified and documented by the laboratory using a procedure approved by corporate quality personnel. Otherwise, the expired material is promptly removed from the work

area or clearly labeled as acceptable for qualitative/troubleshooting purposes only.

- The second source materials used for verification of instrument calibration are obtained from a different manufacturer or may be a different lot from the same manufacturer.
- Procedures to check reference materials for degradation and replacement of material if degradation or evaporation is suspected.
- Procedures for labeling. At a minimum the container must identify the material, the ID of the material and the expiration date. Original containers should also be labeled with date opened.

5.6.4.3 Intermediate Checks

Checks to confirm the calibration status of standards and materials are described in laboratory SOPs. These checks include use of second source standards and reference materials reserved only for the purpose of calibration checks.

5.6.4.4 Transport and Storage

The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials. Standards and reference materials are stored separately from samples, extracts, and digestates. All standards are stored according to the manufacturer's recommended conditions. Temperatures colder than the manufacturer's recommendation are acceptable if it does not compromise the integrity of the material (e.g. remains in liquid state and does not freeze solid). In the event a standard is made from more than a single source with different storage conditions, the standard will be stored according to the conditions specified in the analytical method.

See the applicable analytical SOPs for specific reference material storage and transport protocols.

5.7 Sampling

Sampling refers to the field collection of samples and to subsamples taken by the laboratory for analysis from the field collected sample.

Subsampling procedures are included in each test method SOP or a stand-alone SOP to assure the aliquot used for testing is representative of the field collected sample.

The requirements in the following subsections apply when field sampling is performed by the laboratory.

5.7.1 Sampling Plans and SOPs

When the laboratory performs field collection of samples, sampling is carried out in accordance with a written sample plan prepared by the customer or by the laboratory and by

relevant sampling SOPs. These documents are made readily accessible at the sampling location. Sampling plans and SOPs are, whenever reasonable, based on appropriate governing methods and address the factors to be controlled to ensure the validity of the analytical results.

5.7.2 Customer Requested Deviations

When the customer requires deviations, additions, or exclusions from the documented laboratory sampling plan and/or procedure, the laboratory records the client's change request in detail with the sampling record, communicates the change to sampling personnel, and includes this information in the final test report.

5.7.3 Recordkeeping

The laboratory assures the sampling record includes the sampling procedure used, any deviations from the procedure, the date and time of sampling, the identification of the sampler, environmental conditions (if relevant), and the sampling location.

5.8 Sample Management & Handling

5.8.1 Procedures

The laboratory's procedures for sample management and handling are outlined in laboratory SOP Log-in Procedures Doc #268 and SOP Air log-in procedures Doc #375.

The procedures in these SOPs are established to maintain the safe handling and integrity of samples from transport, storage, to disposal and during all processing steps to maintain client confidentiality, and to protect the interests of PAS and its customers.

5.8.1.1 Chain of Custody

All samples received by the laboratory must be accompanied with a Chain of Custody (COC) record. The COC provides information about the samples collected and submitted for testing and documents the possession of samples from time of collection to receipt by the laboratory.

The COC record must minimally include the following information:

- Client name, address, phone number;
- Project Reference;
- Client Sample Identification (Client ID);
- Date, Time, and Location of Sampling;
- Sampler's Name or Initials;
- Matrix;
- Type of container, and total number collected for each sample;
- Preservatives;
- Analyses Requested;
- Mode of collection;

- Any special instructions; and
- The date and time and signature of each sample transfer from time of collection to receipt in the laboratory. When the COC is transported inside the cooler, independent couriers do not sign the COC, the shipping manifests and/or air bills are the records of possession during transport. The shipping manifest must be retained as part of the COC record and included in the test report when required (See Section 5.10.3).

A complete and legible COC is required. If the laboratory observes that the COC is incomplete or illegible, the client is contacted for resolution. The COC must be filled out in indelible ink. Personnel correct errors by drawing a single line through the initial entry so the entry is not obscured, entering the correct information, and initialing, and dating the change.

5.8.1.2 Legal Chain of Custody

Legal chain of custody is a chain of custody protocol used for evidentiary or legal purposes. The protocol is followed by the laboratory when requested by customer or where mandated by a regulatory program.

Legal chain of custody (COC) protocol establishes an intact, continuous record of the physical possession*, storage, and disposal of "samples" which includes sample aliquots, and sample extracts/digestates/distillates.

Legal COC records account for all time periods associated with the samples and identifies all individuals who physically handled individual samples. Legal COC begins at the point established by legal authority, which is usually at the time the sample containers are provided by the laboratory for sample collect or when sample collection begins.

*A sample is in someone's custody if:

- It is in one's physical possession;
- It is in one's view after being in one's physical possession;
- It has been in one's physical possession and then locked or sealed so that no one can tamper with it; and/or
- It is kept in a secure area, restricted to authorized personnel only.

Refer to laboratory SOP Log-in Procedures Doc #268 and SOP Air log-in procedures Doc #375 for more information.

5.8.2 Unique Identification

Each sample is assigned a unique identification number by the laboratory (Lab ID) after the sample has been checked and accepted by the laboratory in accordance with the laboratory's sample acceptance policy (See 5.8.3). The Lab ID is affixed to the sample container using a durable label.

The unique identification of samples also applies to subsamples, and prepared samples, such as extracts, digestates, etc.

The lab ID is linked to the field ID (client ID) in the laboratory's record. Both IDs are linked to the testing activities performed on the sample and the documentation records of the test.

Also see 5.8.4.

5.8.3 Sample Receipt Checks and Sample Acceptance Policy

The laboratory checks the condition and integrity of samples on receipt and compares the labels on the sample containers to the COC record. Any problem or discrepancy is recorded. If the problem impacts the suitability of the sample for analysis or if the documentation is incomplete, the client is notified for resolution. Decisions and instructions from the client are maintained in the project record.

5.8.3.1 Sample Receipt Checks

The following checks are performed:

- Verification that the COC is complete and legible.
- Verification that each sample's container label includes the client sample ID, the date and time of collection and the preservative in indelible ink.
- The container type and preservative are appropriate for each test requested.
- Adequate volume is received for each test requested.
- Visual inspection for damage or evidence of tampering.
- Visual inspection for presence of headspace in VOA vials. (VOA = volatile organic analysis).
- Thermal Preservation: Generally, for chemical testing methods for which thermal preservation is required, temperature on receipt is acceptable if the measurement is above freezing but <6°C. The requirements for thermal preservation vary based on test method or by regulatory program. For example, for microbiology, temperature on receipt is acceptable if the measurement is <10°C. Refer to the laboratory's SOP for sample receipt for specific requirements. For samples that are hand-delivered to the laboratory immediately after sample collection, there must be evidence that the chilling process began immediately after sample collection and prior to delivery of the samples to the laboratory or service center, such as arrival of the samples on ice.
- Chemical Preservation
- Holding Time: Sample receiving personnel are trained to recognize tests where the holding time is 48 hours or less and to expedite the log-in of these samples. Except for tests with immediate holding times (15 minutes from time of collection or less), when samples are received out of hold, the laboratory will

notify the client and request instruction. If the decision is made to proceed with analysis, the final test report will include notation of this instruction.

5.8.3.2 Sample Acceptance Policy

The laboratory maintains a sample acceptance policy in accordance with regulatory guidelines to clearly establish the circumstances in which sample receipt is accepted or rejected.

When receipt does not meet criteria for any one of these conditions, the laboratory must document the noncompliance, contact the customer, and either reject the samples or fully document any decisions to proceed with testing. In accordance with regulatory specifications, test results associated with receipt conditions that do not meet criteria are qualified in the final test report.

All samples received must meet each of the following criteria:

- Be listed on a complete and legible COC;
- Be received in properly labeled sample containers;
- Be received in appropriate containers that identify preservative;
- The COC must include the date and time of collection for each sample;
- The COC must include the test method requested for each sample;
- Be in appropriate sample containers with clear documentation of the preservatives used;
- Be received within holding time. Any samples received beyond the holding time will not be processed without prior customer approval;
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval; and
- Be received within appropriate temperature ranges unless program requirements or customer contractual obligations mandate otherwise. The cooler temperature is recorded directly on the COC.

  Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

5.8.4 Sample Control and Tracking

The samples are controlled and tracked using the Laboratory Information Management System (LIMS). The LIMS stores information about the samples and project. The process of entering information into the LIMS is called log-in and these procedures are described in laboratory SOP Log-in procedures Doc #268 and Air Log-in procedures Doc#375. After log-in, a label is generated and affixed to each sample container. Information on this label, such as the lab ID, links the sample container to the information in LIMS.

At a minimum, the following information is entered during log-in:

- Client Name and Contact Information;
- The laboratory ID linked to the client ID;
- Date and time of sample collection;
- Date and time of sample receipt;
- Matrix; and
- Tests Requested.

5.8.5 Sample Storage, Handling, and Disposal

The laboratory procedures for sample storage, handling and disposal are detailed in laboratory SOPs Log-in Procedures Doc#268, SOP Air Log-in procedures Doc#375 and SOP Sample Disposal Doc #540.

5.8.5.1 Sample Storage

The samples are stored according to method and regulatory requirements as per test method SOPs. Samples are stored away from all standards, reagents, or other potential sources of contamination and stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Refrigerated storage areas are maintained at ≤6°C (but not frozen) and freezer storage areas are maintained at <-10°C, unless otherwise required per method or program. The temperature of each storage area is checked and documented at least once for each day of use. If the temperature falls outside the acceptable limits, then corrective actions are taken and appropriately documented.

The laboratory is operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted while on-site. Samples are taken to the appropriate storage location immediately after sample receipt and log-in procedures are completed. All sample storage areas have limited access. Samples are removed from storage areas by designated personnel and returned to the storage areas as soon as possible after the required sample quantity has been taken.

5.8.5.2 Sample Retention and Disposal

The procedures used by the laboratory for sample retention and disposal are detailed in laboratory SOP Sample Disposal Doc#540.

In general, unused sample volume and prepared samples such as extracts, digestates, distillates and leachates (samples) are retained by the laboratory for the timeframe necessary to protect the interests of the laboratory and the customer.

Samples may be stored at ambient temperature when all analyses are complete, the hold time is expired, the report has been delivered, and/or when allowed by the customer or program. Samples requiring storage beyond the minimum sample retention time due to special requests or contractual obligations may be stored at ambient temperature unless the laboratory has a capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer.

5.9 Assuring the Quality of Test Results

5.9.1 Quality Control (QC) Procedures

The laboratory monitors the validity and reliability of test results using quality control (QC) samples that are prepared and analyzed concurrently with field samples in the same manner as field samples. QC results are always associated to and reported with the field samples they were prepared and analyzed with from the same preparation or analytical batch. See the glossary for definition of preparation and analytical batch.

The results of QC performed during the testing process are used by the laboratory to assure the results of analysis are consistent, comparable, accurate, and/or precise within a specified limit. When the results are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

Other QC measures performed include the use of certified reference materials (see 5.6.4), participation in interlaboratory proficiency testing (see 5.9.1.2), verification that formulae used for reduction of data and calculation of results is accurate (see 5.9.3), on-going monitoring of environmental conditions that could impact test results (see 5.3.2), and evaluation and verification of method selectivity and sensitivity (see 5.4.5).

QC results are also used by the laboratory to monitor performance statistical trends over time and to establish acceptance criteria when no method or regulatory criteria exist. (See 5.9.1.1.9)).

5.9.1.1 Essential QC

Although the general principles of QC for the testing process apply to all testing, the QC protocol used for each test depends on the type of test performed.

QC protocol used by the laboratory to monitor the validity of the test are specified in test method SOPs. The SOP includes QC type, frequency, acceptance criteria, corrective actions, and procedures for reporting of nonconforming work.

These requirements in the SOP conform to the reference method and any applicable regulations or certification and accreditation program requirement for which results of the test are used. When a project requires more stringent QC protocol than specified in the SOP, project specification is followed. When the project requires less stringent QC protocol, the project specification may be followed as an authorized departure from the SOP when the project specifications meet the requirements in the mandated method and any regulatory compliance requirements for which the data will be used.

The following are examples of essential QC for Chemistry:

5.9.1.1.1 Second Source Standard (ICV/QCS)

The second source standard is a standard obtained from a different vendor than the vendor of the standards used for calibration or it may be from a different lot from the same vendor when there are limited vendors that offer the material. It is a positive control used to verify the accuracy of a new calibration relative to the purity of the standards used for calibration. This check is referred to in test method and quality system standards as the initial calibration verification (ICV) or quality control sample (QCS). The second source standard is analyzed immediately after the calibration and before analysis of any samples. When the ICV is not within acceptance criteria, a problem with the purity or preparation of the standards may be indicated.

5.9.1.1.2 Continuing Calibration Verification (CCV)

CCV results are used to determine if the analytical response has significantly changed since initial calibration. If the response of the CCV is within criteria, the calibration is considered valid. If not, there is a problem that requires further investigation. Actions taken are technology and method specific.

5.9.1.1.3 Method Blank (MB) / Other Blanks

A method blank is a negative control used to assess for contamination during the prep/analysis process. The MB consists of a clean matrix, similar to the associated samples that is known to be free of analytes of interest. The MB, unless otherwise specified by the test method, is processed with and carried through all preparation and analytical steps as the associated samples.

In general, contamination is suspected when the target analyte is detected in the MB above the reporting limit. Some programs may require evaluation of the MB to ½ the reporting limit or the

detection limit. When contamination is evident, the source is investigated, and corrections are taken to reduce or eliminate it. Analytical results associated with MB that does not meet criteria are qualified in the final test report.

Other types of blanks that serve as negative controls in the process may include:

- Trip Blanks (VOA)
- Storage Blanks
- Equipment Blanks
- Field Blanks
- Calibration Blanks
- Cleanup Blanks
- Instrument Blanks

5.9.1.1.4 Laboratory Control Sample (LCS)

The LCS is positive control used to measure the accuracy of process in a blank matrix. The LCS is spiked by the laboratory with a known amount of analyte. The spike is a standard solution that is pre-made or prepared from a certified reference standard. Like the MB, unless otherwise specified in the test method, the LCS is processed with and carried through all preparation and analytical steps as the associated samples.

When the percent recovery (%R) of the LCS is within the established control limit, sufficient accuracy has been achieved. If not, the source of the problem is investigated and corrected, and the procedure may be repeated. Analytical results associated with LCS that does not meet criteria are qualified in the final test report.

5.9.1.1.5 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

Matrix spikes measure the effect the sample matrix has on precision and accuracy of the determinative test method. The MS and MSD are replicates of a client sample that is spiked with known amount of target analyte.

Due to the heterogeneity of matrices even of the same general matrix type, matrix spike results mostly provide information on the effect of the matrix to the client whose sample was used and on samples of the same matrix from the same sampling site. Therefore, MS should be client-specific when the impact of matrix on accuracy and precision is a project data quality objective. When there is not a client-specified MS for any sample in the batch, the laboratory randomly selects a sample from the batch; the sample selected at random is called a "batch" matrix spike.

The MS/MSD results for percent recovery and relative percent difference are checked against control limits. Because the performance of matrix spikes is matrix-dependent, the result of matrix spikes is not used to determine the acceptability of the test.

5.9.1.1.6 Sample Duplicate (SD)

A sample duplicate is a second replicate of sample that is prepared and analyzed in the laboratory along another replicate. The SD is used to measure precision.

The relative percent difference between replicates are evaluated against the method or laboratory derived criteria for relative percent difference (RPD), when this criterion is applicable. If RPD is not met, associated test results are reported with qualification.

5.9.1.1.7 Surrogates

Surrogates are compounds that mimic the chemistry of target analytes but are not expected to occur naturally in real world samples. Surrogates are added to each sample and matrix QC samples (MS, MSD, SD) at known concentration to measure the impact of the matrix on the accuracy of method performance. Surrogates are also added to the positive and negative control samples (MB, LCS) to evaluate performance in a clean matrix, and included in the calibration standards and calibration check standards.

The percent recovery of surrogates is evaluated against method-specified limits or statistically derived in-house limits. Project-specific limits and/or program-specific limits are used when required. Results with surrogate recovery out of limits in samples are reported with qualification. Samples with surrogate failures can also be re-extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error.

5.9.1.1.8 Internal Standards

Internal Standards are compounds not expected to occur naturally in field samples. They are added to every standard and sample at a known concentration prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. The laboratory follows specific guidelines for the treatment of internal standard recoveries and further information can be found in the applicable laboratory SOP.

5.9.1.1.9 QC Acceptance Criteria and Control Limits

The QC acceptance criteria are specified in test method SOPs. The criteria in the SOP are based on the requirements in the published

test method or regulatory program. When there are no established acceptance criteria, the laboratory develops acceptance criteria in accordance with recognized industry standards.

Some methods and programs require the laboratory to establish control limits for LCS, MS/MSD, and surrogate evaluation using historical data. Laboratory developed limits are referred to as "in-house" control limits. In-house control limits represent ± 3 Standard Deviations (99% confidence level) from the average recovery of at least 20 data points generated using the same preparation and analytical procedure in a similar matrix.

See laboratory SOP Control Chart Limits and Trends Doc#602 for more information about the procedures used to establish in-house control limits.

5.9.1.2 Proficiency Testing (PT)

The laboratory participates in interlaboratory proficiency testing (PT) studies to measure performance of the test method and to identify or solve analytical problems. PT samples measure laboratory performance through the analysis of unknown samples provided by an external source.

The PT samples are obtained from accredited proficiency testing providers (PTP) and handled as field samples which means they are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results during the duration of the study, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

The laboratory investigates and implements corrective action whenever PT results are scored unacceptable by the PT provider.

The frequency of PT participation is based on the certification and accreditation requirements held by the laboratory.

5.9.2 QC Corrective Action

When the results of QC are not within acceptance criteria or expectations for method performance, correction and corrective action(s) are taken per the specifications in the test method SOP. These actions may include retesting or reporting of data with qualification to alert the end user of the situation.

5.9.3 Data Review

The laboratory uses a tiered system for data review. The tiered process provides sequential checks to verify data transfer is complete; manual calculations, if performed, are correct, manual integrations are appropriate and documented, calibration and QC requirements are met, appropriate corrective action was taken when required, test results are properly qualified,

process and test method SOPs were followed, project specific requirements were met, when applicable, and the test report is complete.

The sequential process includes three tiers referred to as primary review, secondary review, and administrative/completeness review.

Detailed procedures for the data review process are described in laboratory SOP Data Review Doc#390. The general expectations for the tiered review process are described in the following sections:

5.9.3.1 Primary Review

Primary review is performed by the individual that performed the task. All laboratory personnel are responsible for review of their work product to assure it is complete, accurate, documented, and consistent with policy and SOPs.

Checks performed during primary review include but are not limited to:

- Verification that data transfer and acquisition is complete
- Manual calculations, if performed, are documented and accurate
- Manual integrations, if performed, are documented and comply with SOP ENV-SOP-CORQ-006 *Manual Integration*
- Calibration and QC criteria were met, and/or proper correction and corrective actions were taken, and data and test results associated with QC and criteria exceptions are properly qualified
- Work is consistent with SOPs and any other relevant instructional document such as SWI, program requirements, or project QAPP

5.9.3.2 Secondary Review

Secondary review is performed by a qualified peer or supervisor. Secondary review is essentially a repeat of the checks performed during primary review by another person. In addition to the checks of primary review, secondary review includes chromatography review to check the accuracy of quantitative analyte identification.

5.9.3.3 Completeness Review

Completeness review is an administrative review performed prior to release of the test report to the customer. Completeness review verifies that the final test report is complete and meets project specification. This review also assures that information necessary for the client's interpretation of results are explained in the case narrative or footnoted in the test report.

5.9.3.4 Data Audits

In addition to the 3-tier data review process, test reports may be audited by local quality personnel to verify compliance with SOPs and to check for data integrity, technical accuracy, and regulatory compliance. These audits are not usually done prior to issuance of the test report to the customer. The reports chosen for the data audits are selected at random.

If any problems with the data or test results are found during the data audit, the impact of the nonconforming work is evaluated using the process described in Section 4.9.

Also see Section 4.14 for internal audits.

5.9.4 Calibration Certificates

The laboratory does not perform calibration activities for its customers and calibration certificates are not offered or issued.

5.9.5 Opinions and Interpretations

The laboratory provides objective data and information to its customers of sufficient detail for their interpretation and decision making. Objective data and information are based solely on fact and does not attempt to explain the meaning (interpret) or offer a view or judgement (opinion). Sometimes the customer may request the laboratory provide opinion or interpretation to assist them with their decisions about the data.

When opinions and interpretations are included in the test report, the laboratory will document the basis upon which the opinions and interpretations have been made and clearly identify this content as opinion or interpretation in the test report.

Examples of opinion and interpretation include but are not limited to:

- The laboratory's viewpoint on how a nonconformance impacts the quality of the data or usability of results.
- The laboratory's judgment of fulfillment of contractual requirements.
- Recommendations for how the customer should use the test results and information.
- Suggestions or guidance to the customer for improvement.

When opinions or interpretations are verbally discussed with the customer, the content of these conversations is summarized by the laboratory and kept in the project record.

5.9.6 Subcontractor Reports

When analytical work has been subcontracted to an organization external to PAS, the test report from the subcontractor is included in its entirety as an amendment to the final test report.

Test results performed by multiple locations within the PAS network may be merged into a single test report. The test report issued clearly identifies the location and address of each network location that performed testing, and which tests they performed. (See 5.10.2)

5.9.7 Electronic Transmission of Results

When test results and/or reports are submitted to the customer through electronic transmission, the procedures established in this manual for confidentiality and protection of data apply.

5.9.8 Format of Test Reports

The test formats offered by the laboratory are designed to accommodate each type of analytical test method carried out by the laboratory and to minimize the possibility of misunderstanding or misuse of analytical results. The format of electronic data deliverables (EDD) follow the specifications for the EDD.

5.9.9 Amendments to Test Reports

Test reports that are revised or amended by the laboratory after date of release of the original final test report to the customer are issued as a new test report that is clearly identified as an amendment or revision and that includes a reference to the originally issued final test report.

The customer is the organization doing business with PAS external to PAS.

Changes made to test results and data before the final test report is issued to the customer are not amendments or revisions, these are corrections to errors found during the laboratory's data verification and review process.

The laboratory's procedure for report amendments and revision are outlined in laboratory SOP Revision to Reports Doc#245.

5.10 Reporting

5.10.1 General Requirements

The laboratory reports results of testing in a way that assures the results are clear, and unambiguous. All data and results are reviewed prior to reporting to assure the results reported are accurate and complete.

Test results are summarized in test reports that include all information necessary for the customer's interpretation of the test results. Additional information necessary to clarify the data or disclose nonconformance, exceptions, or deviations that occurred during the analytical process are also reported to the customer in the test report.

The specifications for test reports and EDD are established between the laboratory and the customer at the time the request for analytical services is initiated. The report specifications include the test report format, protocol for the reporting limit (RL), conventions for the reporting of results less than the limit of quantitation (LOQ), and specification for the use of project or program specific data qualifiers. Information about review of analytical service requests is provided in Section 4.4.

5.10.2 Test Reports: Required Items

Test Reports are prepared by the laboratory at the end of the testing process. The format of the report depends on the level of reporting requested by the customer. The laboratory offers a variety of standardized test report formats and can provide custom test report formats, when necessary.

The level of detail required in the test report depends on the customer's needs for data verification, validation, and usability assessments that occur after the laboratory releases the test report to the customer. The test report formats offered by the laboratory provide gradient levels of detail to meet the unique needs of each customer. The laboratory project manager helps the customer select the test report format that best meets their needs. When a specific report format or protocol is required for a regulatory or program compliance, the laboratory project manager must ensure the test report selected meets those requirements.

Every test report issued by the laboratory includes each of the following items:

a) Title

b) Name and phone number of a point of contact from the laboratory issuing the report.

c) Name and address of the laboratory where testing was performed. When testing is done at multiple locations within network (IRWO), the report must clearly identify which network laboratory performed each test and must include the physical address of each laboratory.

d) Unique identification of the test report and an identifier on each page of the report to link each page to the test report and clear identification of the end of the report.

e) The name and address of the customer

f) Identification of test methods used

g) Cross reference between client sample identification number (Sample ID) and the laboratory's identification number for the sample (Lab ID) to provide unambiguous identification of samples.

h) The date of receipt of samples, condition of samples on receipt, and identification of any instance where receipt of the samples did not meet sample acceptance criteria.

i) Date and times of sample collection, receipt, preparation, and analysis.

j) Test results and units of measurement, and qualification of results associated with QC criteria exceptions, and identification of reported results outside of the calibration range.

k) All chains of custody (COC) including records of internal transfer between locations within the PAS network.

l) Name, title, signature of the person(s) authorizing release of the test report and date of release.

m) A statement that the results in the test report relate only to the items tested.

n) Statement that the test report may not be reproduced except in full without written approval from the laboratory.

5.10.3 Test Reports: Supplemental Items

5.10.3.1 Supplemental Requirements

The following items are included in the test report when required or relevant:

a) Shipping manifests / bill of ladings as applicable when common couriers are utilized for shipment of samples,

b) Explanation of departure from test method SOPs including, what the departure was and why it was necessary.

c) Statistical methods used. (Required for Whole Effluent Toxicity)

d) For solid samples, specification that results are reported on a dry weight or wet weight basis.

e) Signed Affidavit, when required by client or regulatory agency.

f) A statement of compliance / non-compliance with requirements or specifications (client, program, or standard) that includes identification of test results that did not meet acceptance criteria.

g) When requested by the client, statement of estimated measurement uncertainty. In general, for environmental testing, estimated uncertainty of measurement is extrapolated from LCS control limits. Control limits incorporate the expected variation of the data derived from the laboratory's procedure. When the control limits are specified by the test method or regulatory program, the control limits represent the expected variation of the test method and/or matrices for which the test method was designed.

h) Opinions and Interpretations

i) If a claim of accreditation/certification is included in the test report, identification of any test methods or analytes for which accreditation/certification is not held by the laboratory if the accrediting body offers accreditation/certification for the test method/analyte. The fields of accreditation/certification vary between agencies and it cannot be presumed that because accreditation/certification is not held that it is offered or required.

j) Certification Information, including certificate number and issuing body.

5.10.3.2 Test Reports: Sampling Information

The following items are included in the test report when samples are collected by the laboratory or when this information is necessary for the interpretation of test results:

a) Date of Sampling.

b) Unambiguous identification of material samples.

c) Location of sampling including diagrams, sketches, or photographs.

d) Reference to the sampling plan and procedures used.

e) Details of environmental conditions at time of sample that may impact test results.

f) Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned.

6.0 REVISION HISTORY

This Version:

Section	Description of Change
Manual Approval Signatory Page	Added "Quality" before Manual. Updated the list of required signatories and changed job titles to match current job descriptions.
All	Replaced "PAS" with "ENV" to denote that ENV is division of PAS. References to PAS were left in some sections when the policy or procedure applies to all business units in addition to environmental sciences.
All	Corrected spelling, typographical, and format errors.
All	Changed "laboratory" to "location" when requirement applies to non-testing locations, such as service centers.
All	References to "Local QA" was replaced with "Local QM"
1.2.1	Changed frequency of review from every 2 years to annually.
1.2.2	Clarified local management refers to the signatories of the manual.
2.0	Replaced reference "current version" for ISO Standard with 2nd and 3rd Editions and publication dates.
4.1.3	Removed table and inserted reference to Title Page, where locations covered by the manual are listed.
4.1.4.1	Updated content to match current organization structure and job titles maintained by corporate HR.
4.5.1.1	Updated content to match current organization structure and job titles maintained by corporate HR.
4.5.1.2	Added new positions, updated job titles to current HR job titles, removed obsolete job titles.
4.5.2.1	Added timeframe for AB notification for absence of acting TNI Technical Manager.
4.2.2.1	Replaced term "tertiary" with completeness and replaced reference to MintMiner with data surveillance.
4.2.5.1	Updated definition of Guide; Added Guidance
4.5	Changed reference to procurement program to vendor qualification program.
4.6	Added reference to corporate SOP for vendor qualification.
4.7.1	Removed reference to SME, the SME program was not formalized as planned.
4.7.2	Removed reference to monthly; the frequency of management reports is established by the executive leadership team based on need.
4.11	Replaced reference to local SOP with corporate SOP. The corporate SOP replaced all local SOPs for the process. Updated 7 Stage process to match SOP.
4.11.1	Changed reference to root cause analysis to cause analysis.
4.12	Removed 7 step process for preventive action. PA is rolled into the 7-stage process for CAPA.
4.12.1	Removed reference to preventive action SOP – this was a typo for this section.

4.13.1	Added reference to the corporate policy for records.
4.13.1.2	Updated record retention time frame to match policy.
4.13.1.5	Added this section to incorporate electronic signature policy.
4.14.1	Rewrote paragraph that describes audit program.
4.15	Replaced reference to local SOP with corporate SOP. The corporate SOP replaced all local SOPs for the process.
4.16	Rewrote paragraph for clarity and updated SOP references.
5.2.2	Updated section to match current requirements.
5.2.2.1	Changed "monitor" to "tracks" to clarify expectation.
5.2.2.3	Added this section.
5.2.2.1.3	Changed "attendance sheet" to signature record.
5.4.5.2	Replaced local SOP reference with referral to corporate policy.
5.4.5.3.4	Fixed typographical error related to RL as qualitative/quantitative value. Moved SOP reference from section 5.4.5.3.3 to this section.
5.5.2.2	Updated policy reference.
5.5.9	Replaced typographical error reference to Appendix E with reference to local SOP.
5.6.4.2	Clarified requirements for expired reference materials.
5.8.1.1	Added requirement for locations to retain shipping manifest as COC record.
5.8.3.1	Updated requirements for thermal preservation.
5.9.1.1.1	Updated section to specify the second source standard may also be a different lot from the same manufacturer.
5.9.1.1.3	Added unless otherwise specified by test method exception.
5.9.1.1.4	Added unless otherwise specified by test method exception.
5.9.1.1.9	Clarified that in-house limits are calculated using historical data.
5.10.2	Added requirement that all test reports must include copies of the COCs, including COC for in-network transfer. (CAR to State Audit Deficiency)
Glossary	Added Definition of MRL (CAR to State Audit Deficiency)
Glossary	Changed definition of MintMiner
Appendix 8.1	Added DoD/DOE requirements for LOD/LOQ

This document supersedes the following documents:

Document Number	Title	Version
ENV-MAN-CORQ-0001	Quality Manual	00

7.0 APPENDICES

7.1 Appendix A: Certification / Accreditation Listing

The certifications / accreditation lists provided in this manual represent those that were held by the named location on the effective date of this manual. This information is subject to change without notice and must not be considered valid proof of certification or accreditation status. Current certificates are maintained by the local QM and a copy of the certificate is posted to ENV eDMS Portal for access by all ENV employees. External parties should contact the laboratory for the most current information.

7.1.1 PAS- Contest, A Pace Analytical Laboratory

Authority	ID	Authority	ID
AIHA-LAP, LLC	100033		
CT Dept. of Health	PH-0165		
FL Dept. of Health	E871027		
MA DEP	M-MA100		
State of Maine	MA00100		
MI Dept of Env, Great Lakes, and Energy	9100		
NC DENR	652		
NC Dept of Health DW	25703		
NH ELAP Secondary	2516		
NH ELAP Primary	2557		
NJ DEP	MA007		
NYSDOH	10899		
PA DEP	68-05812		
RI Dept of Health	LAO00112		
Commonwealth of Virginia	460217		
VT Dept of Health Lead program	LL720741		
VT Dept of Health DW	VT-255716		
AIHA-LAP, LLC	100033		
CT Dept. of Health	PH-0165		
FL Dept. of Health	E871027		
MA DEP	M-MA100		
State of Maine	MA00100		

7.2 Appendix B: Capability Listing

The capabilities listed in this Appendix were held by the location referenced on the effective date of this manual. This information is subject to change without notice. External parties should contact the laboratory for the most current information.

Table Legend:

- DW = Drinking Water
- NPW = Non-Potable Water
- SCM = Solid and Chemical Materials
- Waste = Non-Aqueous Phase Liquid (NAPL), Oil
- Tissue = Biota and Tissue

7.2.1 PAS-Contest, A Pace Analytical Laboraory

Parameter	Method	Matrices							
		Air	DW	NPW	SCM	Waste	Tissue		
Total Coliform	SM 9223 (Colisure) SM 9223B-Colielrt		X[1]						
Fecal Coliform	SM 9222D SM 9223B-Colilert 18			X[1]					
E. coli	SM 9223 (Colisure) SM 9223B-Colilert		X[1]	X[1]					
Enterococci	SM 9223 (Enterolert)		X[1]						
Heterotrophic Plate Count (HPC)	Simplate		X[1]						
Alkalinity	SM 2320B		X	X	X[1] (mod)				
Chloride	SM 4500 Cl-B		X	X	X[1] (mod)				
Chloride (IC)	EPA 300.0		X	X					
Hexavalent Chromium (Cr+6)	SM 3500 Cr-B		X	X					
Hexavalent Chromium (Cr+6)	SW-846 7196A			X	X				
Conductivity	SM 2510B		X[1]	X	X[1] (mod)				
Dissolved Oxygen	SM 4500 O-C		X[1]	X[1]					
Ferrous Iron	SM 3500 Fe-D		X[1]	X[1]	X[1] (mod)				
Fluoride	SM 4500 F-C		X	X[1]					
Fluoride (IC)	EPA 300.0		X	X					
Hardness	SM 2340C		X[1]						

pH	SM 4500 H-B		X[1]	X[1]					
pH	SW-846 9040C/9045D			X[1]	X[1]				
Total Solids	SM 2540B		X[1]	X					
Total Dissolved Solids	SM 2540 C		X	X					
Total Suspended Solids	SM 2540D		X[1]	X					
Settleable Solids	SM 2540F		X[1]	X					
Sulfate	ASTM D516		X	X					
Sulfate	EPA 300.0		X	X					
Sulfide	SM 4500 S2-F		X[1]	X					
Ammonia	SM 4500 NH3-C			X	X[1] (mod)				
Ammonia	EPA 350.1			X	X[1] (mod)				
Nitrite	SM 4500 NO2-B		X	X	X[1] (mod)				
Nitrite (IC)	EPA 300.0		X[1]	X					
Nitrite (Gallery)	NECi Nitrate Reductase		X						
Nitrite (Gallery)	NECi Method N07-0003			X	X[1] (mod)				
Nitrate (IC)	EPA 300.0		X[1]	X					
Nitrate (Gallery)	NECi Nitrate Reductase		X						
Nitrate (Gallery)	NECi Method N07-0003			X	X[1] (mod)				
Nitrate/Nitrite (Gallery)	NECi Method N07-0003			X	X[1] (mod)				
Total Kjeldahl Nitrogen (TKN)	SM 4500 NH3-C SM 4500 N-org B,C			X	X[1] (mod)				
Ortho Phosphate	SM 4500 P-E		X[1]	X	X[1] (mod)				
Ortho Phosphate (IC)	EPA 300.0		X	X					
Total Phosphate	SM 4500 P-E			X	X[1] (mod)				
Biological Oxygen Demand (BOD)	SM 5210B			X					
Carbonaceous BOD (CBOD)	SM 5210B			X					
Chemical Oxygen Demand (COD)	EPA 410.4			X					
Total Residual Chlorine (TRC)	SM 4500 Cl-G		X[1]	X[1]					
Total Organic Carbon	SM 5310B		X	X					
Total Organic Carbon	SW-846 9060A				X				
Total Organic Carbon	Lloyd Kahn Method				X				
Color	SM 2120B		X	X					
Odor	SM 2150B		X	X[1]					

Turbidity	EPA 180.1		X	X					
Bromide (IC)	EPA 300.0			X					
Oil and Grease HEM	EPA 1664B			X					
Oil and Grease SGT/HEM	EPA 1664B			X[1]					
Phenol	EPA 420.1			X					
Cyanide	SM 4500 CN-E		X	X					
Cyanide	SW-846 9014			X	X				
Physiological Available Cyanide (PAC)	SW-846 9014			X[1]	X[1]				
Amenable Cyanide	SM 4500 CN-E		X[1]	X[1]					
Amenable Cyanide	SW-846 9014			X[1]	X[1]				
Paint Filter Liquids Test	SW-846 9095A				X				
Flashpoint	SW-846 1010A+B			X[1]	X				
Ignitability	SW-846 1030				X				
Reactive Cyanide	SW-846 Chapter 7 – SW-846 9014			X[1]	X[1]				
Reactive Sulfide	SW-846 Chapter 7 – SW-846 9030A			X[1]	X[1]				
Volatile Purgeable Aromatics (GC)	EPA 602			X					
Volatile Purgeable (GC/MS)	EPA 624.1			X					
Volatile Purgeable (GC/MS)	EPA 524.2		X						
Volatile Organics (GC/MS)	SW-846 8260D			X	X				
Volatile EDB/DBCP (GC)	EPA 504.1		X						
Semi-Volatile B/N + Acids (GC/MS)	EPA 625.1			X					
Semi-Volatile Organics (GC/MS)	SW-846 8270E			X	X				
Pesticide's + PCB's (GC)	EPA 608.3			X					
Pesticides (GC)	SW-846 8081B			X	X				
PCB's (GC)	SW-846 8082A			X	X				
PCB's in Oil (GC)	EPA 600/4-81-045				X				
PCB's in OIl (GC)	SW-846 8082A				X				
Herbicides (GC)	SW-846 8151A			X	X				
CT Extractable Petroleum Hydrocarbons (GC)	CT ETPH			X[1]	X[1]				
MA Volatile Petroleum Hydrocarbons (GC)	MA VPH			X	X				
MA Extractable Petroleum Hydrocarbons (GC)	MA EPH			X	X				
Gasoline Range Organics (GRO) (GC)	SW-846 8015C/D			X	X				

Diesal Range Organics (DRO) (GC)	SW-846 8015C/D			X	X				
Fuel Hydrocarbons (GC)	SW-846 8015 (mod)			X[1]	X[1]				
Fuel Hydrocarbons (GC)	SW-846 8100 (mod)			X[1]	X[1]				
PFAS (LC/MS/MS)	EPA 537.1		X	X[1] (Mod)	X[1] (mod)				
PFAS (LC/MS/MS)	EPA 533		X	X (mod)	X (mod)				
Aluminum (Al) - ICP	EPA 200.7		X	X					
Aluminum (Al) - ICP	EPA 6010D			X	X				
Aluminum (Al) – ICP-MS	EPA 6020B			X	X				
Antimony (Sb) - ICP	EPA 200.7		X	X					
Antimony (Sb) - ICP	EPA 6010D			X	X				
Antimony (Sb) – ICP-MS	EPA 200.8		X	X					
Antimony (Sb) – ICP-MS	EPA 6020B			X	X				
Arsenic (As) - ICP	EPA 200.7		X	X					
Arsenic (As) - ICP	EPA 6010D			X	X				
Arenic (As) – ICP-MS	EPA 200.8		X	X					
Arsenic (As) – ICP-MS	EPA 6020B			X	X				
Arsenic (As) - ICP	NIOSH 7303	X[12]							
Barium (Ba) - ICP	EPA 200.7		X	X					
Barium (Ba) - ICP	EPA 6010D			X	X				
Barium (Ba) – ICP-MS	EPA 200.8		X	X					
Barium (Ba) – ICP-MS	EPA 6020B			X	X				
Beryllium (Be) - ICP	EPA 200.7		X	X					
Beryllium (Be) - ICP	EPA 6010D			X	X				
Beryllium (Be) – ICP-MS	EPA 200.8		X	X					
Beryllium (Be) – ICP-MS	EPA 6020B			X	X				
Beryllium (Be) - ICP	NIOSH 7303	X[2]							
Boron (B) - ICP	EPA 200.7		X	X					
Boron (B) - ICP	EPA 6010D			X	X				
Cadmium (Cd) - ICP	EPA 200.7		X	X					
Cadmium (Cd) - ICP	EPA 6010D			X	X				
Cadmium (Cd) – ICP-MS	EPA 200.8		X	X					
Cadmium (Cd) – ICP-MS	EPA 6020B			X	X				

Cadmium (Cd) - ICP	NIOSH 7303	X[12]							
Calcium (Ca) - ICP	EPA 200.7		X	X					
Calcium (Ca) - ICP	EPA 6010D			X	X				
Chromium (Cr) - ICP	EPA 200.7		X	X					
Chromium (Cr) - ICP	EPA 6010D			X	X				
Chromium (Cr) – ICP-MS	EPA 200.8		X	X					
Chromium (Cr) – ICP-MS	EPA 6010D			X	X				
Chromium (Cr) - ICP	NIOSH 7303	X[2]							
Cobalt (Co) - ICP	EPA 200.7		X	X					
Cobalt (Co) - ICP	EPA 6010D			X	X				
Cobalt (Co) – ICP-MS	EPA 200.8		X	X					
Cobalt (Co) – ICP-MS	EPA 6020B			X	X				
Copper (Cu) - ICP	EPA 200.7		X	X					
Copper (Cu) - ICP	EPA 6010D			X	X				
Copper (Cu) – ICP-MS	EPA 200.8		X	X					
Copper (Cu) – ICP-MS	EPA 6020B			X	X				
Copper (Cu) - ICP	NIOSH 7303	X[12]							
Iron (Fe) - ICP	EPA 200.7		X	X					
Iron (Fe) - ICP	EPA 6010D			X	X				
Iron (Fe) – ICP-MS	EPA 200.8		X	X					
Iron (Fe) – ICP-MS	EPA 6020B			X	X				
Lead (Pb) - ICP	EPA 200.7		X	X					
Lead (Pb) - ICP	EPA 6010D			X	X				
Lead (Pb) – ICP-MS	EPA 200.8		X	X					
Lead (Pb) – ICP-MS	EPA 6020B			X	X				
AIHA-LAP, LLC Lead (Pb) Air - ICP	NIOSH 7303	X[2]							
AIHA-LAP, LLC Lead (Pb) Paint - ICP	SW-846 6010D (mod)/3050B				X[2]				
AIHA-LAP, LLC Lead (Pb) Dust Wipes - ICP	SW-846 6010D (mod)/3050B				X[2]				
AIHA-LAP, LLC Lead (Pb) Soil - ICP	SW-846 6010D (mod)/3050B/3051A				X[2]				
Magnesium (Mg) - ICP	EPA 200.7		X	X					
Magnesium (Mg) - ICP	EPA 6010D			X	X				
Magnesium (Mg) – ICP-MS	EPA 200.8		X	X					

Magnesium (Mg) – ICP-MS	EPA 6020B			X	X				
Manganese (Mn) - ICP	EPA 200.7		X	X					
Manganese (Mn) - ICP	EPA 6010D			X	X				
Manganese (Mn) – ICP-MS	EPA 200.8		X	X					
Manganese (Mn) – ICP-MS	EPA 6020B			X	X				
Mercury (Hg)	EPA 245.1		X	X					
Mercury (Hg)	EPA 7470A			X					
Mercury (Hg)	EPA 7471B				X				
Mercury (Hg)	NIOSH 6009	X[2]							
Molybdenum (Mo) - ICP	EPA 200.7		X	X					
Molybdenum (Mo) - ICP	EPA 6010D			X	X				
Molybdenum (Mo) – ICP-MS	EPA 200.8		X	X					
Molybdenum (Mo) – ICP-MS	EPA 6020B			X	X				
Nickel (Ni) - ICP	EPA 200.7		X	X					
Nickel (Ni) - ICP	EPA 6010D			X	X				
Nickel (Ni) – ICP-MS	EPA 200.8		X	X					
Nickel (Ni) – ICP-MS	EPA 6020B			X	X				
Nickel (Ni) - ICP	NIOSH 7303	X[12]							
Potassium (K) - ICP	EPA 200.7		X	X					
Potassium (K) - ICP	EPA 6010D			X	X				
Selenium (Se) - ICP	EPA 200.7		X	X					
Selenium (Se) - ICP	EPA 6010D			X	X				
Selenium (Se) – ICP-MS	EPA 200.8		X	X					
Selenium (Se) – ICP-MS	EPA 6020B			X	X				
Silver (Ag) - ICP	EPA 200.7		X	X					
Silver (Ag) - ICP	EPA 6010D			X	X				
Silver (Ag) – ICP-MS	EPA 200.8		X	X					
Silver (Ag) – ICP-MS	EPA 6020B			X	X				
Sodium (Na) - ICP	EPA 200.7		X	X					
Sodium (Na) - ICP	EPA 6010D			X	X				
Thallium (Tl) - ICP	EPA 200.7		X	X					
Thallium (Tl) - ICP	EPA 6010D			X	X				

Thallium (Tl) – ICP-MS	EPA 200.8		X	X					
Thallium (Tl) – ICP-MS	EPA 6020B			X	X				
Tin (Sn) - ICP	EPA 200.7		X	X					
Tin (Sn) - ICP	EPA 6010D			X	X				
Vanadium (V) - ICP	EPA 200.7		X	X					
Vanadium (V) - ICP	EPA 6010D			X	X				
Vanadium (V) – ICP-MS	EPA 200.8		X	X					
Vanadium (V) – ICP-MS	EPA 6020B			X	X				
Zinc (Zn) - ICP	EPA 200.7		X	X					
Zinc (Zn) - ICP	EPA 6010D			X	X				
Zinc (Zn) – ICP-MS	EPA 200.8		X	X					
Zinc (Zn) – ICP-MS	EPA 6020B			X	X				
Zinc (Zn) - ICP	NIOSH 7303	X[12]							
Acid Digestion of Aqueous samples	SW-846 3005A			X					
Acid Digestion of Aqueous samples by Microwave	SW-846 3015A			X					
Acid Digestion of Sediments and Sludges	SW-846 3050B				X				
Acid Digestion of Sediments and Sludges by Microwave	SW-846 3051A				X				
TCLP	SW-846 1311			X[1]	X				
SPLP	SW-846 1312			X[1]	X[1]				
Separatory Funnel Liquid-Liquid Extraction	SW-846 3510C			X					
Sonication Extraction	SW-846 3550B			X[1]	X[1]				
Microwave Extraction	SW-846 3546				X				
Soxhlet Extraction	SW-846 3540C	X			X				
Total Dust	NIOSH 0500	X[12]							
Respirable Dust	NIOSH 0600	X[12]							
PCB's in Air (GC)	NIOSH 5503	X[2]							
PCB's/Pesticide in Air (GC)	EPA TO-4A	X[2]							
PCB'/Pesticide in Air (GC)	EPA TO-10A	X[2]							
Semi-Volatiles in Air (GC/MS)	EPA TO-13A	X[2]							
Volatiles in Air (GC/MS)	EPA TO-14A	X[2]							
Volatiles in Air (GC/MS)	EPA TO-15	X[2]							
Volatiles in Air (GC/MS)	EPA TO-17	X[2]							

Air-Phase Petroleum Hydrocarbons (APH) (GC/MS)	MA DEP APH	X[1]							
Fixed Gases	EPA 3C (Mod)	X[1]							
Dissolved Gases	RSK-175			X					

Footnotes:
1 = Laboratory does not hold TNI Accreditation for this test method.
2 = Laboratory holds AIHA-LAP, LLC certification for this test method

7.3 Appendix C: Glossary

This glossary provides common terms and definitions used in the laboratory. **It is not intended to be a complete list of all terms and definitions used.** The definitions have been compiled mostly from the TNI Standard and DoD QSM. Although this information has been reproduced with care, errors cannot be entirely excluded. Definitions for the same term also vary between sources. When the meaning of a term used in a laboratory document is different from this glossary or when the glossary does not include the term, the term and definition is included or defined in context in the laboratory document.

Term	Definition
3P Program	PAS-The continuous improvement program used by PAS that focuses on Process, Productivity, and Performance.
Acceptance Criteria	TNI- Specified limits placed on characteristics of an item, process, or service defined in requirement documents.
Accreditation	TNI- The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. DoD- Refers to accreditation in accordance with the DoD ELAP.
Accreditation Body (AB)	TNI- The organization having responsibility and accountability for environmental laboratory accreditation and which grants accreditation under this program. DoD- Entities recognized in accordance with the DoD-ELAP that are required to operate in accordance with ISO/IEC 17011, *Conformity assessment: General requirements for accreditation bodies accrediting conformity assessment bodies*. The AB must be a signatory, in good standing, to the International Laboratory Accreditation Cooperation (ILAC) mutual recognition arrangement (MRA) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that its accredited laboratories comply with ISO/IEC 17025.
Accuracy	TNI- The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator.
Activity, Absolute	TNI- Rate of nuclear decay occurring in a body of material, equal to the number of nuclear disintegrations per unit time. NOTE: Activity (absolute) may be expressed in becquerels (Bq), curies (Ci), or disintegrations per minute (dpm), and multiples or submultiples of these units.
Activity, Areic	TNI- Quotient of the activity of a body of material and its associated area.
Activity, Massic	TNI- Quotient of the activity of a body of material and its mass; also called specific activity.
Activity, Volumic	TNI- Quotient of the activity of a body of material and its volume; also called activity concentration. NOTE: In this module [TNI Volume 1, Module 6], unless otherwise stated, references to activity shall include absolute activity, areic activity, massic activity, and volumic activity.
Activity Reference Date	TNI- The date (and time, as appropriate to the half-life of the radionuclide) to which a reported activity result is calculated. NOTE: The sample collection date is most frequently used as the Activity Reference Date for environmental measurements, but different programs may specify other points in time for correction of results for decay and ingrowth.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
American Society for Testing and Materials (ASTM)	An international standards organization that develops and publishes voluntary consensus standards for a wide range of materials, products, systems and services.
Analysis	DoD- A combination of sample preparation and instrument determination.
Analysis Code (Acode)	All the set parameters of a test, such as Analytes, Method, Detection Limits and Price.
Analysis Sequence	A compilation of all samples, standards and quality control samples run during a specific amount of time on a particular instrument in the order they are analyzed.
Analyst	TNI- The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analyte	TNI- A substance, organism, physical parameter, property, or chemical constituent(s) for which an environmental sample is being analyzed. DoD- The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family and are analyzed together.
Analytical Method	DoD- A formal process that identifies and quantifies the chemical components of interest (target analytes) in a sample.
Analytical Uncertainty	TNI- A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.
Aliquot	DoD- A discrete, measured, representative portion of a sample taken for analysis.
Annual (or Annually)	Defined by PAS as every 12 months ± 30 days.
Assessment	TNI - The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its system to defined criteria (to the standards and requirements of laboratory accreditation). DoD- An all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection, or surveillance conducted on-site.
Atomic Absorption Spectrometer	Instrument used to measure concentration in metals samples.
Atomization	A process in which a sample is converted to free atoms.
Audit	TNI- A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.
Batch	TNI- Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours or the time-frame specified by the regulatory program. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed 20 samples.
Batch, Radiation Measurements (RMB)	TNI- An RMB is composed of 1 to 20 environmental samples that are counted directly without preliminary physical or chemical processing that affects the outcome of the test (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors). The samples in an RMB share similar physical and chemical parameter, and analytical configurations (e.g., analytes, geometry, calibration, and background corrections). The maximum time between the start of processing of the first and last in an RMB is 14 calendar days.
Bias	TNI- The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).
Blank	TNI and DoD- A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results (See Method Blank). DoD- Blank samples are negative control samples, which typically include field blank samples (e.g., trip blank, equipment (rinsate) blank, and temperature blank) and laboratory blank samples (e.g., method blank, reagent blank, instrument blank, calibration blank, and storage blank).
Blind Sample	A sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
BNA (Base Neutral Acid compounds)	A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment.
BOD (Biochemical Oxygen Demand)	Chemical procedure for determining how fast biological organisms use up oxygen in a body of water.

Calibration	TNI- A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.
Calibration Curve	TNI- The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Method	A defined technical procedure for performing a calibration.
Calibration Range	DoD- The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range.
Calibration Standard	TNI- A substance or reference material used for calibration.
Certified Reference Material (CRM)	TNI- Reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute.
Chain of Custody	An unbroken trail of accountability that verifies the physical security of samples, data, and records.
Chain of Custody Form (COC)	TNI- Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and type of containers; the mode of collection, the collector, time of collection; preservation; and requested analyses.
Chemical Oxygen Demand (COD)	A test commonly used to indirectly measure the amount of organic compounds in water.
Client (referred to by ISO as Customer)	Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations.
Code of Federal Regulations (CFR)	A codification of the general and permanent rules published in the Federal Register by agencies of the federal government.
Comparability	An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
Completeness	The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is: % Completeness = (Valid Data Points/Expected Data Points)*100
Confirmation	TNI- Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include but are not limited to: second-column confirmation; alternate wavelength; derivatization; mass spectral interpretation; alternative detectors; or additional cleanup procedures. DoD- Includes verification of the identity and quantity of the analyte being measured by another means (e.g., by another determinative method, technology, or column). Additional cleanup procedures alone are not considered confirmation techniques.
Conformance	An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.
Congener	A member of a class of related chemical compounds (e.g., PCBs, PCDDs).
Consensus Standard	DoD- A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof.
Continuing Calibration Blank (CCB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method.
Continuing Calibration Check Compounds (CCC)	Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column.
Continuing Calibration Verification	DoD- The verification of the initial calibration. Required prior to sample analysis and at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models.

Continuing Calibration Verification (CCV) Standard	Also referred to as a Calibration Verification Standard (CVS) in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method.
Continuous Emission Monitor (CEM)	A flue gas analyzer designed for fixed use in checking for environmental pollutants.
Continuous Improvement Plan (CIP)	The delineation of tasks for a given laboratory department or committee to achieve the goals of that department.
Contract Laboratory Program (CLP)	A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality.
Contract Required Detection Limit (CRDL)	Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts.
Contract Required Quantitation Limit (CRQL)	Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts.
Control Chart	A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit)
Control Limit	A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data.
Correction	DoD- Action taken to eliminate a detected non-conformity.
Corrective Action	DoD- The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. A root cause analysis may not be necessary in all cases.
Corrective and Preventative Action (CAPA)	The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes.
Critical Value	TNI- Value to which a measurement result is compared to make a detection decision (also known as critical level or decision level). NOTE: The Critical Value is designed to give a specified low probability α of false detection in an analyte-free sample, which implies that a result that exceeds the Critical Value, gives high confidence $(1 - \alpha)$ that the radionuclide is actually present in the material analyzed. For radiometric methods, α is often set at 0.05.
Customer	DoD- Any individual or organization for which products or services are furnished or work performed in response to defined requirements and expectations.
Data Integrity	TNI- The condition that exists when data are sound, correct, and complete, and accurately reflect activities and requirements.
Data Quality Objective (DQO)	Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user.
Data Reduction	TNI- The process of transforming the number of data items by arithmetic or statistical calculation, standard curves, and concentration factors, and collating them into a more usable form.
Definitive Data	DoD- Analytical data of known quantity and quality. The levels of data quality on precision and bias meet the requirements for the decision to be made. Data that is suitable for final decision-making.
Demonstration of Capability (DOC)	TNI- A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. DoD- A procedure to establish the ability of the analyst to generate analytical results by a specific method that meet measurement quality objectives (e.g., for precision and bias).
Department of Defense (DoD)	An executive branch department of the federal government of the United States charged with coordinating and supervising all agencies and functions of the government concerned directly with national security.
Detection Limit (DL)	DoD- The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration with 99% confidence. At the DL, the false positive rate (Type 1 error) is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific analyte in a specific matrix with a specific method with 99% confidence.

Detection Limit (DL) for Safe Drinking Water Act (SDWA) Compliance	TNI- Laboratories that analyze drinking-water samples for SDWA compliance monitoring must use methods that provide sufficient detection capability to meet the detection limit requirements established in 40 CFR 141. The SDWA DL for radioactivity is defined in 40 CFR Part 141.25.c as the radionuclide concentration, which can be counted with a precision of plus or minus 100% at the 95% confidence level (1.96σ where σ is the standard deviation of the net counting rate of the sample).
Deuterated Monitoring Compounds (DMCs)	DoD- SIM specific surrogates as specified for GC/MS SIM analysis.
Diesel Range Organics (DRO)	A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific).
Digestion	DoD- A process in which a sample is treated (usually in conjunction with heat and acid) to convert the target analytes in the sample to a more easily measured form.
Document Control	The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Documents	DoD- Written components of the laboratory management system (e.g., policies, procedures, and instructions).
Dry Weight	The weight after drying in an oven at a specified temperature.
Duplicate (also known as Replicate or Laboratory Duplicate)	The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.
Electron Capture Detector (ECD)	Device used in GC methods to detect compounds that absorb electrons (e.g., PCB compounds).
Electronic Data Deliverable (EDD)	A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results.
Eluent	A solvent used to carry the components of a mixture through a stationary phase.
Elute	To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent.
Elution	A process in which solutes are washed through a stationary phase by movement of a mobile phase.
Environmental Data	DoD- Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology.
Environmental Monitoring	The process of measuring or collecting environmental data.
Environmental Protection Agency (EPA)	An agency of the federal government of the United States which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.
Environmental Sample	A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows: • Non Potable Water (Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts) • Drinking Water - Delivered (treated or untreated) water designated as potable water • Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents • Sludge - Municipal sludges and industrial sludges. • Soil - Predominately inorganic matter ranging in classification from sands to clays. • Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes
Equipment Blank	A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures.
Extracted Internal Standard Analyte	Isotopically labeled analogs of analytes of interest added to all standards, blanks and samples analyzed. Added to samples and batch QC samples prior to the first step of sample extraction and to standards and instrument blanks prior to analysis. Used for isotope dilution methods.
Facility	A distinct location within the company that has unique certifications, personnel and waste disposal identifications.

False Negative	DoD- A result that fails to identify (detect) an analyte or reporting an analyte to be present at or below a level of interest when the analyte is actually above the level of interest.
False Positive	DoD- A result that erroneously identifies (detects) an analyte or reporting an analyte to be present above a level of interest when the analyte is actually present at or below the level of interest.
Field Blank	A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Field Measurement	Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and sPAS to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory.
Field of Accreditation	TNI- Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.
Field of Proficiency Testing (FoPT)	TNI- Matrix, technology/method, analyte combinations for which the composition, spike concentration ranges and acceptance criteria have been established by the PTPEC.
Finding	TNI- An assessment conclusion referenced to a laboratory accreditation standard and supported by objective evidence that identifies a deviation from a laboratory accreditation standard requirement. DoD- An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive, negative, or neutral and is normally accompanied by specific examples of the observed condition. The finding must be linked to a specific requirement (e.g., this standard, ISO requirements, analytical methods, contract specifications, or laboratory management systems requirements).
Flame Atomic Absorption Spectrometer (FAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame.
Flame Ionization Detector (FID)	A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured.
Gas Chromatography (GC)	Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times.
Gas Chromatograph/ Mass Spectrometry (GC/MS)	In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra).
Gasoline Range Organics (GRO)	A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific).
Graphite Furnace Atomic Absorption Spectrometry (GFAA)	Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes.
High Pressure Liquid Chromatography (HPLC)	Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase.
Holding Time	TNI- The maximum time that can elapse between two specified activities. 40 CFR Part 136- The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised. For sample prep purposes, hold times are calculated using the time of the start of the preparation procedure. DoD- The maximum time that may elapse from the time of sampling to the time of preparation or analysis, or from preparation to analysis, as appropriate.
Homogeneity	The degree to which a property or substance is uniformly distributed throughout a sample.
Homologue	One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. For instance, methanol, ethanol, propanol, butanol, etc., form a homologous series.
Improper Actions	DoD- Intentional or unintentional deviations from contract-specified or method-specified analytical practices that have not been authorized by the customer (e.g., DoD or DOE).
Incremental Sampling Method (ISM)	Soil preparation for large volume (1 kg or greater) samples.

In-Depth Data Monitoring	TNI- When used in the context of data integrity activities, a review and evaluation of documentation related to all aspects of the data generation process that includes items such as preparation, equipment, software, calculations, and quality controls. Such monitoring shall determine if the laboratory uses appropriate data handling, data use and data reduction activities to support the laboratory's data integrity policies and procedures.
Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)	Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths.
Inductively Coupled Plasma- Mass Spectrometry (ICP/MS)	An ICP that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice.
Infrared Spectrometer (IR)	An instrument that uses infrared light to identify compounds of interest.
Initial Calibration (ICAL)	The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method.
Initial Calibration Blank (ICB)	A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. This blank is specifically run in conjunction with the Initial Calibration Verification (ICV) where applicable.
Initial Calibration Verification (ICV)	DoD- Verifies the initial calibration with a standard obtained or prepared from a source independent of the source of the initial calibration standards to avoid potential bias of the initial calibration.
Injection Internal Standard Analyte	Isotopically labeled analogs of analytes of interest (or similar in physiochemical properties to the target analytes but with a distinct response) to be quantitated. Added to all blanks, standards, samples and batch QC after extraction and prior to analysis.
Instrument Blank	A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.
Instrument Detection Limits (IDLs)	Limits determined by analyzing a series of reagent blank analyses to obtain a calculated concentration. IDLs are determined by calculating the average of the standard deviations of three runs on three non-consecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day.
Interference, spectral	Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible.
Interference, chemical	Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte.
Internal Standard	TNI and DoD- A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.
International Organization for Standardization (ISO)	An international standard-setting body composed of representatives from various national standards organizations.
Intermediate Standard Solution	Reference solutions prepared by dilution of the stock solutions with an appropriate solvent.
International System of Units (SI)	The coherent system of units adopted and recommended by the General Conference on Weights and Measures.
Ion Chromatography (IC)	Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules.
Isomer	One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. For example, hexane (C6H14) could be n-hexane, 2-methylpentane, 3-methylpentane, 2,3-dimethylbutane, 2,2-dimethylbutane.
Laboratory	A body that calibrates and/or performs testing..

Laboratory Control Sample (LCS)	TNI- (also known as laboratory fortified blank (LFB), spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of all or a portion of the measurement system.
Laboratory Duplicate	Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.
Laboratory Information Management System (LIMS)	DoD- The entirety of an electronic data system (including hardware and software) that collects, analyzes, stores, and archives electronic records and documents.
Learning Management System (LMS)	A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator.
Legal Chain-of-Custody Protocols	TNI- Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain-of-Custody (COC) Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory.
Limit(s) of Detection (LOD)	TNI- The minimum result, which can be reliably discriminated from a blank with predetermined confidence level. DoD- The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate (Type II error) is 1%. A LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method at 99% confidence.
Limit(s) of Quantitation (LOQ)	TNI- The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. DoD- The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range.
Linear Dynamic Range	DoD- Concentration range where the instrument provides a linear response.
Liquid chromatography/ tandem mass spectrometry (LC/MS/MS)	Instrumentation that combines the physical separation techniques of liquid chromatography with the mass analysis capabilities of mass spectrometry.
Lot	TNI- A definite amount of material produced during a single manufacturing cycle, and intended to have uniform character and quality.
Management	Those individuals directly responsible and accountable for planning, implementing, and assessing work.
Management System	System to establish policy and objectives and to achieve those objectives.
Manager (however named)	The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual.
Matrix	TNI- The substrate of a test sample.
Matrix Duplicate	TNI- A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.
Matrix Spike (MS) (spiked sample or fortified sample)	TNI- A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.
Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate)	TNI- A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.
Measurement Performance Criteria (MPC)	DoD- Criteria that may be general (such as completion of all tests) or specific (such as QC method acceptance limits) that are used by a project to judge whether a laboratory can perform a specified activity to the defined criteria.

Measurement Quality Objective (MQO)	TNI- The analytical data requirements of the data quality objectives are project- or program-specific and can be quantitative or qualitative. MQOs are measurement performance criteria or objectives of the analytical process. Examples of quantitative MQOs include statements of required analyte detectability and the uncertainty of the analytical protocol at a specified radionuclide activity, such as the action level. Examples of qualitative MQOs include statements of the required specificity of the analytical protocol, e.g., the ability to analyze for the radionuclide of interest given the presence of interferences.
Measurement System	TNI- A method, as implemented at a particular laboratory, and which includes the equipment used to perform the test and the operator(s). DoD- A test method, as implemented at a particular laboratory, and which includes the equipment used to perform the sample preparation and test and the operator(s).
Measurement Uncertainty	DoD- An estimate of the error in a measurement often stated as a range of values that contain the true value within a certain confidence level. The uncertainty generally includes many components which may be evaluated from experimental standard deviations based on repeated observations or by standard deviations evaluated from assumed probability distributions based on experience or other information. For DoD/DOE, a laboratory's Analytical Uncertainty (such as use of LCS control limits) can be reported as the minimum uncertainty.
Method	TNI- A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.
Method Blank	TNI- A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.
Method Detection Limit (MDL)	TNI- One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.
Method of Standard Additions	A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration.
Minimum Detectable Activity (MDA)	TNI- Estimate of the smallest true activity that ensures a specified high confidence, $1 - \beta$, of detection above the Critical Value, and a low probability β of false negatives below the Critical Value. For radiometric methods, β is often set at 0.05. NOTE 1: The MDS is a measure of the detection capability of a measurement process and as such, it is an a priori concept. It may be used in the selection of methods to meet specified MQOs. Laboratories may also calculate a "sample specific" MDA, which indicates how well the measurement process is performing under varying real-world measurement conditions, when sample-specific characteristics (e.g., interferences) may affect the detection capability. However, the MDA must never be used instead of the Critical Value as a detection threshold. NOTE 2: For the purpose of this Standard, the terms MDA and minimum detectable concentration (MDC) are equivalent.
Minimum Reporting Limit (MRL)	the lowest concentration of standard used for calibration – Drinking Water Manual
MintMiner	Commercial software program used to scan large amounts of chromatographic data to monitor for errors or data integrity issues.
Mobile Laboratory	TNI- A portable enclosed structure with necessary and appropriate accommodation and environmental conditions for a laboratory, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.
National Environmental Laboratory Accreditation Conference (NELAC)	See definition of The NELAC Institute (TNI).
National Institute of Occupational Safety and Health (NIOSH)	National institute charged with the provision of training, consultation and information in the area of occupational safety and health.
National Institute of Standards and Technology (NIST)	TNI- A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI).

National Pollutant Discharge Elimination System (NPDES)	A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters.
Negative Control	Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.
Nitrogen Phosphorus Detector (NPD)	A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon.
Nonconformance	An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements.
Not Detected (ND)	The result reported for a compound when the detected amount of that compound is less than the method reporting limit.
Operator Aid	DoD- A technical posting (such as poster, operating manual, or notepad) that assists workers in performing routine tasks. All operator aids must be controlled documents (i.e., a part of the laboratory management system).
Performance Based Measurement System (PBMS)	An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner.
Physical Parameter	TNI- A measurement of a physical characteristic or property of a sample as distinguished from the concentrations of chemical and biological components.
Photo-ionization Detector (PID)	An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions.
Polychlorinated Biphenyls (PCB)	A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity.
Positive Control	Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.
Post-Digestion Spike	A sample prepared for metals analyses that has analytes spike added to determine if matrix effects may be a factor in the results.
Power of Hydrogen (pH)	The measure of acidity or alkalinity of a solution.
Practical Quantitation Limit (PQL)	Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions.
Precision	TNI- The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.
Preservation	TNI and DoD- Any conditions under which a sample must be kept in order to maintain chemical, physical, and/or biological integrity prior to analysis.
Primary Accreditation Body (Primary AB)	TNI- The accreditation body responsible for assessing a laboratory's total quality system, on-site assessment, and PT performance tracking for fields of accreditation.
Procedure	TNI- A specified way to carry out an activity or process. Procedures can be documented or not.
Proficiency Testing (PT)	TNI- A means to evaluate a laboratory's performance under controlled conditions relative to a given set of criteria, through analysis of unknown samples provided by an external source.
Proficiency Testing Program (PT Program)	TNI- The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories.
Proficiency Testing Provider (PT Provider)	TNI- A person or organization accredited by a TNI-approved Proficiency Testing Provider Accreditor to operate a TNI-compliant PT Program.
Proficiency Testing Provider Accreditor (PTPA)	TNI- An organization that is approved by TNI to accredit and monitor the performance of proficiency testing providers.
Proficiency Testing Reporting Limit (PTRL)	TNI- A statistically derived value that represents the lowest acceptable concentration for an analyte in a PT sample, if the analyte is spiked into the PT sample. The PTRLs are specified in the TNI FoPT tables.
Proficiency Testing Sample (PT)	TNI- A sample, the composition of which is unknown to the laboratory, and is provided to test whether the laboratory can produce analytical results within the specified acceptance criteria.

Proficiency Testing (PT) Study	TNI- a) Scheduled PT Study: A single complete sequence of circulation and scoring of PT samples to all participants in a PT program. The study must have the same pre-defined opening and closing dates for all participants; b) Supplemental PT Study: A PT sample that may be from a lot previously released by a PT Provider that meets the requirements for supplemental PT samples given in Volume 3 of this Standard [TNI] but that does not have a pre-determined opening date and closing date.
Proficiency Testing Study Closing Date	TNI- a) Scheduled PT Study: The calendar date by which all participating laboratories must submit analytical results for a PT sample to a PT Provider; b) Supplemental PT Study: The calendar date a laboratory submits the results for a PT sample to the PT Provider.
Proficiency Testing Study Opening Date	TNI- a) Scheduled PT Study: The calendar date that a PT sample is first made available to all participants of the study by a PT Provider; b) Supplemental PT Study: The calendar date the PT Provider ships the sample to a laboratory.
Protocol	TNI- A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) that must be strictly followed.
Qualitative Analysis	DoD- Analysis designed to identify the components of a substance or mixture.
Quality Assurance (QA)	TNI- An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.
Quality Assurance Manual (QAM)	A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality Assurance Project Plan (QAPP)	A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved.
Quality Control (QC)	TNI- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.
Quality Control Sample (QCS)	TNI- A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control.
Quality Manual	TNI- A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.
Quality System	TNI and DoD- A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance and quality control activities.

Quality System Matrix	TNI and DoD- These matrix definitions shall be used for purposes of batch and quality control requirements and may be different from a field of accreditation matrix: • **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device • **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts. • **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin. • **Chemical Waste**: A product or by-product of an industrial process that results in a matrix not previously defined. • **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source. • **Non-aqueous liquid**: Any organic liquid with <15% settleable solids • **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other saltwater source such as the Great Salt Lake. • **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.
Quantitation Range	DoD- The range of values (concentrations) in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard used to relate instrument response to analyte concentration. The quantitation range (adjusted for initial sample volume/weight, concentration/dilution and final volume) lies within the calibration range.
Quantitative Analysis	DoD- Analysis designed to determine the amounts or proportions of the components of a substance.
Random Error	The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases.
Raw Data	TNI- The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records.
Reagent Blank (method reagent blank)	A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.
Reagent Grade	Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
Records	DoD- The output of implementing and following management system documents (e.g., test data in electronic or hand-written forms, files, and logbooks).
Reference Material	TNI- Material or substance one or more of whose property values are sufficiently homogenized and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.
Reference Method	TNI- A published method issued by an organization generally recognized as competent to do so. (When the ISO language refers to a "standard method", that term is equivalent to "reference method"). When a laboratory is required to analyze by a specified method due to a regulatory requirement, the analyte/method combination is recognized as a reference method. If there is no regulatory requirement for the analyte/method combination, the analyte/method combination is recognized as a reference method if it can be analyzed by another reference method of the same matrix and technology.
Reference Standard	TNI- Standard used for the calibration of working measurement standards in a given organization or at a given location.
Relative Percent Difference (RPD)	A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements.

Reporting Limit (RL)	The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e., statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL. DoD- A customer-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.
Reporting Limit Verification Standard (RLVS)	A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level.
Representativeness	A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan.
Requirement	Denotes a mandatory specification; often designated by the term "shall".
Retention Time	The time between sample injection and the appearance of a solute peak at the detector.
Revocation	TNI- The total or partial withdrawal of a laboratory's accreditation by an accreditation body.
Sample	Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.
Sample Condition Upon Receipt Form (SCURF)	Form used by sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC).
Sample Delivery Group (SDG)	A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently.
Sample Receipt Form (SRF)	Letter sent to the client upon login to show the tests requested and pricing.
Sample Tracking	Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a chain-of-custody form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples.
Sampling	TNI- Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.
Selected Ion Monitoring (SIM)	A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector. DoD- Using GC/MS, characteristic ions specific to target compounds are detected and used to quantify in applications where the normal full scan mass spectrometry results in excessive noise.
Selectivity	TNI- The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system.
Sensitivity	TNI- The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.
Serial Dilution	The stepwise dilution of a substance in a solution.
Shall	Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification as long as the requirement is fulfilled.
Should	Denotes a guideline or recommendation whenever noncompliance with the specification is permissible.
Signal-to-Noise Ratio (S/N)	DoD- A measure of signal strength relative to background noise. The average strength of the noise of most measurements is constant and independent of the magnitude of the signal. Thus, as the quantity being measured (producing the signal) decreases in magnitude, S/N decreases and the effect of the noise on the relative error of a measurement increases.
Source Water	TNI- When sampled for drinking water compliance, untreated water from streams, rivers, lakes, or underground aquifers, which is used to supply private and public drinking water supplies.
Spike	A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard (Document)	TNI- The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies.
Standard (Chemical)	Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method.
Standard Blank (or Reagent Blank)	A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background.
Standard Method	A test method issued by an organization generally recognized as competent to do so.
Standard Operating Procedure (SOP)	TNI- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.
Standard Reference Material (SRM)	A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method.
Statement of Qualifications (SOQ)	A document that lists information about a company, typically the qualifications of that company to compete on a bid for services.
Stock Standard	A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source.
Storage Blank	DoD- A sample of analyte-free media prepared by the laboratory and retained in the sample storage area of the laboratory. A storage blank is used to record contamination attributable to sample storage at the laboratory.
Supervisor	The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses.
Surrogate	DoD- A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.
Suspension	TNI- The temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed 6 months or the period of accreditation, whichever is longer, in order to allow the laboratory time to correct deficiencies or area of non-conformance with the Standard.
Systems Audit	An on-site inspection or assessment of a laboratory's quality system.
Target Analytes	DoD- Analytes or chemicals of primary concern identified by the customer on a project-specific basis.
Technical Director	Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory.
Technology	TNI- A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.
Test	A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate.
Test Method	DoD- A definitive procedure that determines one or more characteristics of a given substance or product.
Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846)	EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations.
Test Source	TNI- A radioactive source that is tested, such as a sample, calibration standard, or performance check source. A Test Source may also be free of radioactivity, such as a Test Source counted to determine the subtraction background, or a short-term background check.
The NELAC Institute (TNI)	A non-profit organization whose mission is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the community. Previously known as NELAC (National Environmental Laboratory Accreditation Conference).

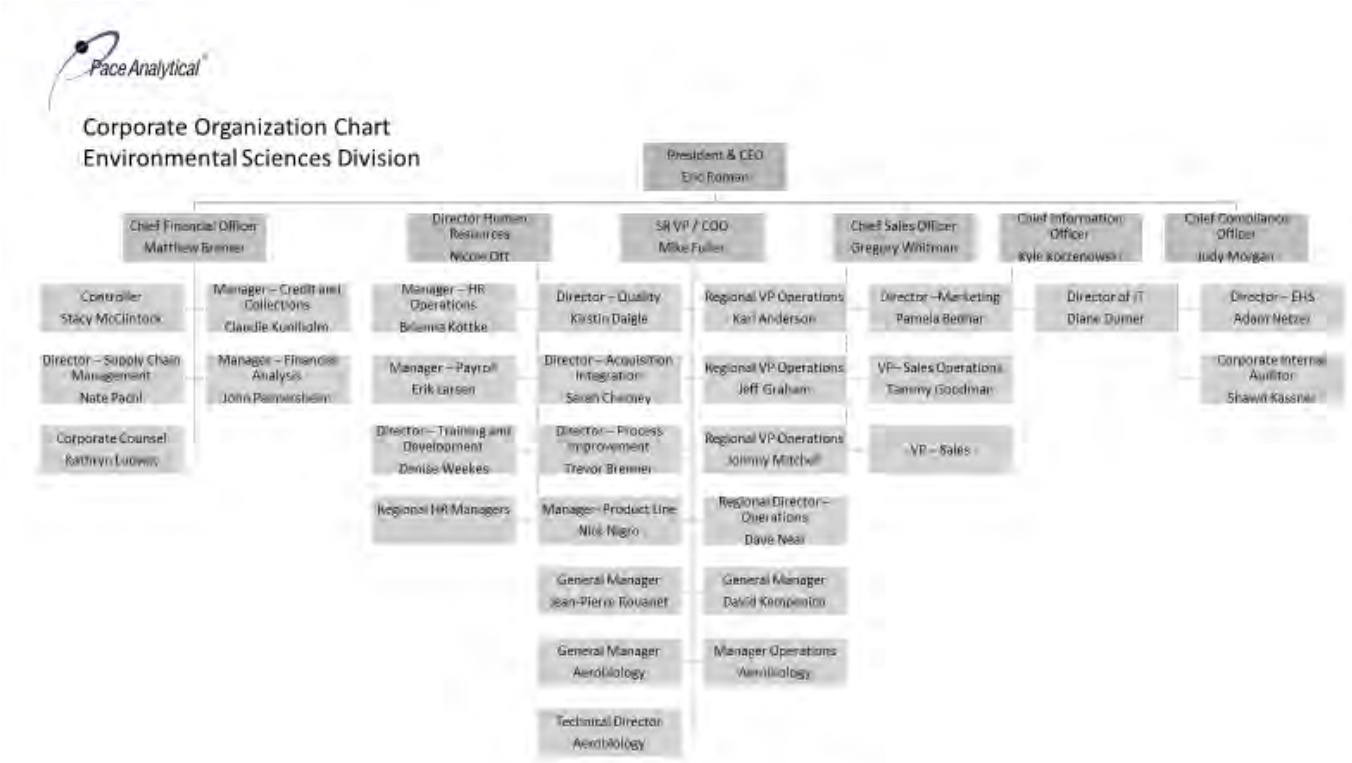
Total Petroleum Hydrocarbons (TPH)	A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc.
Toxicity Characteristic Leaching Procedure (TCLP)	A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill.
Traceability	TNI- The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.
Training Document	A training resource that provides detailed instructions to execute a specific method or job function.
Trip Blank	This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples.
Tuning	A check and/or adjustment of instrument performance for mass spectrometry as required by the method.
Ultraviolet Spectrophotometer (UV)	Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds.
Uncertainty, Counting	TNI- The component of Measurement Uncertainty attributable to the random nature of radioactive decay and radiation counting (often estimated as the square root of observed counts (MARLAP). Older references sometimes refer to this parameter as Error, Counting Error or Count Error (c.f., Total Uncertainty).
Uncertainty, Expanded	TNI- The product of the Standard Uncertainty and a coverage factor, k, which is chosen to produce an interval about the result that has a high probability of containing the value of the measurand (c.f., Standard Uncertainty). NOTE: Radiochemical results are generally reported in association with the Total Uncertainty. Either if these estimates of uncertainty can be reported as the Standard Uncertainty (one-sigma) or as an Expanded Uncertainty (k-sigma, where k > 1).
Uncertainty, Measurement	TNI- Parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand.
Uncertainty, Standard	TNI- An estimate of the Measurement Uncertainty expressed as a standard deviation (c.f., Expanded Uncertainty).
Uncertainty, Total	TNI- An estimate of the Measurement Uncertainty that accounts for contributions from all significant sources of uncertainty associated with the analytical preparation and measurement of a sample. Such estimates are also commonly referred to as Combined Standard Uncertainty or Total Propagated Uncertainty, and in some older references as the Total Propagated Error, among other similar items (c.f., Counting Uncertainty).
Unethical actions	DoD- Deliberate falsification of analytical or quality control results where failed method or contractual requirements are made to appear acceptable.
United States Department of Agriculture (USDA)	A department of the federal government that provides leadership on food, agriculture, natural resources, rural development, nutrition and related issues based on public policy, the best available science, and effective management.
United States Geological Survey (USGS)	Program of the federal government that develops new methods and tools to supply timely, relevant, and useful information about the Earth and its processes.
Unregulated Contaminant Monitoring Rule (UCMR)	EPA program to monitor unregulated contaminants in drinking water.
Validation	DoD- The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
Verification	TNI- Confirmation by examination and objective evidence that specified requirements have been met. In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

Voluntary Action Program (VAP)	A program of the Ohio EPA that gives individuals a way to investigate possible environmental contamination, clean it up if necessary and receive a promise from the State of Ohio that no more cleanup is needed.
Whole Effluent Toxicity (WET)	The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent).

7.4 Appendix D: Organization Chart(s)

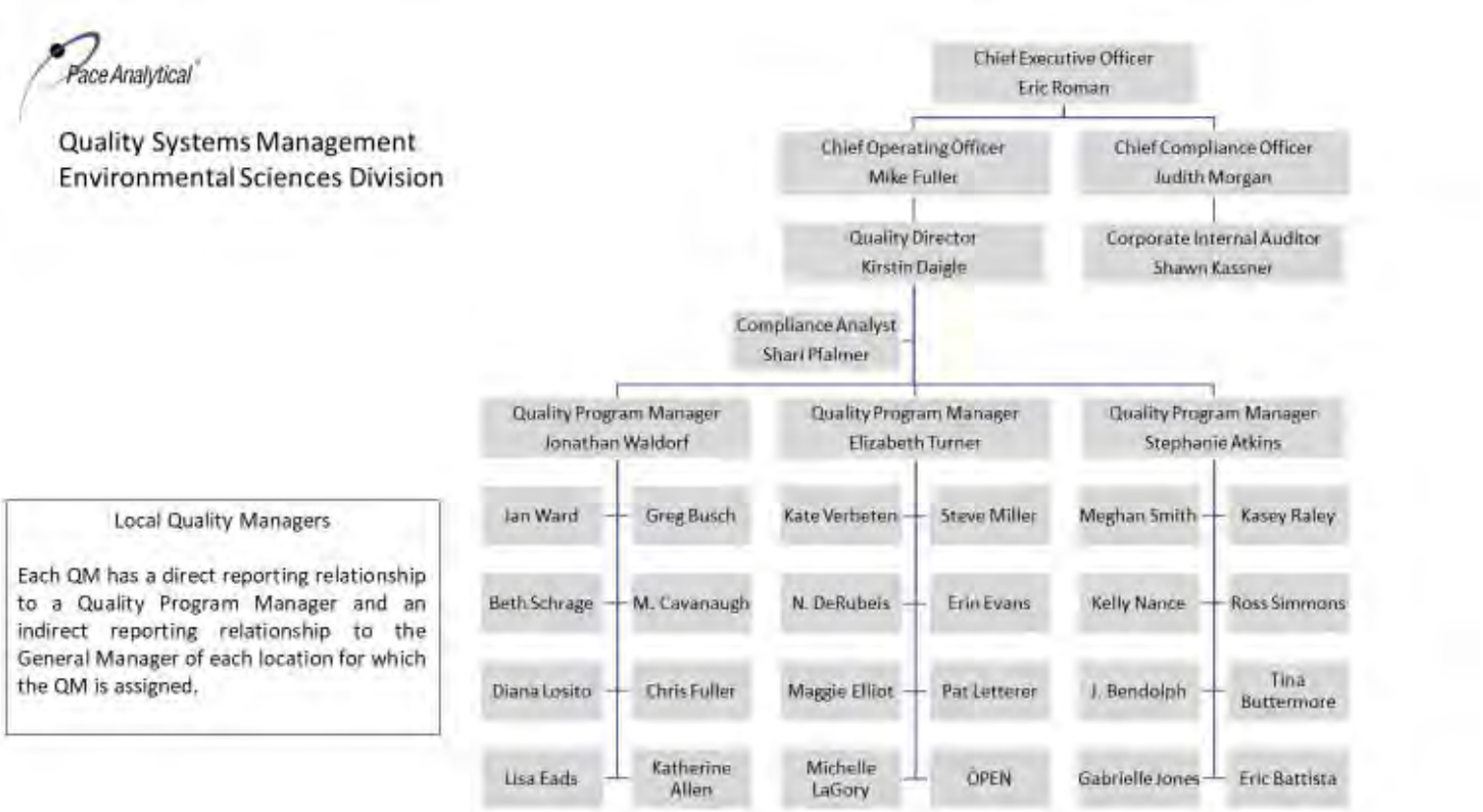
7.4.1 Corporate Organization Chart

Disclaimer: The following organization chart shows the structure of the and the relationships and relative ranks of its parts and positions/jobs in place on the date this version of this manual was published. This information is subject to change; contact the Quality Manager for the most current version.

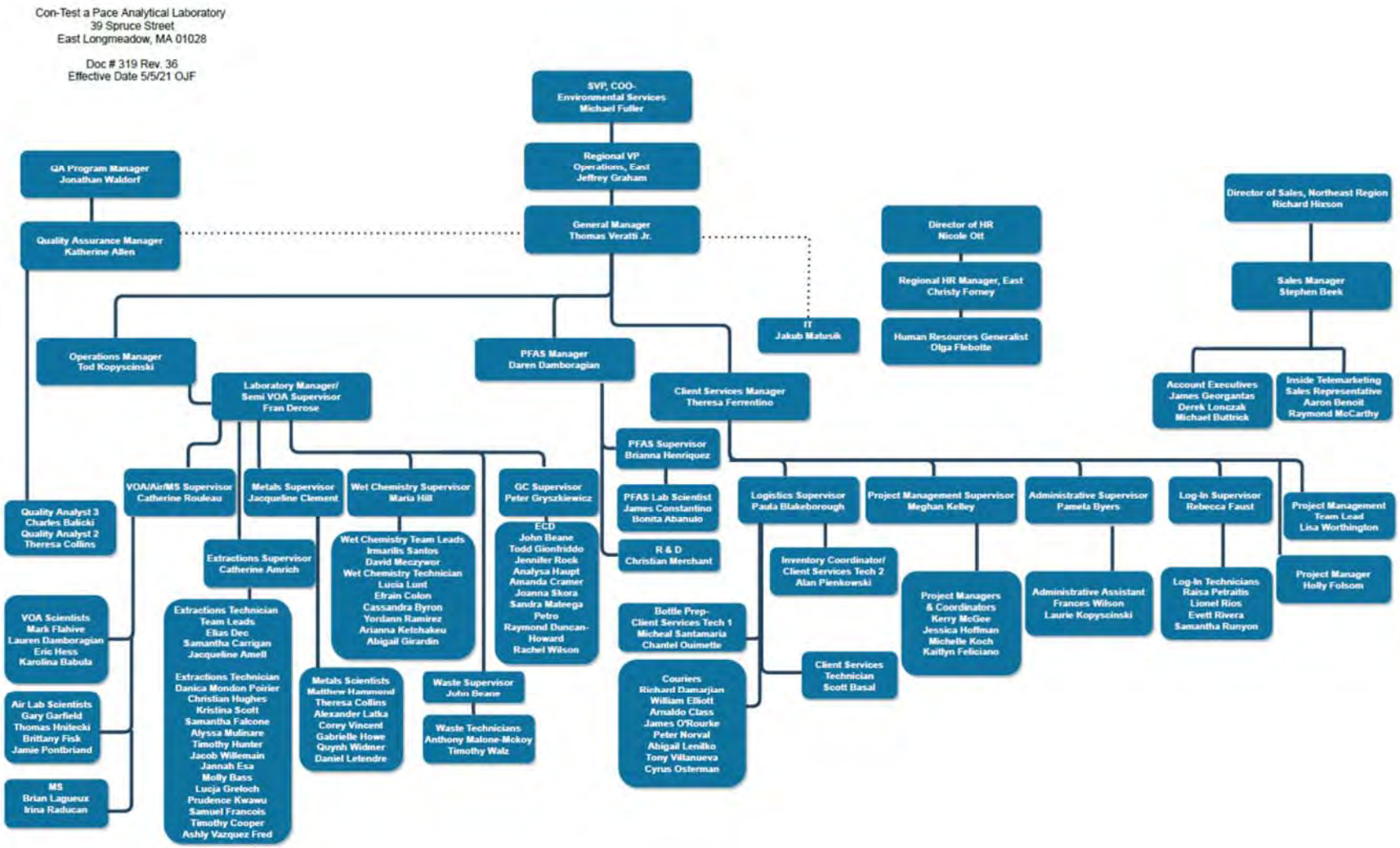


7.4.2 Quality Systems Management

Disclaimer: The following organization chart shows the structure of the and the relationships and relative ranks of its parts and positions/jobs in place on the date this version of this manual was published. This information is subject to change; contact the Quality Manager for the most current version.



7.4.3 Contest, A Pace Analytical Laboratory (ELON) – Organization Chart



7.5 Appendix E: Equipment Listing

The equipment listed represents equipment were held by each location on the effective date of this manual. This information is subject to change without notice. External parties should contact the location for the most current information.

7.5.1 PAS-ELON

Equipment List: PAS-ELON

Description	Manufacturer	Model	Serial Number	Service Date	Condition	Location	Internal ID	Location of Manual
Volatile Organics Lab								
GC	Agilent	6890N	CN10513041	03/2006	New	VOA Lab	VOA1	VOA Lab
MS	Agilent	5973N	US10441201	03/2006	New	VOA Lab	VOA1	VOA Lab
Concentrator	EST	ENCON	175113001	03/2006	New	VOA Lab	VOA1	VOA Lab
Autosampler	EST	ARCHON	13652	03/2006	New	VOA Lab	VOA1	VOA Lab
GC	Agilent	6890N	CN10423068	04/2006	New	VOA Lab	VOA2	VOA Lab
MS	Agilent	5973N	US40646523	04/2006	New	VOA Lab	VOA2	VOA Lab
Concentrator	EST	ENCON Evolution	EVX1172032320	04/2020	New	VOA Lab	VOA2	VOA Lab
Autosampler	EST	Centurion	CENTW737032320	04/2020	New	VOA Lab	VOA2	VOA Lab
GC	Agilent	6890N	CN10428074	09/2004	New	VOA Lab	VOA3	VOA Lab
MS	Agilent	5973N	US42546715	09/2004	New	VOA Lab	VOA3	VOA Lab
Concentrator	Teledyne	Tekmar ATOMX	US15197003	10/2015	New	VOA Lab	VOA3	VOA Lab
Autosampler	Teledyne	Tekmar ATOMX	US15197003	10/2015	New	VOA Lab	VOA3	VOA Lab
GC	Agilent	6890N	CN10513041	08/2005	New	VOA Lab	VOA4	VOA Lab
MS	Agilent	5973N	US44647080	08/2005	New	VOA Lab	VOA4	VOA Lab
Concentrator	EST	ENCON	175413001	08/2005	New	VOA Lab	VOA4	VOA Lab
Autosampler	EST	Centurion	CENTS119101509	12/2010	New	VOA Lab	VOA4	VOA Lab
GC	Agilent	7890	CN10944065	01/2010	New	VOA Lab	VOA5	VOA Lab
MS	Agilent	5975C	US92013095	01/2010	New	VOA Lab	VOA5	VOA Lab
Concentrator	EST	ENCON Evolution	EV232120809	01/2010	New	VOA Lab	VOA5	VOA Lab
Autosampler	EST	Centurion	CENTS127120809	01/2010	New	VOA Lab	VOA5	VOA Lab
GC	Agilent	7890B	CN14513073	10/2015	New	VOA Lab	VOA6	VOA Lab
MS	Agilent	5977A	US1514L416	10/2015	New	VOA Lab	VOA6	VOA Lab
Concentrator	Teledyne	Tekmar ATOMX	US15217001	10/2015	New	VOA Lab	VOA6	VOA Lab
Autosampler	Teledyne	Tekmar ATOMX	US15217001	10/2015	New	VOA Lab	VOA6	VOA Lab
GC	Agilent	7890A	CN10511048	03/2019	New	VOA Lab	VOA7	VOA Lab
MS	Agilent	5975C	US10507508	03/2019	New	VOA Lab	VOA7	VOA Lab
Concentrator	EST	ENCON Evolution	EV983080118	03/2019	New	VOA Lab	VOA7	VOA Lab
Autosampler	EST	Centurion	CENTS568080618	03/2019	New	VOA Lab	VOA7	VOA Lab
GC	HP	5890 Series II	3336A50263	10/2002	New	VOA Lab	VPH2	VOA Lab
Concentrator	EST	ENCON	256093002	10/2002	New	VOA Lab	VPH2	VOA Lab
Autosampler	EST	ARCHON	13823	10/2002	New	VOA Lab	VPH2	VOA Lab

GC	Agilent	7890B	CN15323125	10/2016	New	VOA Lab	VPH3	VOA Lab
Concentrator	Teledyne	Tekmar ATOMX	US16097001	10/2016	New	VOA Lab	VPH3	VOA Lab
Autosampler	Teledyne	Tekmar ATOMX	US16097001	10/2016	New	VOA Lab	VPH3	VOA Lab
Balance	Ohaus	SPX	B626691629	12/27/16	New	VOA Lab	B626691629	VOA Lab
DI System	Millipore	Milli Q Integral 10	F6JA88571A	12/1/16	New	VOA Lab	VOA DI	VOA Lab
Petro Organics Lab								
GC	HP	5890 GC Series II	3336A51646	06/2005	Unknown	Petro Lab	GCFID1	Petro Lab
Autosampler	Agilent	Front Tower 18593B	30009A20702	06/2005	Unknown	Petro Lab	GCFID1	Petro Lab
Autosampler	Agilent	Back Tower G15132A	US00001310	06/2005	Unknown	Petro Lab	GCFID1	Petro Lab
GC	HP	6890	US00004350	9/6/2006	New	Petro Lab	GCFID2	Petro Lab
Autosampler	Agilent	6890 Front Tower	US00000914	9/6/2006	New	Petro Lab	GCFID2	Petro Lab
Autosampler	Agilent	6890 Back Tower	CN12420201	9/6/2006	New	Petro Lab	GCFID2	Petro Lab
Autosampler	Agilent	7673A Tray	2718A04619	9/6/2006	New	Petro Lab	GCFID2	Petro Lab
Autosampler	Agilent	Controller	US70701037	9/6/2006	New	Petro Lab	GCFID2	Petro Lab
GC	Agilent	6890N	CN10722032	10/9/07	New	Petro Lab	GCFID4	Petro Lab
Autosampler	Agilent	7683	CN71943915	10/9/07	New	Petro Lab	GCFID4	Petro Lab
Autosampler	Agilent	Front Tower 7683B	CN71439900	10/9/07	New	Petro Lab	GCFID4	Petro Lab
Autosampler	Agilent	Back Tower 7683B	CN71139576	10/9/07	New	Petro Lab	GCFID4	Petro Lab
GC	Agilent	7890B	CN13413141	11/20/13	New	Petro Lab	GCFID5	Petro Lab
Autosampler	Agilent	7693	13340011	11/20/13	New	Petro Lab	GCFID5	Petro Lab
Autosampler	Agilent	Front Tower 7693	13320011	11/20/13	New	Petro Lab	GCFID5	Petro Lab
Autosampler	Agilent	Back Tower 7693	13310167	11/20/13	New	Petro Lab	GCFID5	Petro Lab
GC	Agilent	7890B	US19283011	9/25/19	New	Petro Lab	GCFID6	Petro Lab
Autosampler	Agilent	7693	CN13340021	9/25/19	New	Petro Lab	GCFID6	Petro Lab
Autosampler	Agilent	Front Tower 7693	CN18050017	9/25/19	New	Petro Lab	GCFID6	Petro Lab
Autosampler	Agilent	Back Tower 7693	CN1730053	9/25/19	New	Petro Lab	GCFID6	Petro Lab
Semi-Volatile Organics Lab								
GC	Agilent	6890	US00008893	06/2006	New	SVOA Lab	GCMSSV2	SVOA Lab

MS	Agilent	5973N	US10940464	06/2006	New	SVOA Lab	GCMSSV2	SVOA Lab
Autosampler	HP	7673A	2942020017	06/2006	New	SVOA Lab	GCMSSV2	SVOA Lab
GC	Agilent	6890N	CN10511066	4/15/05	New	SVOA Lab	GCMSSV3	SVOA Lab
MS	Agilent	5973N	US44647002	4/15/05	New	SVOA Lab	GCMSSV3	SVOA Lab
Autosampler	Leap	7683B	CN81548572	4/15/05	New	SVOA Lab	GCMSSV3	SVOA Lab
GC	Agilent	7890A	CN1080619	6/21/08	New	SVOA Lab	GCMSSV4	SVOA Lab
MS	Agilent	5975C	US80818740	6/21/08	New	SVOA Lab	GCMSSV4	SVOA Lab
Autosampler	Agilent	7693	CN12070047	6/21/08	New	SVOA Lab	GCMSSV4	SVOA Lab
GC	Agilent	7890A	CN10939098	1/8/10	New	SVOA Lab	GCMSSV5	SVOA Lab
MS	Agilent	5975C	US94323865	1/8/10	New	SVOA Lab	GCMSSV5	SVOA Lab
Autosampler	Agilent	7693	CN90800042	1/8/10	New	SVOA Lab	GCMSSV5	SVOA Lab
Autosampler	Agilent	Tower G4513A	CN93201279	1/8/10	New	SVOA Lab	GCMSSV5	SVOA Lab
GC	Agilent	7890A	CN10501014	1/3/11	New	SVOA Lab	GCMSSV6	SVOA Lab
MS	Agilent	5975C	US10502706	1/3/11	New	SVOA Lab	GCMSSV6	SVOA Lab
Autosampler	Agilent	7693	CN10300083	1/3/11	New	SVOA Lab	GCMSSV6	SVOA Lab
Autosampler	Agilent	Tower G4513A	CN10310079	1/3/11	New	SVOA Lab	GCMSSV6	SVOA Lab
GC	Agilent	7890A	CN10521046	7/2/19	New	SVOA Lab	GCMSSV8	SVOA Lab
MS	Agilent	5977A	US15131424	7/2/19	New	SVOA Lab	GCMSSV8	SVOA Lab
Autosampler	Agilent	7693	CN10360016	7/2/19	New	SVOA Lab	GCMSSV8	SVOA Lab
Autosampler	Agilent	Tower G4513A	CN11100177	7/2/19	New	SVOA Lab	GCMSSV8	SVOA Lab
ECD Organics Lab								
GC	Agilent	6890	US10135015	1/19/15	Unknown	ECD Lab	ECD1	ECD Lab
Autosampler	Leap	PAL GC-XT	211473	1/19/15	Unknown	ECD Lab	ECD1	ECD Lab
GC	Agilent	7890A	CN10940075	8/27/10	New	ECD Lab	ECD2A	ECD Lab
Autosampler	Leap	PAL	160882	8/27/10	New	ECD Lab	ECD2A	ECD Lab
GC	Agilent	6890N	CN10426061	8/26/14	Unknown	ECD Lab	ECD3	ECD Lab
Autosampler	Leap	PAL	160871	8/26/14	Unknown	ECD Lab	ECD3	ECD Lab
GC	Agilent	7890A	CN10715067	2/24/15	Unknown	ECD Lab	ECD4	ECD Lab

Autosampler	Leap	PAL	161401	2/24/15	Unknown	ECD Lab	ECD4	ECD Lab
GC	Agilent	7890A	CN10805007	7/23/08	New	ECD Lab	ECD5	ECD Lab
Autosampler	Leap	PAL	161641	7/23/08	New	ECD Lab	ECD5	ECD Lab
GC	Agilent	7890A	CN10491024	10/3/11	New	ECD Lab	ECD6	ECD Lab
Autosampler	Leap	PAL	160637	10/3/11	New	ECD Lab	ECD6	ECD Lab
GC	HP	5890 Series II	3203A41006	10/26/05	Unknown	ECD Lab	ECD7	ECD Lab
Autosampler	Leap	PAL	160926	10/26/05	Unknown	ECD Lab	ECD7	ECD Lab
GC	Agilent	7890A	CN11121138	9/30/11	new	ECD Lab	ECD8	ECD Lab
Autosampler	Leap	PAL GC-XT	230972	9/30/11	New	ECD Lab	ECD8	ECD Lab
GC	Agilent	7890A	CN11321159	10/22/11	New	ECD Lab	ECD9	ECD Lab
Autosampler	Leap	PAL GC-XT	230973	10/22/11	New	ECD Lab	ECD9	ECD Lab
GC	Agilent	7890A	CN134110002	10/28/13	New	ECD Lab	ECD10	ECD Lab
Autosampler	Leap	PAL GC-XT	290823	10/28/13	New	ECD Lab	ECD10	ECD Lab
GC	Agilent	7890A	CN13503023	2/12/21	New	ECD Lab	ECD11	ECD Lab
Autosampler	Agilent	7693	CN17420059	2/12/21	New	ECD Lab	ECD11	ECD Lab
Hydrogen Generator	Parker	H2-800-154C	N/A	4/3/10	New	ECD Lab	Hydrogen Gen	ECD Lab
Org Extractions Prep Lab								
Balance	Mettler Toledo	PB303-S/FACT	1128442754	Unknown	New	Ext Lab	% Solids Balance	Ext Lab
Balance	OHAUS	SPX2201	B852011371	Unknown	New	Ext Lab	TCLP	Ext Lab
Balance	OHAUS	SPX421	8340076034	Unknown	New	Ext Lab	8340076034	Ext Lab
Balance	OHAUS	SPX421	8340076046	Unknown	New	Ext Lab	8340076046	Ext Lab
Balance	VWR	164 AC	525973	Unknown	New	Ext Lab	VWR 525973	Ext Lab
Balance	OHAUS	Scout	B334691720	Unknown	New	Ext Lab	ScoutScoutB 334691720	Ext Lab
Microwave	CEM	MARS Xpress	MD9428	9/12/15	New	Ext Lab	Microwave #1	Ext Lab
DI System	Millipore	Milli-Q Integral 10	F2HA18917A	9/16/14	New	Ext Lab	DI #1	Ext Lab
DI System	Millipore	Millipore	11919-C	9/16/14	New	Ext Lab	DI #2	Ext Lab
Buchi Concentrator	Buchi	Syncore	1000118659	Unknown	New	Ext Lab	Buchi #1	Ext Lab
Buchi Concentrator	Buchi	Syncore	1000112070	Unknown	New	Ext Lab	Buchi #2	Ext Lab
Buchi Concentrator	Buchi	Syncore	1000120842	Unknown	New	Ext Lab	Buchi #3	Ext Lab
Buchi Concentrator	Buchi	Syncore	1000149974	Unknown	New	Ext Lab	Buchi #4	Ext Lab
Buchi Concentrator	Buchi	Syncore	1000134011	Unknown	New	Ext Lab	Buchi #6	Ext Lab
Buchi Concentrator	Buchi	Syncore	1000290469	Unknown	New	Ext Lab	Buchi #8	Ext Lab
S-EVAP	Organomation	S-EVAP	24528	12/2020	New	Ext Lab	S-EVAP #1	Ext Lab

S-EVAP	Organomation	S-EVAP	24529	12/2020	New	Ext Lab	S-EVAP #2	Ext Lab
N-EVAP Heating Mantle	Organomation	N-EVAP	9924	Unknown	New	Ext Lab	N-EVAP#1	Ext Lab
N-EVAP Manifold	Organomation	N-EVAP	22588	Unknown	New	Ext Lab	N-EVAP#1	Ext Lab
N-EVAP	Organomation	N-EVAP 111	61959	Unknown	New	Ext Lab	N-EVAP#2	Ext Lab
N-EVAP Heating Mantle	Organomation	N-EVAP 111	17355	Unknown	New	Ext Lab	N-EVAP#3	Ext Lab
N-EVAP Manifold	Organomation	N-EVAP 111	9632	Unknown	New	Ext Lab	N-EVAP#3	Ext Lab
N-EVAP Heating Mantle	Organomation	N-EVAP 111	7166	Unknown	New	Ext Lab	N-EVAP#4	Ext Lab
N-EVAP Manifold	Organomation	N-EVAP 111	18503	Unknown	New	Ext Lab	N-EVAP#4	Ext Lab
pH Meter	Thermo	Orion Versa Star Pro	V16100	3/9/21	New	Ext Lab	pH #1	Ext Lab
Centrifuge	Beckman	J6-HC	Unknown	2010	New	Ext Lab	Centrifuge	Ext Lab
Wetchem Lab								
Gallery	Thermo Scientific	Discrete Gallery Auto Analyzer	861100120070	8/17/18	Used	Wetchem	Gallery	Wetchem
IC	Therm Dionex	Integrion	17110066	11/17/17	New	Wetchem	IC #1	Wetchem
Autosampler	Thermo Dionex	AS-AP	17090219	11/17/17	New	Wetchem	IC#1	Wetchem
IC	Therm Dionex	Integrion	19040120	7/25/19	New	Wetchem	IC #2	Wetchem
Autosampler	Thermo Dionex	AS-AP	19041884	7/25/19	New	Wetchem	IC#2	Wetchem
TOC Analyzer	Teledyne	Lotix	US15047005	7/10/17	New	Wetchem	TOC #1	Wetchem
TOC Soil Module	Teledyne	Lotix	US16295009R	7/10/17	New	Wetchem	TOC #1	Wetchem
TOC Analyzer	Teledyne	Lotix	US21075010	5/6/2021	New	Wetchem	TOC #2	Wetchem
TOC Soil Module	Teledyne	Lotix	US21062003	5/6/2021	New	Wetchem	TOC #2	Wetchem
Autoclave	Tuttnauer		9603982	6/28/18	New	Wetchem	Autoclave #1	Wetchem
Balance	Sartorius	CPA 26P	2413554	8/28/13	New	Wetchem	Balance 2413554	Wetchem
Balance	AND	HR-200	12336744	2/21/19	New	Wetchem	Balance 12336744	Wetchem
Balance	Ohaus	Scout	B627697290	Unknown	New	Wetchem	Balance B627697290	Wetchem
Balance	Mettler Toledo	ML 104T	B630799076	10/14/16	New	Wetchem	Balance B630799076	Wetchem
DI	Millipore	Milli-Q	F7JA13123A	Unknown	New	Wetchem	DI #1	Wetchem

Flashpoint Tester	Koehler	AK16200	R070022132-B	Unknown	New	Wetchem	Flashpoint #1	Wetchem
Flashpoint Tester	Koehler	AK16200	1600010053B	Unknown	New	Wetchem	Flashpoint #2	Wetchem
BOD Autoanalyzer	Skalar	21088903-01	14106	Unknown	New	Wetchem	BOD #1	Wetchem
pH/Cond Meter	Thermo	Orion Versa Star Pro	13050	Unknown	New	Wetchem	Versa Star #1	Wetchem
pH	Thermo	Orion Versa Star Pro	13886	Unknown	New	Wetchem	Versa Star #2	Wetchem
pH Meter	Orion	Expandable Ion Analyzer EA 920	QT11A	Unknown	Unknown	Wetchem	Orion	Wetchem
COD Reactor	Rocker	CR-25	179250-11-AHH100	Unknown	New	Wetchem	COD #1	Wetchem
COD Reactor	Bioscience		COD-B0224	Unknown	Unknown	Wetchem	COD #2	Wetchem
Turbidity Meter	WTW	Turb 550	201509323	Unknown	New	Wetchem	Turb #1	Wetchem
Spectrophotometer	Genesys 30	840-277000	9A1V089010	Unknown	New	Wetchem	Genesys 30	Wetchem
Spectrophotometer	Genesys 20	401-4	35GT027006	Unknown	New	Wetchem	Genesys 20 #4	Wetchem
Spectrophotometer	Genesys 20	401-4	35GH164001	Unknown	New	Wetchem	Genesys 20 # 2	Wetchem
Midi Distillation Block	Environmental Express	Midi	2394	2019	New	Wetchem	Block #1	Wetchem
Midi Distillation Block	Environmental Express	Midi	2393	2019	New	Wetchem	Block #2	Wetchem
Distillation Unit	FOSS	Kjeltec 8100	91849887	Unknown	New	Wetchem	Foss #1	Wetchem
Distillation Unit	FOSS	Kjeltec 8100	91717863	Unknown	New	Wetchem	Foss #2	Wetchem
Digestor	FOSS	Tecator Digetor 20	91718494	Unknown	New	Wetchem	Digestor #1	Wetchem
Scrubber	FOSS	Scrubber 2501	91831380	Unknown	New	Wetchem	Scrubber #1	Wetchem
Microscope	Olympus	BH2	Unknown	Unknown	New	Wetchem	Microscope	Wetchem
Metals Lab								
Hg Analyzer	Perkin Elmer	FIMS 100	1015S091101	01/31/08	New	Metals	FIMS #1	Metals
Hg Analyzer	Perkin Elmer	FIMS 100	101S20092201	11/24/20	New	Metals	FIMS #2	Metals
Shared Autosampler	Perkin Elmer	S10	102S7093825	1/31/08	New	Metals	FIMS#1+2	Metals
ICP	Perkin Elmer	Optima 4300 DV	077N0022803	Unknown	New	Metals	ICP#2	Metals
Chiller	Poly Science	Water Chiller	2004-01773	Unknown	New	Metals	ICP#2	Metals
Autosampler	Perkin Elmer	S10 Autosampler	102S10125019	Unknown	New	Metals	ICP#2	Metals
ICP	Perkin Elmer	Optima 8300 Cross Flow	078S1703073	Unknown	New	Metals	ICP#3	Metals
Chiller	Poly Science	Water Chiller	7V1712250	Unknown	New	Metals	ICP#3	Metals
Autosampler	Perkin Elmer	S10 Autosampler	102S16114512	Unknown	New	Metals	ICP#3	Metals

ICP	Perkin Elmer	AVIO 500	081S2009251	10/19/20	New	Metals	ICP#4	Metals
Chiller	Perkin Elmer	Water Chiller	1911-01635	10/19/20	New	Metals	ICP#4	Metals
Autosampler	Perkin Elmer	S23 Autosampler	092009S23	10/19/20	New	Metals	ICP#4	Metals
ICPMS	Perkin Elmer	ELAN 9000	P2210502	5/1/12	New	Metals	ELAN	Metals
Chiller	Polyscience	WhisperCool Chiller	1909-03446	5/1/12	New	Metals	ELAN	Metals
Autosampler	Perkin Elmer	SC-4 with Fast 200.8 Bayonet Autosampler	X4DX-B-150412	5/1/12	New	Metals	ELAN	Metals
ICPMS	Agilent	7900 ICP-MS G8403A	JP15391053	1/7/2016	New	Metals	Agilent	Metals
Autosampler	Agilent	SPS 4 Autosampler	AU15190166	1/7/2016	New	Metals	Agilent	Metals
Heat Exchanger	Agilent	Heat Exchanger	3F1590212	1/7/2016	New	Metals	Agilent	Metals
ICPMS	Perkin Elmer	NexION 1000	815N0082801X	1/4/2021	New	Metals	NexION	Metals
Autosampler	Perkin Elmer	SC4 DX	SC4-200770	1/4/2021	New	Metals	NexION	Metals
Chiller	Poly Science	WhisperCool Chiller N0772046	2005-00345	1/4/2021	New	Metals	NexION	Metals
Turbidity Meter	WTW	Turb 500	201602530	Unknown	New	Metals	Turb#1	Metals
Hg Water Bath	Thermo Scientific		8601504155	Unknown	Unknown	Metals	Hg Bath	Metals
Balance	Mettler Toledo	AL 204	1226310638	Unknown	New	Metals	Balance #1	Metals
Balance	Mettler Toledo	AL 2014	1228410501	Unknown	New	Metals	Balance #2	Metals
Balance	Ohaus	Scout Pro	205654500	11/11/16	New	Metals	Balance #7	Metals
Hot block	SCP Science	Digi Prep	MSX1016061534	2/29/16	New	Metals	Digi Prep#3	Metals
Hot block	Environmental Express	Hotblock	SC154-2020CECW5307	6/10/20	New	Metals	HB-1	Metals
Microwave	CEM	Mars6	MJ7871	Unknown	New	Metals	Metals Microwave	Metals
DI System	Millipore	Q-integral 10	F2HA18917E	9/28/12	New	Metals	Metals DI	Metals
Air Lab								
Diluter	Entech	4700	0014	2/11/14	New	Airlab	Diluter	Airlab
Desorber	Entech	5400	0153	2/11/14	New	Airlab	Desorber	Airlab
GC	Agilent	7890B	CN13393065	6/28/17	New	Airlab	System "I"	Airlab
Autosampler	EST	Centurion LGX-50	LGX117122717	6/28/17	New	Airlab	System "I"	Airlab
GC	HP	5890 Series II	3203A41005	09/2004	New	Airlab	System "E"	Airlab
GC	Agilent	7890B	CN18253111	12/11/18	New	Airlab	System "J"	Airlab
MS	Agilent	5977B	US1844R031	12/11/18	New	Airlab	System "J"	Airlab
Concentrator	Entech	7200A	00101	12/11/18	New	Airlab	System "J"	Airlab

Autosampler	Entech	7650-M	0082	12/11/18	New	Airlab	System "J"	Airlab
Autosampler	Entech	7016D	1715	12/11/18	New	Airlab	System "J"	Airlab
GC	Agilent	7890B	CN17073071	7/1/20	New	Airlab	System "K"	Airlab
MS	Agilent	5977B	US1735R007	7/1/20	New	Airlab	System "K"	Airlab
Concentrator	Entech	7200A	00112	7/1/20	New	Airlab	System "K"	Airlab
Autosampler	Entech	7016D	1831	7/1/20	New	Airlab	System "K"	Airlab
Autosampler	Entech	7016D	1833	7/1/20	New	Airlab	System "K"	Airlab
GC	Agilent	7890A	CN10717066	8/23/07	New	Airlab	System "G"	Airlab
MS	Agilent	5975C	US71215897	8/23/07	New	Airlab	System "G"	Airlab
Concentrator	Entech	7100A	1387	8/23/07	New	Airlab	System "G"	Airlab
Autosampler	Entech	7016CA	1180	8/23/07	New	Airlab	System "G"	Airlab
Autosampler	Entech	7016CA	1178	8/23/07	New	Airlab	System "G"	Airlab
Autosampler	Entech	7016CA	1179	8/23/07	New	Airlab	System "G"	Airlab
GC	Agilent	7890A	CN10441117	12/9/10	New	Airlab	System "H"	Airlab
MS	Agilent	5975C	US10407505	12/9/10	New	Airlab	System "H"	Airlab
Concentrator	Entech	7200	1206	12/9/10	New	Airlab	System "H"	Airlab
Autosampler	Entech	7016D	1628	12/9/10	New	Airlab	System "H"	Airlab
Autosampler	Entech	7016D	1438	12/9/10	New	Airlab	System "H"	Airlab
GC	Agilent	6890	CN10426080	Unknown	New	Airlab	System "F"	Airlab
MS	Agilent	5973	US42546705	Unknown	New	Airlab	System "F"	Airlab
Concentrator	Entech	7100	0107	Unknown	New	Airlab	System "F"	Airlab
Autosampler	Entech	7016CA	00023	Unknown	New	Airlab	System "F"	Airlab
Autosampler	Entech	7016CA	00139	Unknown	New	Airlab	System "F"	Airlab
PFAS Lab								
Balance	VWR	164AC	577112	5/29/18	New	PFAS Lab	577112	PFAS Lab
LC/MS/MS	Agilent	6460	SG15477305	9/1/16	New	PFAS Lab	QQQ 1	PFAS Lab
LC/MS/MS	Agilent	1260 Infinity G1316A	DEACN45273	9/1/16	New	PFAS Lab	QQQ 1	PFAS Lab
Vial Sampler	Agilent	1260 Infinity	DEAEQ02143	9/1/16	New	PFAS Lab	QQQ 1	PFAS Lab
Bin Pump	Agilent	1260 Infinity	DEABM01554	9/1/16	New	PFAS Lab	QQQ 1	PFAS Lab
Degasser	Agilent	HiP Degasser	JPAAB07158	9/1/16	New	PFAS Lab	QQQ 1	PFAS Lab
LC/MS/MS	Agilent	G6470A	SG1913G106	11/12/19	New	PFAS Lab	QQQ 2	PFAS Lab
LC/MS/MS	Agilent	1290 Infinity II	DEBA403047	11/12/19	New	PFAS Lab	QQQ 2	PFAS Lab
Multi sampler	Agilent	1290 Infinity II	DEBAQ00135	11/12/19	New	PFAS Lab	QQQ 2	PFAS Lab
Highspeed Pump	Agilent	1290 Infinity II	DEBAY016112	11/12/19	New	PFAS Lab	QQQ 2	PFAS Lab
LC/MS/MS	Agilent	G6470A	SG1702G001	01/2021	New	PFAS Lab	QQQ3	PFAS Lab
LC/MS/MS	Agilent	1290 Infinity II	DEBA404359	01/2021	New	PFAS Lab	QQQ3	PFAS Lab
Multi sampler	Agilent	1290 Infinity II	DEBAS01112	01/2021	New	PFAS Lab	QQQ3	PFAS Lab
Highspeed Pump	Agilent	1290 Infinity II	DEBA200339	01/2021	New	PFAS Lab	QQQ3	PFAS Lab
LC/MS/MS	Agilent	G6470A	SG2041D201	05/10/21	New	PFAS Lab	QQQ4	PFAS Lab
LC/MS/MS	Agilent	1290 Infinity II	DEBA406618	05/10/21	New	PFAS Lab	QQQ4	PFAS Lab
Multi sampler	Agilent	1290 Infinity II	DEBAS02800	05/10/21	New	PFAS Lab	QQQ4	PFAS Lab

Highspeed Pump	Agilent	1290 Infinity II	DEBA204500	05/10/21	New	PFAS Lab	QQQ4	PFAS Lab
N-EVAP Heating Mantle	Organomation	9125	63712	03/2021	New	PFAS Lab	PFAS N-EVAP	PFAS Lab
N-EVAP Manifold	Oganomation	N-EVAP 112	N2431763	03/2021	New	PFAS Lab	PFAS N-EVAP	PFAS Lab
General Lab								
35 Refrigerators/ Freezers	Various	Various	Various	Unknown	Unknown	General Lab	Various	QA
70 Thermometers	Various	Various	Various	Unknown	Unknown	General Lab	Various	QA
Evaporator System	ENCON	DE4-B	Unknown		New	General Lab	EVAP #1	Waste
Solvent Distillation	B/R Instrument	9600 High Efficiency Distillation System	Unknown	2014	New	General Lab	Solvent Dist #1	Waste
Solvent Distillation	B/R Instrument	9600 High Efficiency Distillation System	Unknown	2017	New	General Lab	Solvent Dist #2	Waste
Solvent Distillation	B/R Instrument	9600 High Efficiency Distillation System	Unknown	2014	New	General Lab	Solvent Dist #1	Waste
Solvent Distillation	B/R Instrument	9600 High Efficiency Distillation System	Unknown	2017	New	General Lab	Solvent Dist #2	Waste

NOTE: Leachate limits are 5X all other AQ because only 100 mL is used per the method.

			Pace Gulf Coast - Water			Pace Gulf Coast - Soil		
			EPA Draft Method 1633			EPA Draft Method 1633		
Target	Acronym	CAS RN	ng/L			µg/kg		
Perfluoroalkyl carboxylic acid (PFCA)			LOQ	LOD	DL	LOQ	LOD	DL
Perfluorobutanoic acid	PFBA	375-22-4	4	2	0.545	0.8	0.4	0.1436
Perfluoropentanoic acid	PFPeA	2706-90-3	2	1	0.2891	0.4	0.2	0.0616
Perfluorohexanoic acid	PFHxA	307-24-4	1	0.5	0.1179	0.2	0.16	0.0775
Perfluoroheptanoic acid	PFHpA	375-85-9	1	0.5	0.158	0.2	0.1	0.0296
Perfluorooctanoic acid	PFOA	335-67-1	1	0.5	0.1571	0.2	0.1	0.0362
Perfluorononoic acid	PFNA	375-95-1	1	0.5	0.1664	0.2	0.1	0.0441
Perfluorodecanoic acid	PFDA	335-76-2	1	0.5	0.1812	0.2	0.1	0.384
Perfluoroundecanoic acid	PFUnA	2058-94-8	1	0.5	0.1815	0.2	0.1	0.0299
Perfluorododecanoic acid	PFDoA	307-55-1	1	0.5	0.1692	0.2	0.1	0.0378
Perfluorotridecanoic acid	PFTrDA	72629-94-8	1	0.5	0.196	0.2	0.1	0.0314
Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7	1	0.5	0.1676	0.2	0.1	0.0303
Perfluoroalkane sulfonic acid (PFSA)								
Perfluorobutanesulfonic acid	PFBS	375-73-5	1	0.5	0.1041	0.2	0.1	0.0269
Perfluoropentanesulfonic acid	PFPeS	2706-91-4	1	0.5	0.1164	0.2	0.1	0.0323
Perfluorohexanesulfonic acid	PFHxS	355-46-4	1	0.5	0.1714	0.2	0.1	0.0328
Perfluoroheptanesulfonic acid	PFHpS	375-92-8	1	0.5	0.1122	0.2	0.1	0.0249
Perfluorooctanesulfonic acid	PFOS	1763-23-1	1	0.75	0.2586	0.2	0.1	0.0516
Perfluorononesulfonic acid	PFNS	68259-12-1	1	0.5	0.2182	0.2	0.1	0.0396
Perfluorodecanesulfonic acid	PFDS	335-77-3	1	0.5	0.1534	0.2	0.1	0.0333
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	1	0.5	0.3408	0.2	0.1	0.0281
Perfluorooctane sulfonamides								
Perfluorooctanesulfomide	PFOSA	754-91-6	1	0.5	0.1539	0.2	0.1	0.0471
N-ethyl perfluorooctane sulfomide	NEtFOSA	4151-50-2	1	0.5	0.1443	0.2	0.15	0.0588
N-methyl perfluorooctane sulfomide	NMeFOSA	31506-32-8	1	0.5	0.1529	0.2	0.1	0.0341
Perfluorooctane sulfonamide ethanols								
N-ethyl perfluorooctane sulfomidoethanol	NEtFOSE	1691-99-2	10	5	2.3555	2	1	0.4418
N-methyl perfluorooctane sulfomidoethanol	NMeFOSE	24448-09-7	10	5	1.5154	2	1	0.3955
Perfluorooctane sulfonamidoacetic acids								
N-ethyl perfluorooctanesulfomidoacetic acid	NEtFOSAA	2991-50-6	1	0.75	0.2571	0.2	0.1	0.0262
N-methyl perfluorooctanesulfomidoacetic acid	NMeFOSAA	2355-31-9	1	0.5	0.2174	0.2	0.1	0.0485
Fluorotelomer sulfonic acid (FTSA)								
4:2 Fluorotelomer sulfonic acid	4:2 FTS	757124-72-4	4	2	0.6337	0.8	0.4	0.1507
6:2 Fluorotelomer sulfonic acid	6:2 FTS	27619-97-2	4	2	0.9453	0.8	0.4	0.1391
8:2 Fluorotelomer sulfonic acid	8:2 FTS	39108-34-4	4	2	0.5442	0.8	0.4	0.1281
Per- and Polyfluoroalkyl ether carboxylic acid (PFECA)								
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	2	1	0.3205	0.4	0.2	0.0417
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	2	1	0.2962	0.4	0.2	0.0382
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	4	2	0.8906	0.8	0.4	0.1001
Nofluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	2	1	0.4918	0.4	0.2	0.0597
4,8-dioxa-3H-perfluorononoic acid	ADONA	919005-14-4	4	2	0.5716	0.8	0.4	0.0991
Ether sulfonic acids								
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7	2	1	0.4772	0.4	0.2	0.048
9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1	4	2	0.7343	0.8	0.4	0.0814
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9	4	2	0.9354	0.8	0.4	0.1136
Fluorotelomer carboxylic acid (FTCA)								
2H,2H,3H,3H-Perfluorohexanoic acid (3:3 FTCA)	3:3 FTCA	356-02-5	5	3	1.4817	1	0.5	0.2091
2H,2H,3H,3H-Perfluorooctanoic acid (5:3 FTCA)	5:3 FTCA	914637-49-3	25	8	1.8805	5	2.5	1.114
2H,2H,3H,3H-Perfluorodecanoic acid (7:3 FTCA)	7:3 FTCA	812-70-4	25	10	2.5639	5	2.5	0.998

Phoenix Environmental Laboratories, Inc.

Quality Manual

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Controlled Copy on Ivory Paper

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1.0 Quality Manual Identification Form

Document Title:	Quality Manual Phoenix Environmental Laboratories, Inc.
Document Control Number:	21-0128-1
Organization Title:	Phoenix Environmental Laboratories, Inc.
Address:	587 Middle Turnpike East Manchester, CT 06040
Responsible Official:	Phyllis Shiller
Title:	Laboratory Director
Phone:	(860) 645-1102
Quality Assurance Officer:	Kathleen Cressia
Title:	Director of Quality Assurance
Phone:	(860) 645-1102

Manual Coverage: Environmental Laboratories Including:

- Project Planning and Control
- Glassware Preparation and Laboratory Supplies
- Sample Receipt and Control
- Sample Extraction and Preparation Laboratory
- Inorganic Laboratory
- GC/MS Laboratory
- GC Laboratory
- Data Entry and Report Preparation
- Data Technical Review
- Customer Inquiry
- Quality Assurance

Concurrences

(1) Name: Kathleen Cressia
Title: Quality Assurance Officer

Signature: Kathleen Cressia

Date: 01/28/21

(2) Name: Phyllis Shiller
Title: Laboratory Director

Signature: Phyllis Shiller

Date: 01/28/21

2.0 Introduction

Phoenix Environmental Laboratories, Incorporated is committed to providing the highest quality laboratory services and data available. All laboratory analyses are performed in full compliance within applicable State, or Federal Quality Control guidelines. The Quality Assurance (QA) program and Quality Control (QC) procedures are defined by the Quality Manual and the Laboratory Standard Operating Procedure (SOP) Manual. The QA program meets or exceeds EPA recommended guidelines with quality control samples accounting for at least 20% of the total number of samples analyzed. Data from the analysis of these samples can be used to update control limits, or in the case of projects with defined control limits, the data serves to demonstrate the overall lab performance. Data which exceed control limits are considered suspicious and shall initiate specific actions as defined in this Manual and the SOP Manual. The Quality Assurance Office ensures that facilities, equipment, personnel, methods, records, and Quality Control procedures are in conformance with Phoenix Environmental Standard Operating Procedures (SOPs) as well as with applicable EPA Quality Control guidelines.

Each laboratory project is monitored through application of a QA/QC program, which includes the following elements:

- Centralized Project files
- Written Standard Operating Procedures
- Rigorous Chain-of-Custody procedures
- Documentation of nonconformance events and corrective actions taken
- Quality Control of data is assessed by analysis of reference samples, spiked samples, duplicates and surrogate spikes
- Periodic inspections of projects in progress
- Frequent equipment calibration and maintenance inspections
- Archiving of project records under controlled access

3.0 Quality Assurance Policy Statement

Statement of Authority and Responsibility

This document is the Quality Assurance Manual for Phoenix Environmental Laboratories, Incorporated. This Manual describes the activities necessary to meet or exceed the data quality objectives of Phoenix Environmental Laboratories, Inc.'s clients.

The management of Phoenix Environmental Laboratories, Incorporated is dedicated to the quality assurance program described in this Manual, and procedures as defined in the SOP manual. Each Director, and Supervisor as well as their staff members, as assigned in accordance with this Manual, are obligated to comply with its stated requirements, responsibilities, and objectives.

The Quality Assurance Program shall be maintained and expanded or modified as necessary to ensure all reportable data are of uncompromising quality.

The Quality Assurance Officer is responsible for the contents of the Manual and is committed to assuring that the stated requirements are met.

Kathleen Cressia
Kathleen Cressia
Quality Assurance Officer

01/28/21
Date

Phyllis Shiller
Phyllis Shiller
Laboratory Director

01/28/21
Date

4.0 Quality Assurance Management

4.1 Introduction

The management of the Quality Assurance Unit at Phoenix Environmental Laboratories, Incorporated is headed by the Director of Quality Assurance. The Quality Assurance Unit is independent of the data generating and Project Management groups and reports directly to the Board of Directors of the Company through the General Manager.

4.2 Assignment of Responsibilities

The Quality Assurance Office operates independently of the data generating areas for which they have quality assurance oversight. The Quality Assurance Director reports directly to the Corporate Management.

The goal of the Quality Assurance Program is to assure that data generated by Phoenix Environmental Laboratories, Incorporated is of the highest quality available. To reach this goal the program seeks to develop policies and procedures to monitor, maintain and improve data quality, and maintain the necessary documentation of laboratory performance. A listing of Quality Assurance personnel responsibilities is detailed below.

Director of Quality Assurance

The Director of Quality Assurance has the responsibility for the development and administration of the Quality Assurance Program. This effort is supported by the Laboratory Director and Assistant Laboratory Director.

Additionally, the Director of Quality Assurance's duties include:

- Preparation of written documents defining Quality Assurance and Quality Control Procedures.
- Maintaining current knowledge of approved methods and other regulatory requirements.
- Serving as a liaison to regulatory agencies in Quality Assurance matters.
- Reviewing Nonconformance Reports and corrective actions to assure that operations have been appropriately corrected.
- Employee training in Quality Control procedures and Quality Assurance practices.
- Preparation of reports of lab inspections and data reviews for the QA office and the Laboratory Director.

- Reviewing and approving performance evaluation sample results prior to submission to regulatory agencies.
- Assistance in preparation, review and approval of SOPs.
- Maintaining copies of all current procedures.
- Scheduling and performance of quality audits.
- Performance of inspections of lab operations and records to assess compliance with SOPs and contract requirements.
- Informing management of the status of the Quality Assurance Program.
- Continually assessing the Quality Assurance Program

.

The Director of Quality Assurance has the final authority to stop or change any incorrect or improper sampling or analytical procedure to assure data quality.

Quality Assurance Specialists

In addition to the Director of Quality Assurance, the Quality Assurance Office consists of technical specialists who have the responsibility and authority to monitor all phases of laboratory operations. Their functions include:

- Preparing and submitting blind QC check samples to the lab and evaluating lab performance.
- Reviewing the outcome of QC samples on a routine basis to assure that control limits are being met and internal SOPs for control chart analyses are followed.
- Immediately notifying the QA office of nonconformance events.
- Ensuring that all standards are traceable to NBS or EPA provided materials.

Quality Control Staff

An analytical quality control program is conducted to ensure the production of valid data. The QA office supervises the analytical Quality Control Program and interacts with the project staff in determining corrective action procedures. Duties of the Quality Control Staff include:

- Maintenance quality control charts for each area of the laboratory.
- Preparation of current tabular results of control charts.
- Posting of these control chart tables at each instrument and/or bench.

Laboratory Management

The laboratory management has the responsibility for directing that the laboratory sections follow the Quality Assurance Program. This obligation is met through the following steps:

- Recruiting, hiring, and training of suitably qualified personnel.
- Allocation of sufficient resources including staff, time, materials and equipment to complete required tasks.
- Integration of Quality Control measures into the Job Descriptions of laboratory personnel so that each employee is responsible for the quality of the work they produce.
- Effective response to corrective action requirements identified by the Quality Assurance Office.
- Assignment of Standard Operating Procedure development as required by Quality Assurance.
- Review and approval of SOPs.
- Evaluation of the lab performance of policies outlined in this manual including the ethics policy, the conflict of interest policy, and the client confidentiality policy. Review of the labworks audit trail is one of the mechanisms to these evaluate these policies.

Laboratory Section Supervisors

Laboratory Section Supervisors are an integral part of the implementation of the Quality Assurance Program. Each Supervisor is responsible for the quality of the data generated by their group. All activities performed in the lab section must comply with the internal Standard Operating Procedures and individual contract requirements. It is the responsibility of the Section Supervisor to train analytical personnel, prepare and update SOPs for each operation, and instruct analysts to perform QC checks at the appropriate intervals. The Section Supervisor reviews data and assures that all QC criteria for each data set have been met before releasing results for reporting. Additionally, it is the responsibility of the Section Supervisor to document nonconformance events and corrective action taken.

Chemists and Lab Technicians

It is the responsibility of the individual analysts to follow the appropriate methods, documenting their activities and results concisely, and implementing the QC checks as required by the contract and/or the Standard Operating Procedures. The analysts are expected to produce data of measurable quality and, therefore, must evaluate the outcome of QC samples as part of the regular analytical procedure. Individual analysts, as the first line of quality control, must identify quality problems and initiate a Nonconformance Report.

Coverage during Absence

In the absence of the QA Director, the QA specialists with assistance from the Lab Director cover the duties of the QA Director. In the absence of the Lab Director, the Assistant Laboratory Director with assistance from the QA Director covers the duties of the Lab Director.

4.3 Communications

The Quality Assurance Office communicates with other laboratory sections in two predominant methods, by regular staff meetings and by memorandum or report.

Management Meetings are held regularly between the Laboratory Directors, Project Managers, Laboratory Management, and the Director of Quality Assurance. In addition to production planning, marketing efforts, and laboratory management issues, Quality Assurance concerns are discussed. This forum provides immediate access to responsible individuals for the resolution of Quality Assurance concerns. Decisions made are documented in memoranda following the meeting.

Reports are issued to document findings of audits, inspections, and data reviews performed by the Quality Assurance Office. Findings and recommendations are documented in a report issued by Quality Assurance. Reports are issued to supervisors responsible for the work reviewed, and to management. The Supervisor responds to each of the findings and documents corrective actions. The report is then circulated to management for review. Quality Assurance verifies that corrective actions have been implemented and then files the report in Quality Assurance Office files.

Memoranda are generally issued to communicate results of Performance Testing (P.T.) studies or interlaboratory studies, to document problems brought to the attention of Quality Assurance, and as a form of written communication to keep laboratory staff and management informed of activities related to Quality Assurance.

In addition, reports are issued to the President and Laboratory Section Supervisors/Directors to summarize activities of the Quality Assurance Office. Quality Assurance Audit Reports and Corrective Action Reports are other forms of written communication between laboratory staff, management and the Quality Assurance Office.

4.4 Document Control

Quality Assurance Reports are maintained in locked file cabinets which are separate from other study records. Quality Assurance records are often direct and forthright in addressing problems and to allow these records to become public knowledge would hinder the performance of the Quality Assurance Office. Thus, these records are considered most confidential and are not available for inspection by persons outside the company.

Procedures described in Section 1.4.1 of the Quality Assurance Handbook for Air Pollution Measurement Systems. Volume I (EPA-600/9-76-005) and Chapter 3 of the Manual for the Certification of Laboratories Analyzing Drinking Water 5th edition, January 2005 are used in the publication of this Quality Manual and the laboratory's Standard Operating Procedure Manual.

Original copies of Standard Operating Procedure documents are maintained in the Quality Assurance Office. All SOPs are available to all employees in PDF format in the Phoenix LIMS system. SOP distribution lists are maintained by the Quality Assurance Office for those departments that also keep a hard copy SOP Manual.

Document control of this Quality Assurance Manual is basically the same as that described for the SOP documentation described above. A current and historical file system, distribution list, and limited copies of the document are used in the production of the Quality Manual to maintain its integrity. The Quality Manual is printed on Ivory paper and the current version is always available in electronic format in the LIMS system for all employees.

4.5 Quality Assurance Program Assessment

The Director of Quality Assurance and the staff of the Quality Assurance Office conduct periodic assessments of the total Quality Assurance Program. Based upon these assessments, and an annual review of the Quality Manual, an annual status report of Quality Assurance activities and progress is presented during the annual management review meeting. This report is used to define areas of focus for the coming year and will determine changes required in the Quality Manual. This report shall include such information as:

A. Status of or changes to the Quality Manual.

B. Status of Quality Assurance Project Plans (QAPjP), if any.

C. Measures of Data Quality.

D. Significant Quality Assurance problems, accomplishments, and recommendations.

E. Results of Performance Audits.

F. Results of Systems Audits.

G. Status of Quality Assurance requirements for contracts.

H. Summary of Quality Assurance Training.

5.0 Personnel Qualifications

5.1 Introduction

Phoenix Environmental Laboratories has over 50 employees within the Laboratory with the scientific and technical expertise needed to serve the analytical needs of our clients. These employees have been chosen based upon their education, training and experience to ensure that Phoenix Environmental Laboratories Incorporated can perform their assigned tasks and successfully follow their chosen career paths.

Phoenix Environmental Laboratories, Incorporated provides its employees with opportunities for continuing education and training so that our employees may grow with the company. The benefits of supplying continuing education, training, and on the job experience are not only for the individual employee. The company benefits also, since it profits by the stability of the work force and internal promotion of its employees. Finally, the benefits to the clients are that they may have confidence in the precise and accurate performance of contracted analyses.

5.2 Qualifications

Phoenix Environmental Laboratories, Incorporated has minimum education and experience qualifications for all job categories within the laboratory. In-house training programs and policies augment these basic education and experience requirements by supplying additional information about technical subjects, safety, corporate policy, quality assurance, ethics, and supervisory and managerial techniques.

For each position, critical educational requirements, specialized training requirements, and experience have been identified. Documentation of personnel qualifications training, and experience is accomplished through the use of an Employee Training and Experience Record system. The Employee Training and Experience Files are maintained and reviewed by the Quality Assurance Office. The files contain Training forms, Job Description forms, Capability forms, and any Training and Experience Update forms that may be necessary. Additional items which may be included are copies of company resumes, copies of training certificates, or professional certifications, and any other documentation of training or educational course work.

Personnel resumes are attached as Appendix A: Resumes of Laboratory Personnel. A Laboratory Organizational Chart is attached as Appendix C.

5.3 Training

New employees are trained on a one-on-one basis with their supervisor or assigned individual. Training is initiated by discussion of applicable SOP and method documents for a particular analysis. The procedures are then demonstrated by the trainer, to be repeated by the new employee, on a set of trial samples. Results of the trainee's analysis, and an appraisal of techniques used are reviewed by the trainer. Successful results and suitable techniques are to be the basis for the qualification of an analyst in a particular procedure. Failure in either of these areas must result in additional one-on-one training. Until the trainer is convinced of the ability of the new employee, and the new employee has completed an acceptable demonstration of capabilities, the new employee may not perform analysis on client supplied samples.

After initial training, an employee's performance is monitored by their supervisor for compliance with quality, production and safety goals.

Documentation of employee training procedures is accomplished through the Employees Training and Experience files as described in Section 5.2. These training records are maintained by the Quality Assurance Office. Additionally, training is routinely performed upon the introduction of new instruments into the laboratory. Generally, these courses are provided by the instrument manufacturer who issues training certificates upon successful completion of the course. Copies of such certificates are to be placed in the employees' qualifications file.

Training is also presented in the form of seminars given to explain new methods, techniques, and procedures. These courses generally are given by senior level personnel for the benefit of those with less experience. These courses are also documented and included in the employees' qualification files.

Each employee is trained under the Federal Right-to-Know statute. We believe that employees well trained in safety issues, working in a safe environment produce a better quality product.

5.4 Data Integrity/Ethics Policy

Phoenix Environmental Laboratories, Inc. is committed to maintaining high ethical standards. This is accomplished by promoting a highly trained and motivated staff. All personnel are urged to discuss any problem or uncertainty that may have an effect on data quality. All personnel can report data integrity issues to management, confidentially and outside of the chain of command, without concern of exposure. As part of the training process, each employee is educated in the ethical and legal aspects of the analysis performed and should be confident about their responsibility for ensuring data integrity and ethical conduct in the workplace. Employees complete Ethics & Data Integrity Training annually.

Compromising standards for any purpose is unacceptable at Phoenix Labs. Any employee found to misrepresent analytical data would be disciplined up to termination. If merited, outside authorities would be notified, which could lead to civil or criminal prosecution.

Data integrity is defined as a state that exists when information is predictably related to its source and has been processed in an authorized manner.

Any data manipulation to misrepresent quality control will be considered fraud by Phoenix Environmental and will result in immediate employee dismissal.

The following practices are not tolerated by Phoenix and will result in termination:

- Time travel (reporting the analysis date incorrectly to meet the sample holding time),
- Manual integration of chromatography (not following accepted criteria) for the sole purpose of meeting QC criteria,
- Modifying a reported method without permission of the client to cut costs, save time, etc.,
- Using white out or obliterating data (The only approved method for an analyst to correct data is single line cross out with initials and date),
- Falsifying data.

5.5 CONFLICT OF INTEREST POLICY

Phoenix Environmental Laboratories, Inc. ensures that its personnel are free from any commercial, financial, and other undue pressures which may adversely affect the quality of their work; by emphasizing that potential conflicts of interest can occur.

The company has a stringent policy not to profit from any potential conflict. All personnel are urged to notify management of any known or suspected conflict. All potential conflicts are completely divulged to clients and regulatory authorities.

6.0 Facilities, Equipment and Services

6.1 Introduction

Phoenix Environmental Laboratories, Incorporated is located in Manchester Connecticut, east of Hartford CT. The facility encompasses approximately 10,000 square feet, which includes the laboratories, data processing, copy areas, and administrative offices. All entrances to the facility are locked and alarmed after hours. Supplemental security is provided by a contracted security service. Members of the staff escort visitors while in the facility.

Laboratory Safety is a important aspect of Phoenix Environmental Laboratory. The Phoenix Safety Manual is located in the general area along side the chemical MSDS volumes. The Safety program at Phoenix includes:

The role of the safety committee
The chemical hygiene Plan
The Right to Know SOP
The Hazardous Chemical Handling SOP
The Emergency Evacuation Plan
Safety Equipment Procedures

The entire facility is provided with a sprinkler system for fire protection. Additionally, there are fire extinguishers throughout the building and emergency showers, fire blankets, and eyewash stations in the laboratories.

The laboratory has a full complement of instrumentation and support equipment such as fume hoods, refrigerators, freezers, ovens, a deionized and reverse osmosis water systems, etc.

All instruments are maintained by trained employees, and by manufacturer service personnel, in some cases working under service contract for critical equipment. Instrument logbooks are maintained for each individual instrument in each of the laboratories.

A complete listing of instrumentation and equipment may be found in the Laboratory Capabilities Statement (Appendix B).

6.2 Laboratory Facilities

The analytical laboratories adjoin the administrative offices in order to provide close interaction between management and the analytical staff. Figure 1 presents a floor plan of the facility, Laboratory environmental aspects that could affect the quality of data generated are discussed below.

- **Environmental Control**

  The facility is divided into numerous laboratory and office areas each with its own requirements for airflow, exhaust, and equipment cooling. The entire facility is served by two large central HVAC units equipped with carbon filters to minimize contamination. These units are maintained by a local HVAC contractor by service agreement. Filters on the units are replaced on a quarterly basis to reduce dust and pollen infiltration into the facility. Temperature is maintained between 68" and 72" F to prevent temperature induced artifacts in the data obtained from the instrumentation. Laboratory hoods are required to have a face velocity of at least 100 linear feet per minute flow at all points across the hood face. Facility Maintenance is responsible for performing semi-annual compliance checks for all laboratory hoods. General housekeeping is provided by full-time in-house personnel. Wet mopping of all laboratory tile floors is performed regularly to provide for additional dust control. All labs and office areas are adequately lighted with fluorescent-type lighting. Emergency battery powered lighting is installed in all areas in the event of total power failure.

· **Electrical Power**

Power is supplied to the facility via underground cable by Northeast Utilities. Service capacity is 1000 amperes at 208 volts. Three-stage surge and spike suppression equipment is employed on instrumentation sensitive to this type of power problem.

· **Laboratory Utilities**

The laboratory benches are supplied with electrical power, compressed air, vacuum, hot and cold water, and deionized reagent water utilities, where needed. Compressed air and vacuum systems are maintained by the Facilities Maintenance. An electric water heater supplies hot water.

There is located within the laboratory a deionized water system. The system utilizes a filter unit, anion, cation and mixed bed ion-exchange resin tanks for deionization, along with activated carbon tanks for organic contamination removal. There is also a reverse osmosis system. These systems are maintained by their contractors. The laboratory water is checked monthly for bacteria, volatiles, metals, and other inorganics. The conductivity and pH of the laboratory water is checked daily with a calibrated conductivity/pH meter.

· **Laboratory Facility Safety Engineering**

Laboratory Safety is taken as a serious responsibility. To that end the laboratory has special solvent storage and waste storage areas.

- Solvent supplies are stored in a large flammable solvent storage locker. Bulk solvents are stored here while small quantities of solvents for immediate use are stored in flammable solvent lockers beneath the laboratory hoods. Corrosive liquids are stored separately in corrosive liquid storage lockers.

- Waste solvents are placed in waste solvent containers for transfer to 55-gallon DOT 17H closed head drums for the accumulation and storage of laboratory wastes prior to shipment. Waste samples are generally handled as labpacks and are sent to a licensed facility for incineration.

- The entire facility is provided with a sprinkler system for fire protection. The building is equipped with dry chemical, carbon dioxide, and Halon fire extinguishers strategically placed throughout the laboratory and office areas. All laboratories are equipped with eye wash stations and drench-type safety showers. Safety glasses are issued to each employee for use in the laboratory.

- **Laboratory Areas**

  - **Shipping and Receiving/Sample Control**

    The Shipping and Receiving/Sample Control area is located immediately adjacent to the Extractions and Preparations Laboratory. The Shipping and Receiving portion of the space encompasses approximately 140 square feet of floor space. The Sample Control area encompasses approximately 250 square feet in addition to the space taken by a large walk-in refrigerator used for the storage of environmental samples. Samples arriving are inspected and entered into the laboratory sample control system at the computer entry work station. Adequate bench space is provided for the unpacking and inspection of samples upon receipt at the laboratory.

- **Walk-in Refrigeration System**

A walk-in refrigeration system for the storage of environmental samples is located adjacent to the Sample Control area. The walk-in encompasses approximately 2500 cubic feet of storage space and the temperature is controlled to $4^{o}C \pm 2.0^{o}C$ with continuous temperature sampling and monitoring devices. The temperatures are taken every 30 seconds and automatically stored into the laboratory LIMS system. The unit is maintained by the Sample Control Supervisor to maintain strict controlled access and chain-of-custody at all times.

- **Volatile Freezer**

A temperature controlled freezer is located in the Organics Laboratory for storing EnCore and DI water preserved low level vials for Volatile analysis.

- **Extractions and Preparations Laboratory**

The Extractions and Preparations Laboratory has nearly 2500 square feet of floor space and is equipped with several large laboratory fume hoods, steam baths for Zymark apparatus, approximately 120 linear feet of bench space, and adequate storage cabinet space necessary to process thousands of samples per month. Additional equipment in the lab includes TCLP extraction equipment including zero headspace extractors (ZHEs), Continuous liquid-liquid extractors, Soxhlet extractors, block digestors, a vacuum system, a laboratory shaker, a six-horn sonicator, a chilled water source for use with reflux equipment, Accelerated Solvent Extractors (ASEs), and analytical balances.

- **Metals Analysis Laboratory**

The Metals Analysis Laboratory is over 1000 square feet in size. There is approximately 60 linear feet of open laboratory bench space for use in inorganic analysis. The room is equipped with special air extractors for the atomic absorption spectrophotometers and the ICPs located in the room.

The AA Spectrophotometers are Perkin-Elmer AA Analyst 600 Spectrophotometers with autosamplers and data systems which are used for Graphite Furnace Atomic Absorption (GFAA). A PSA Mercury Millennium System with a cold vapor detector is used for mercury analysis. Two Spectro Axial Simultaneous ICP with Autosamplers, are also used for metals analyses.

· **Inorganic Analysis Laboratory**

The Inorganic Analysis Laboratory is over 2000 square feet in size. There is approximately 200 linear feet of open laboratory bench space for use in inorganic analysis. Equipment includes a GE and an Elementar TOC analyzers with autosamplers, Lachat QuikChem autoanalyzers for automated spectrometry, Dionex 120 Ion Chromatographs, and a Man-Tec automated titration system. Additional equipment includes ovens, analytical balances, classical chemistry apparatuses, UV spectrophotometers, flash point apparatuses, and ion-selective electrode equipment.

· **Bacteriological Analysis Laboratory**

The Bacteriological Analysis Laboratory is over 250 square feet in size. There is approximately 30 linear feet of open laboratory bench space for use in analysis. Equipment includes four large BOD incubators, an autoclave, a long-wave ultraviolet visualization device, water baths, dry incubators and numerous pieces of miscellaneous equipment for the preparation and storage of sterile media and cultures.

- **Organic Analysis Laboratories**

The Organic Analysis Laboratories have over 2200 square feet of floor space dedicated to organic laboratory instrumentation plus a repair area of over 100 square feet used to make instrument repairs and store spare parts. All volatile analyses are segregated into one of the laboratories to prevent the possibility of solvent cross-contamination. This area also has positive airflow to prevent the influx of vapors. The general features of the organic laboratories include several small hoods for use when spiking standard materials into sample extracts and for the preparation of standards; refrigerators and freezers for the storage of samples and samples extracts, and for the storage of standard materials and solutions; ovens; a Hewlett Packard HPLC Chromatograph; Perkin Elmer and Agilent Gas Chromatographs (GCs) and accessory detectors, autosamplers, headspace samplers and data systems; Hewlett-Packard (Agilent) Gas Chromatograph/Mass Spectrometer (GC/MS) instruments.

Phoenix Environmental Floor Plan

6.3 Instrument Maintenance

In an effort to reduce unexpected instrument failure, ensure reliable and accurate data generation, and control the costs associated with, non-routine maintenance and down time the laboratory has implemented a preventative maintenance system. Routine preventative maintenance is performed as suggested by the manufacturer. When it is found that maintenance is required more often or that additional maintenance is required these procedures are added to the Standard Operating Procedure.

Each instrument has a maintenance logbook that describes the routine inspection, cleaning, maintenance, testing, calibration, and/or standardization. Written records are maintained to document all inspection, preventative and non- routine maintenance, test, calibration and/or standardization procedures. The records include date, description of activity and actual findings, the name of the person performing the operation and a statement as to whether the maintenance operations were routine or unscheduled. Non-routine repairs performed as a result of equipment malfunction are documented in the instrument logbook to show the nature of the problem, when the problem was discovered and remedial actions taken. Repairs made by the manufacturers instrument repair technicians are also documented and the service reports filed in the instrument logbook.

The Quality Assurance Office monitors equipment maintenance and calibration through inspections of instruments and logbooks. Deviations are communicated to the Section Director via memoranda or report. Service contracts have been obtained for most instrumentation identified as vital by management i.e., GC, GC/MS, AA (furnace) and ICP instrumentation. For other equipment, factory service can be arranged, on a time and materials basis, usually within 24 hours.

Preventative/Routine Maintenance Schedule for Organics:

Gas Chromatography

- ECD detector baked out at 450 degrees C for 12 hours quarterly or when mV reading exceeds 15.
- NPD detector bead changed quarterly or as needed.
- FID detector assembly cleaned with solvent quarterly or as needed.
- Injector septum replaced weekly or per every 250 injections.

- Injector liners inspected weekly and replaced as needed.

Gas Chromatography/Mass Spectometry- Volatiles
- Clean source quarterly or if method performance criteria fails.
- Change Tekmar 3000 concentrator trap monthly or as needed.
- Change Tekmar 3000 concentrator MCS loop every 2 months for drinking water, otherwise change quarterly or as needed.
- Replace soil purge needle on autosampler every 2 months.
- Bake Tekmar 3000 concentrator trap daily for 30 minutes.

Semivolatiles
- Clean source monthly or if method performance criteria fails.
- Change liner and clip column daily.

Preventative/Routine Maintenance for Inorganics:

Atomic Absorption Spectrophotometer
- Change graphite tubes weekly or as needed.
- Clean graphite tubes daily with methanol.
- Trim capillary tubing daily or as needed.
- Replace contact rings monthly or as needed.
- Replace lamps as needed.

ICP
- Check tubing daily and replace every 2 days.
- Clean torch daily.
- Check and clean nebulizer daily.
- Clean chilling water quarterly.
- Replace air filters quarterly or as needed.
- Preventative Maintenance yearly by manufacturer.

General Preventative/Routine Maintenance:
- Balances- Calibrate daily with class “s” weights. Reference weights are certified annually.
- Refrigerators/Freezers- Temperatures taken daily with calibrated thermometers. Thermometers are calibrated annually. Reference thermometers are certified every three years.

6.4 Laboratory Materials Procurement and Tracking

The LIMS system stores ordered reagents, standards, and supplies for tracking purposes. The standard certificate of Analysis (COA) are scanned and linked to each standard used. Dilutions of standards are also traced in the LIMS system from ordered "stock". The expiration dates of the stock as well as the prepared standard are tracked. The amount and identity of each stock as well as the final volume and concentration of the prepared standard is recorded electronically.

Each chemical purchased for laboratory use is ordered by specifying the grade required for the intended use. Persons who place the orders are not permitted to make any substitutions without authorization from the Section Director. This restriction is intended to avoid inadvertent purchase of materials of substandard quality. The grades typically used include the following:

Technical	used for cleaning or non-quantitative purposes.
Purified	used for some qualitative analytical work where purity is not critical and specific contamination is noted to be absent.
ACS Reagent	used for analytical work.
Spectrograde	used in IR, AA, and UV applications.
Pesticide Grade	used for pesticide determinations and other GC applications
Primary Standard	used for preparation of standards, calibration, quality control, and standardization.

Standards for organic compounds are typically obtained as concentrated solutions from a commercial source. Metals standards are obtained from commercial sources as 1,000 or 10,000 ppm certified solutions. Standard materials for inorganic parameters are typically primary standard grade, when available, or analytical grade. Independent quality control standards are obtained from commercial sources. Quality Control standards must not be from the same lot as materials used for calibration. Typically, different commercial sources are used.

All reagents, acids, solvents, standards and other chemicals are logged into the LIMS system upon receipt, making them available for tracking.

All stock, prepared standards, reagents, and prepared reagents have the vendor expiration date, the date opened, and the laboratory expiration (which is the earliest of either the vendor expiration or the expiration from date opened) defined in the LIMS setup for each department. All stock, prepared standards, reagents, and prepared reagents flag “red” when they are within 2 weeks of their expiration date. The lab analyst of record will then mark them “inactive” before the expiration date so they can be disposed of.

Solvents are stored in a large flammable storage locker in accordance with laboratory safety requirements. Individual bottles of solvents are kept in the flammable storage cabinets under the laboratory hoods. Acids are kept in a safety cabinet for corrosives and in corrosives storage cabinets under fume hoods. Dry chemicals are stored on designated shelves at ambient temperature. Organic compound standards are stored in several freezers or areas within refrigerators, which are dedicated to standards only. Standards for inorganic compound analysis are stored within a dedicated standard refrigerator and those for metals analysis are stored at room temperature in cabinets.

To control quality of purchased chemicals, the oldest supply is used before a new bottle is opened ("first in, first out"). Analysts are responsible for checking appearance of the chemical prior to use to assure that the physical state of the material is correct. Purity and stability of reagents are monitored by performing blank determinations and Quality Control samples along with analytical batches. Additionally, each manufacturer's lot of solvent is checked for potential contaminants by pre-screening the solvent through the appropriate method.

7.0 Data Generation

7.1 Standard Operating Procedures

Standard Operating Procedures (SOPs) are utilized by Phoenix Environmental Laboratories, Incorporated to define exact routines to be followed in each section. There are SOP documents covering all aspects of the laboratory operation, from sample receipt and analytical methodology through data review and archiving. The entire SOP Manual is available for review during client visits.

Each SOP document is individually reviewed and approved. A Document Control System has been designed for SOP documentation and a historical file is maintained. SOPs are identified by a SOP numbering and revision identification system administered by Quality Assurance. Once approved by signature, an effective date is assigned to the document. Distribution of new SOP documents and retirement of old documents is the responsibility of the Quality Assurance Office. Obsolete documents are maintained in a historical file where they are marked obsolete and the date of replacement noted. Standard Operating Procedure documents are reviewed at least annually to determine if updating is required.

SOP documents may be initiated by any staff member. The proposed document is submitted to the Quality Assurance Office, which, after review, circulates the draft document to lab management for comments. The draft document and management comments are returned to the originator for resolution. The revised document is then circulated by the Quality Assurance Office for approval signatures. Each SOP must be signed by the originator, as well as the Section Supervisor, QA Officer or Director.

All SOP documents are scanned and available to all employees in electronic format in the LIMS system. Original SOP Manuals are controlled by the QA department.

The Quality Assurance Office has a critical role in the establishment and maintenance of the SOP documentation program. The Quality Assurance Office prepares or assists others in the preparation of many SOP documents. The Quality Assurance Office is responsible for the circulation and review of draft SOPs, for maintenance of the SOP document control system, including the historical file, and electronic versions in the LIMS.

All laboratory employees are responsible for reading, understanding and following SOPs particular to their job function. To document this, employees are required to sign a SOP Review Sheet, which states that they have read and understand SOPs particular to their job function. These forms are kept in the original SOP manuals, maintained by the Quality Assurance Office.

Appendix D of this document contains the Table of Contents of the SOP manual.

7.2 Sample Chain-of-Custody

All incoming samples are delivered to the Sample Control office for inspection, log-in, and storage. Immediately upon receipt, the sample set is unpacked and checked versus the chain-of-custody sheet. It is the responsibility of the Sample Coordinator to sign for laboratory custody upon receipt.

The Sample Control inspection of the samples include the following checks:

- Custody seal status
- Sample container integrity
- Holding temperature at time of receipt
- Type of container (plastic or glass)
- Addition of preservation to sample if chemical preservation is required
- Volume of sample
- Sample identity and collection information

The Sample Acceptance Policy details the procedures for inspection of samples upon receipt and the EPA requirements concerning sample preservation and holding times. The client is notified if the samples do not meet the guidelines for sample identification, holding time or preservation. Procedures utilized in the logging of samples are detailed in a separate SOP document.

The result of the incoming sample inspection is noted on the Chain of Custody Form. The temperature of samples and coolant information is also noted on the chain of custody. The pH of preserved containers is recorded in the electronic Sample Preservation record.

Samples are assigned a unique, sequential number during the logging process. Individual sample labels are generated for each sample that reflects the Phoenix sample number. Reporting requirements and criteria should also be recorded on the Chain of Custody by the client and they are logged in accordingly.

The samples are stored in secure sample storage areas by Sample Control. Distribution of samples within the laboratory is monitored by the LIMS. Each analyst logs start time and end time with every use of the sample or sample extract.

Commercial samples are kept for at least 30 days from the time the samples are received. After 30 days the samples are disposed of unless otherwise specified by the client. Extracts of samples submitted for organic analysis will be retained for a period of 30 to 90 days after data submission.

7.3 Sample Management

Phoenix Environmental Laboratories, Inc. uses five techniques as part of its complete sample management program:

- Computerized sample login including printing of Sample Receipts for verification of analyses requested.
- Database printouts of assignments and work backlogs.
- Centralized LIMS input or data transfer of all analytical results and comments regarding any problems encountered during analysis.
- Validation and generation of the final analytical report for transmission to the client in either hard copy or electronic form.
- Archiving of all reports and raw analytical results on a hard disk for storage and potential future retrieval if required.

In section 7.2 of the Quality Manual, the Chain of Custody (COC) Form was discussed as the location where results of the incoming sample inspection are recorded. After this step, a copy of the chain of custody and any field paperwork or client paperwork, which arrived with samples, is sent to the Client Services group. Client Services compares the information submitted with that in its own files to assure that the sample set agrees with work arranged via previous communication. Client Services then records the test codes required for each sample if not previously established. Special instructions to the lab regarding report due date, sample preparation, QC requirements, criteria and reporting requirements or special handling required are also recorded by Client Services.

Sample Control enters the client information, sample identification and test codes into the database. Each set of samples, which are received from a client at the same time, is assigned to a ***Login Group.***

After log-in on the Phoenix Laboratory Information Management System (LIMS), ***Sample Receipt Forms*** are generated from the database. These receipts are checked against the original chain of custody for accuracy.

Departmental, work assignment sheets (backlog reports) are generated by the Section Managers. The LIMS system has been programmed to create a separate backlog for each department or analysis. The backlog contains essential information such as Sample Identification, test required, collection date to comply with EPA holding times, and date results are due to the client.

Each supervisor is responsible for assigning analytical batches for processing by analysis. The analyst then creates a batch, or a listing of samples to be analyzed. The Phoenix LIMS generates batches by holding time and due date, and includes the quality control samples and any special sample instructions. As each test is completed, the majority by data transfer, the LIMS database is updated to close out the test.

The data is then validated and cross-checked for accuracy and conformance with parameter limits, history, and inter-parameter correlations. The final analytical report is then generated for review by the project manager, along with the quality assurance department or Laboratory Directors before transmittal to the client. Preliminary results (before final data validation and review) may be sent to the client as a Sample Progress Report. This preliminary report clearly indicates that the data is of a preliminary nature and subject to review and revision.

After the final data report is submitted to the client in electronic or hard copy form, the final report and raw analytical data is archived on a hard disk for storage and potential future review. See Section 8.3 of this Manual for storage information.

7.4 Additional Procedural and Calibration Requirements to Achieve Quality Assurance Objectives

7.4.1 Organics

Sample Preparation

A minimum of three surrogate standards is added to each organic sample requiring GC/MS analysis for volatile and acid and base neutral extractables. For pesticide analysis, two surrogates are added and for herbicide analysis, one surrogate is added. These surrogate compounds are quantitatively analyzed in the GC/MS or GC phase. Historical records, in the form of laboratory control charts, are maintained on the percent recovery of surrogate compounds for each sample. These records form the statistical basis upon which preparation techniques are monitored. Surrogate recoveries must meet acceptance criteria before the analytical data will be released. All sample preparation methods with analysis dates are reported to the client on the final report. In some instances, the sample matrix may produce interferences that adversely affect recoveries. These interferences must be confirmed by a repreparation and reanalysis of the samples. Affected data are qualified in the report.

A method blank per matrix is prepared at a frequency of at least one for every twenty samples processed for each analysis requested or daily, whichever is greater. The purpose of the method blank is to ensure that contaminants are not introduced by the glassware, reagents, personnel, and sample preparation or sample analysis environment.

Standards

Calibration standards are traceable to the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS). Commercial sources of standards and reagents are checked for purity against a second source standard.

All standards prepared for use throughout the organic laboratory are assigned a unique identification number. The standard number is entered into the LIMS system with all information regarding the preparation of that standard, i.e., date, technician, name and lot number of each compound and amount used, final volume, expiration date and solvent used. All stock standard containers are labeled with the standard's identification number and name, lot number, code, manufacturer, date prepared and expiration date.

The instrument response obtained for each compound in a newly prepared standard is compared to the response obtained from the previous standard. The two standards must agree within $\pm$ 15% for all but a few compounds recognized as being chromatographably atypical or the new standard may not be used until the discrepancy has been resolved.

Gas Chromatography/Mass Spectrometer (GC/MS)

The Gas Chromatograph/Mass Spectrometer analyses are an integral part of the analytical services provided by Phoenix Environmental Laboratories Incorporated. The analyses involve very sophisticated instrumentation, which is operated by a highly trained staff. To assure that the results are of the highest quality, a rigorous program of calibration and quality assurance has been established.

Prior to the utilization of the instrumentation, the instrument performance is adjusted to assure that all manufacturer and method's performance criteria are met. The instrument's performance is monitored, recorded and when appropriate charted in control charts. The instrument is continually monitored and is adjusted on an as-needed basis (specified in the Standard Operating Procedures).

Tuning

On a daily basis, the mass spectrometer is adjusted to meet the method defined tune criteria, using FC-43. Bromofluorobenzene (BFB) or Decafluorotriphenylphosphine (DFTPP) is then used to confirm that the instrument meets these criteria. The BFB ion abundance criteria are outlined within the particular methods and must be satisfied for all volatile organic analyses. The DFTPP ion abundance criteria are outlined within the applicable methods and must be satisfied for all semi-volatile organic analyses. After the tuning criteria are confirmed, the instrument is calibrated for the analyses of interest.

Calibration

The analytical procedure followed for analyses of both volatile and semivolatile organic compounds involves an initial calibration of the instrument. The SOP of each analytical method details the criteria of the calibration curve. This calibration is performed using multiple concentrations of standards. The validity of the calibration is then confirmed using an NIST traceable standard mix containing known concentrations of each analyte. On a daily basis, the instrument calibration is confirmed to be unchanged by analysis of a single standard. The SOP of each analytical method details the criteria of the calibration curve.

Blanks

After calibration, a method blank is analyzed to demonstrate that the system is free of any of the analytes of interest. The method blank consists of organic free water for volatile analyses and an extraction blank for semi-volatile analyses. After demonstration that the system is free of contamination, sample analyses are begun. Maximum allowable levels of contamination are up to the method detection limit for most organic compounds and up to 10X the Contract Required Detection Limit (CRDL) for common laboratory contaminants as defined in the EPA Statement of Work.

Gas Chromatography (GC)

Pesticide, Herbicide and Polychlorinated Biphenyl (PCB) analyses are performed using a gas chromatograph equipped with the appropriate detectors. These analyses often are performed on complex matrices that require an experienced staff for the interpretation of the results. The analysts also must determine the clean-up requirements needed for each individual sample.

Prior to all analyses, the elution time and elution order for each analyte of interest is determined. They are determined by analyses of several standards over a seventy-two (72) hour period. These analyses also define the retention time window. This window is calculated by multiplying the standard deviation of the retention times by a factor of three (3).

Calibration

The instrument is calibrated by analysis of a standard mixture that contains the analytes of interest. The number of standards and their concentration are method specific, but all assure an accurate determination of the concentration of an analyte in the sample. The instrument's sensitivity is adjusted so that all standards are integratable and are also within the instruments linear response range. On a daily basis, and after every twenty samples, the instrument calibration is confirmed to be unchanged by analysis of a single standard. The SOP of each analytical method details the criteria of the calibration curve and the continuing calibration check samples.

Blanks

After calibration, a method blank is analyzed to demonstrate that the system is free of any of the analytes of interest. The method blank consists of an extraction blank for pesticide, herbicide and PCB analyses. After demonstration that the system is free of contamination, sample analyses are begun.

7.4.2 Metals

The analyses performed on the ICP, GFAA and AAS instrumentation are an extremely important part of the analytical services provided by Phoenix Environmental Laboratories, Incorporated. The analyses involve very sophisticated instrumentation, which is operated by a highly trained staff. To assure that the results from this phase of the operation are of the highest quality, a rigorous program of calibration and quality assurance has been established.

Prior to the utilization of the instrumentation, the instrument performance is adjusted to assure that all manufacturer's and accrediting body's performance criteria are met. The instrument's performance is monitored, recorded and when appropriate charted in control charts (specified in the Standard Operating Procedures).

Standards

Calibration standards are traceable to the National Institute of Standards and Technology. Commercial sources of standards and reagents are checked for purity against a second source standard. All standards prepared for use throughout the laboratory are assigned a unique identification number. The standard number is entered in the LIMS system with all information regarding the preparation of that standard, i.e., date, technician, name and lot number of each compound and amount used, final volume, and concentration of acid in the diluent used. All stock standard containers are labeled with the standard's identification number and name, date prepared and expiration date.

Calibration of GFAA, AAS and ICP Systems

Instruments are calibrated each time an analytical run of less than twelve hours is set up. Calibration standards are prepared by diluting the stock metal solutions at the time of analysis. Source identification and analysis date are recorded on the analysts run log cover sheet, which is attached to the analytical data and stored electronically.

The calibration standards are be prepared using the same type of acid or combination of acids as in the sample extracts. Calibration standards are prepared fresh daily for cold vapor and furnace methods. Calibration standards are prepared at least weekly for ICP methods. The calibration curve consists of a blank and at least three calibration standards in the appropriate range

Quality Control Requirements

The quality control program within the metals department consists of analysis and evaluation of various samples. Each QC sample analyzed reflects the conditions of analysis of all associated analytical samples. The duration of analysis, rinses and other related operations that may affect the QC measured result may not be applied to the QC to a greater extent than the extent applied to the associated analytical samples. For instance, the difference in time between a CV analysis and the blank immediately following it as well as the difference in time between the CV and the analytical sample immediately preceding it may not exceed the lowest difference in time between any two consecutive analytical samples associated with the CV. The requirements of each are detailed in the standard operating procedure (SOP).

Calibration Verification Standard

Immediately after calibration and every ten samples, a standard at the midpoint range of the calibration is analyzed and evaluated for each analyte. When measurements exceed the control limits criteria, the analysis for that analyte is terminated. Samples are accepted only when bracketed by acceptable CV standards.

Calibration Blank Standard

After each CV standard, a standard blank is analyzed and evaluated. The purpose of the calibration blank is to determine the effect of instrument drift at the level near the reporting limit.

Laboratory Control Standard (LCS)

After calibration, a LCS standard is analyzed and evaluated for each analyte. The LCS is a certified solution provided by a source independent from the calibration standards. Sample analytes are accepted only when the LCS meets the acceptance criteria.

Fortified Blank/Blank Spike/Preparation LCS

Aqueous and solid Laboratory Control Samples (LCS) are analyzed for each analyte using the same sample preparations and analytical methods as the samples being analyzed. The aqueous LCS solution is obtained by spiking a preparation blank with a spiking solution prepared by the metals department from certified materials. One LCS is prepared and analyzed for every batch samples digested. The control limits are defined by internal control charts or by method SOP. If any analyte exceeds criteria, the analysis will be terminated, the problem corrected and the samples associated with that LCS re-digested and re-analyzed.

Preparation Blank

At least one matrix matched preparation blank to be processed through each sample preparation and analysis procedure must be prepared and analyzed with every sample batch. This blank is reported for each sample batch, if required, and used in all analyses to ascertain whether sample concentrations reflect contamination in the following manner,

A If the absolute value of the concentration of the blank is less than or equal to the method requirements (see individual SOP), no contamination of the sample results is suspected.

B If any analyte concentration in the blank is above the method requirements, the lowest concentration of that analyte in the associated samples must be 10x the blank concentration. Otherwise, all samples associated with that blank must be redigested and reanalyzed for that analyte. The sample concentration is not to be corrected for the blank value.

Interference Check Sample

An Interference Check Sample (ICSAB) is analyzed daily to verify the accuracy of the inter-element corrections. The control limits for this sample are 80-120% of true value.

Spike Sample Analysis

The spike sample analysis is designed to provide information about the effect of the sample matrix on the digestion and measurement methodology. The spike is added before the digestion steps. At least one spike sample analysis is performed on each group of samples of a similar matrix type (i.e., water, soil) or for each sample batch.

If the spike analysis is performed on the same sample that is chosen for the duplicate sample analysis, spike calculations are performed using the results of the sample designated as the "original sample". The average of the duplicate results cannot be used for the purpose of determining percent recovery. Samples identified as field blanks should not be used for spiked sample analysis. The same spiking solution is used for the matrix spike as the blank spike. If two analytical methods are used to obtain the reported values for the same element within a Sample Batch (i.e., ICP, GFAA), spike samples must be run by each method used.

The spike recovery is reported in the Quality Control Sample Section of the LIMS. This sample can be included in the client report if required. In-house limits are produced from control charts.

For ASP-like analyses, if the spike recovery is not at or within the limits of 75-125%, the data of all samples received associated with that spike sample and determined by the same analytical method shall be noted in the report. An exception to this rule is granted in situations where the sample concentration exceeds the spike concentration by a factor of four or more. In such an event, the data shall be reported unflagged even if the percent recovery does not meet the 75-125% recovery criteria.

Duplicate Sample Analysis

One duplicate sample is analyzed from each group of samples of a similar matrix type (i.e., water, soil) or for each sample batch.

Samples identified as field blanks should not be used for duplicate sample analysis. If two analytical methods are used to obtain the reported value for the same element for a Sample Batch (i.e., ICP, GFAA), duplicate samples must be run by each method used.

The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{S-D}{(S + D)/2} \times 100$$

Where, RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

The RPD is reported in the Quality Control Sample Section of the LIMS. This sample can be included in the client report if required.

Instrument Detection Limit Determination (for ASP-like analyses)

The instrument detection limits in *ug*/L shall be determined for each instrument used at a frequency of at least annually, and must meet the method requirements.

The Instrument Detection Limits (in *ug*/L) shall be determined by multiplying by 3 the average of the standard deviations obtained on three non-consecutive days from the analysis of a standard solution (each analyte in reagent water) at a concentration 3x-5x the instrument manufacturer's suggested IDL, with seven consecutive measurements per day. Each measurement must be performed as though it were a separate analytical sample (i.e., each measurement must be followed by a rinse and/or any other procedure normally performed between the analysis of separate samples). IDL's must be determined and reported for each wavelength used in the analysis of the samples.

The most recently determined IDL for an instrument are used as the IDL for that instrument. If the instrument is adjusted in any way that may affect the IDL, the IDL for that instrument must be redetermined and the results submitted for use as the established IDL for that instrument. Instrument detection limits are retained and are available for inspection.

Demonstration of Capability/Performance

Method Detection limits are determined for each instrument for each analyte at least annually following the procedure described in 40 CFR 136 Appendix B.

Linearity of calibration is determined by evaluation of the calibration curve. The correlation coefficient must be 0.9975 or greater. The highest standard must agree within 5% of the true value.

Quality control samples from a source different than the calibration standards are used to verify the calibration standards.

Accuracy and Precision Studies are performed at least yearly where required. Four standards at or near the mid-point of the working range are analyzed and evaluated.

7.4.3 Classical Chemistry

The analyses performed by the classical chemistry department are an extremely important part of the analytical services provided by Phoenix Environmental Laboratories, Incorporated. The analyses, which are performed by a highly trained staff, are the most varied in the laboratory. To assure that the results from this phase of the operation are of the highest quality, a rigorous program of calibration and quality assurance has been established

Standards

Calibration standards are traceable to the National Institute of Standards and Technology. Commercial sources of standards and reagents are checked for purity against a second source standard. All standards prepared are assigned a unique identification number. The standard number is entered into the LIMS system or a bound Standards Notebook with all information regarding the preparation of that standard, i.e., date, technician, name of each compound and amount used, final volume, and expiration date. All stock standard containers are labeled with the standard's identification number, lot number and name, date prepared and expiration date.

Demonstration of Capability/Performance

Method Detection limits are determined for each instrument for each analyte at least annually following the procedure described in 40 CFR 136 Appendix B.

Accuracy and Precision Studies are performed at least yearly where required. Four standards at or near the mid-point of the working range are analyzed and evaluated.

Laboratory Control Standard (LCS)

A LCS is analyzed and evaluated for each batch of samples. The LCS is obtained from certified source independent from the calibration standards. The acceptance criteria are determined by in house control charts. The LCS is reported in the LIMS and is available for the client report if required.

Preparation Blank

A preparation blank, consisting of deionized distilled water processed through each sample preparation and analysis procedure is prepared and analyzed with every sample batch. This blank is reported for each sample batch, if required, and used in all analyses to ascertain whether sample concentrations reflect contamination.

Spike Sample Analysis

The spike sample analysis is designed to provide information about the effect of the sample matrix on the distillation/digestion and measurement methodology. The spike is added before the digestion or distillation steps. At least one spike sample analysis is performed on each group of samples of a similar matrix type (i.e., water, soil) or for each sample batch.

If the spike analysis is performed on the same sample that is chosen for the duplicate sample analysis, spike calculations must be performed using the results of the sample designated as the "original sample". The average of the duplicate results cannot be used for the purpose of determining percent recovery.

The spike recovery is reported in the Quality Control Sample Section of the LIMS. This sample can be included in the client report.

Duplicate Sample Analysis

One duplicate sample is analyzed from each group of samples of a similar matrix type (i.e., water, soil) or for each sample batch.

Samples identified as field blanks should not be used for duplicate sample analysis.

The relative percent differences (RPD) for each component are calculated as follows:

$$RPD = \frac{S-D}{(S + D)/2} \times 100$$

Where, RPD = Relative Percent Difference
S = First Sample Value (original)
D = Second Sample Value (duplicate)

The RPD is reported in the Quality Control Sample Section of the LIMS. This sample can be included in the client report if required.

7.4.4 Bacteria Department

The bacteria department analyzes samples for the presence of coliform (total, fecal and e.coli), Fecal Streptococcus, and Enterococcus. In addition, a Heterotrophic plate count provides an enumeration of all forms of bacteria. These analyses are an important part of the analytical services provided by Phoenix Environmental Laboratories Incorporated. These analyses are performed by a highly trained staff utilizing a rigorous quality assurance program.

Preparation of Culture Media

The culture media used at Phoenix are either prepared from dehydrated material or purchased ready to use. Preparation of media is recorded in the electronic Media Prep Log, and media are given a batch number for each time it is prepared. Prepared media is recorded in the Bacteria Chemicals Receipt Logbook and in the Media Preparation Logbook.

Negative and Positive Control

Coliform Analysis

Coliform bacteria are Gram negative, non-spore-forming rod-shaped bacteria that ferment glucose at 35^{o}C. Each batch and lot of media is then tested to verify amenability to Coliform growth and inability to grow other bacteria. The Gram positive bacterium (P.aeroginosa) is used as the negative control, as it will not grow on coliform media. Two species of coliform bacteria are used to verify amenability (positive control) to the media: K.pneumonea, and E.coli.

Fecal Coliform Analysis
Fecal coliforms are bacteria that fulfil the definition of a Coliform, yet are able to sustain growth at elevated temperatures (thermo-tolerant coliforms). E.coli are fecal coliforms, and are used as the positive control test organism for the culture media. Klebsiella variicola, not considered a fecal coliform because it is absent in the lower digestive tract of mammals, but a thermo-tolerant strain is also used as a positive control. Enterobacter aerogenes is used as the negative control for the culture media.

E. Coli Analysis
E.coli is a fecal coliform that is determined biochemically, rather than by increasing the temperature. K.pneumonea is used as the negative control, and E.coli is used as the positive control when testing the culture media.

Heterotrophic Plate Count Analysis
Heterotrophic Plate Counts (Standard Plate Counts) are the enumeration of all forms of bacteria. Unlike the culture medium for Coliforms (which has a Gram Positive inhibitor), the Standard Plate Count culture medium will allow growth of many kinds of organisms. S.aureus is used as a positive control to verify the lack of inhibition present in the media.

Enterococcus Analysis
Enterococci are a sub-group of fecal streptococci. The most common bacterium in this group is Enterococcus Faecalis, which is used as a positive control. E.coli and Streptococcus bovis are used as the negative controls.

Blanks

Aliquots of sterile buffered water are run at the beginning and end of each batch of membrane filtration. They are incubated as samples, and are checked for growth. The blanks demonstrate the sterility of the glassware used throughout the filtration process. The initial blank demonstrates that the glassware was clean when the batch was begun, and the final blank demonstrates that the glassware was clean when the batch was completed. Batches of greater than 10 samples require blanks that are performed mid-way. When the blanks come back with no growth, it can be assumed that the cleaning between sample filtration was sufficient to remove residue from the previous samples. If any of the blanks come back with growth, this assumption does not hold, and all of the results must be thrown out.
Blanks for methods that do not involve membrane filtration (like multiple tube fermentation, and sample plating) require only one blank, done at the end of the batch of samples. For these methods, it is necessary to demonstrate the sterility of the work area at the time of the testing. If the final blank is shown to have no growth, then it can be assumed that the work area was sterile at the end of the batch and therefore was sterile throughout the run. If the final blank comes back with growth, this assumption does not hold, and the results must be thrown out.

General Equipment

Incubators and waterbaths are monitored to ensure they maintain constant temperatures within the acceptable guidelines. The sterilization apparatus is tested routinely, with a heat resistant strain of spore, to ensure proper sterilization.

7.5 Determination of Detection and Quantitation Limits

Two types of detection limits are routinely determined at Phoenix Environmental Laboratories, Incorporated; the Method Detection Limit study and the Limit of Detection and Quantitation verification study. A Method Detection Limit (MDL) is the minimum concentration that can be measured with 99 percent confidence that the analyte is greater than zero. The MDL's are determined from analysis of spiked blank waters and soils. The Limit of Detection (LOD) is the laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect. The Limit of Quantitation (LOQ) is the minimum levels, concentrations, or quantities of a target analyte that can be reliably quantitated.

Method Detection Limits are measured for all tests employed at Phoenix Environmental Laboratories, Incorporated. The procedure is defined in 40 CFR Part 136, Appendix B (Federal Register, revision 3, October 2020). The procedure is outlined below:

a) An estimate of the detection limit is made.

b) A minimum of seven replicates of blank water or soil are spiked at a level 2 to 5 times the estimated detection limit or three times the standard deviation of a set of method blanks.

c) The spiked samples are processed through every step of the analytical method, and for ongoing MDL studies, two are analyzed each quarter.

d) The standard deviation for the seven samples is multiplied by 3.143 (students t value at 99% confidence at N-l degrees of freedom) to obtain the MDL.

e) A minimum of seven method blanks must be calculated annually using the same procedure.

The Practical Quantitation Limit (PQL) is the lowest calibration standard calculated using sample preparation conditions and the percent solids. The MDL study verifies the capability of the laboratory to detect the compounds at the practical quantitation limit.

7.6 Determination of inter-element correction factors

Inter-element corrections are applied by the manufacturer's software and are established when the instrument method is setup. On a daily basis, the background points are assessed for correctness.

7.7 Table of Methods

Wet Chemistry	
Acidity	SM2310B
Alkalinity	SM2320B
Ammonia/TKN	EPA 350.1/351.1
BOD/cBOD	SM5210B
Bromide	EPA300.0 SW9056
Chloride	SM4500CL E EPA300.0 SW9056
Chlorine	SM4500CL G
Chlorine Demand	SM2350B
COD	SM5220 D
Color	SM2120 B
Conductivity	SM2510 B
Cyanide	EPA335.4 SM4500CN SW9010/9012
DO electrode	SM4500 O G
Flashpoint	SW1010
Fluoride	EPA300.0
Hardness by Calculation	EPA200.7
Hexavalent Chromium soil	SW3060A
Hexavalent Chromium water	SM3500Cr B
Surfactants (MBAS)	SM5540 C
Nitrate	SM353.2 EPA300.0 SW9056
Nitrite	EPA353.2 EPA300.0 SW9056
Odor	SM2150 B
Oil & Grease	EPA1664 / SW9071B

Table of Methods (cont.)

Paint Filter Liquid Test	SW9095
pH and Corrosivity	SM4500H B SW9040/SW9045
Phenols	EPA420.4/SW9066
Phosphorus	SM4500P E
Reactivity	SW7.3
Salinity	SM2520B
SPLP Extraction	SW1312
Solids, Dissolved	SM2540 C
Solids, Fixed & Volatile	SM2540E
Solids, Suspended	SM2540 D
Solids, Total	SM2540 B
Sulfate	SM4500D EPA300.0/SW9056
Sulfide, Total	SW9030A
Sulfite	EPA377.1
TCLP Extraction	SW1311
TKN block digestion	EPA.351.2
TOC soil (sm)	SW9060 / L.Kahn
TOC water (wm)	SM5310B
Turbidity (NTU)	SM2130 B
Bacteria	
E. coli MF	SM9222G
Enterococcus	Enterolert
Fecal coliform MF	SM9222D
Fecal Streptococcus MF	SM9230C
Heterotrophic Plate Count	SM9215B
Total coliform DW	SM9223B
Total coliform MF	SM9222B
Total coliform/E.Coli MPN	SM9223B
Fecal coliform MPN	Colilert18 MPN
Metals	
Mercury by Cold Vapor	EPA245.1 SW7470 SW7471

Metals (continued)	
Metals by GFAA	EPA 200.9, SM 3113 SW 7000 series
Metals by ICP	EPA 200.7/200.8 EPA 200.5 SW 6010/6020
Organic Instrumentation	
EDB, DBCP, 123TCP	EPA 504.1
Carbamates	EPA 531.2
Glyphosate	EPA 547
Diquat, Paraquat	EPA 549.2
Extractable Total Petroleum HC	CTETPH
PCB	EPA 608.3 SW 8082
PCB congeners	SW 8082
Pesticide (NPD)	EPA 525.3 SW 8141
Pesticide (ECD)	EPA 525.3 EPA 608.3 SW 8081
Haloacetic Acids	EPA 552.2
Herbicide	EPA 515.3 SW 8151
VOA by GC/MS	EPA 524.1 EPA 624.1 SW 8260
SVOA by GC/MS	EPA 525.3 EPA 625.1 SW 8270
1,4-Dioxane	EPA 522 SW 8270SIM
PCB in air	EPA TO-10
Volatiles in air	EPA TO-14 EPA TO-15 NJ LL TO-15

EPA: "Methods for chemical Analysis of Water and Wastes", EPA, Environmental Monitoring Systems Laboratory –Cincinnati (EMSL-CI), EPA-600/4-79-020, 1983
40CFR Part 136. Revised July 1, 1998.
"Method for the determination of Organic Compounds in Drinking Water", EPA, Office of Research and development – Washington, EPA/600/4-88/039.
SM: "Standard Methods for the Examination of Water and Wastewater", American Public Health Association.
SW: "Test Methods for Evaluating Solid Waste", EPA SW-846 Third Edition 1986

8.0 Data Processing

8.1 Collection

Accuracy and completeness of data records are essential in maintaining the quality of laboratory results. Ink is used for all entries. All entries are signed and dated. Corrections are made with a single line through the error, a description of the reason for the change, initials, and date.

Data records are maintained for all transfers and processing of each sample from the time the sample is received until the results are reported and the sample is disposed of. The records kept for receipt, log-in, and sample custody have been discussed in Sections 7.3 and 7.4. Preparation of standard solutions is documented in the LIMS. Each stock material and solution is assigned a number, and referenced in the preparation log electronically. Prepared organic solution numbers are recorded on the analysis data sheets. In metals analysis, most solutions are prepared fresh daily and the source and identification information is recorded on the data sheets. The electronic standard solution preparation log contains entries regarding the source material, which includes:

- Compound name
- Purity
- Manufacturer and lot number
- Date received
- Concentration, if in solution form
- Solvent, when appropriate
- Date consumed or disposed of
- Expiration date
- Solution identification number

The solution preparation is documented by the following information:

- Compound identification
- Source material (by number)
- Assigned solution number
- Date prepared
- Quantity weighed out or measured by volume
- Final volume after preparation
- Solvent used
- Final concentration
- Expiration date
- Date disposed of

Data for inorganic (nonmetal) analyses are recorded in bound notebooks or LIMS batching logs assigned to each test. The required information for each analysis includes, but is not limited to: the analytical procedure; any procedure changes required; sample number; raw analytical data; standard solutions used; preparation of reagents when appropriate; signature and date. If an instrument printout is obtained for the analyses, the printouts are signed, dated and retained. The printout is inserted in the notebook if size permits. Otherwise the printout is filed in a separate file with a cross-reference recorded in the lab notebook and on the printout.

For metals analysis, a digestion log is maintained in the LIMS batching program. The digestion is documented by record of internal sample number, Client ID, analysis required or method quantity and identity of spiking solution used, initial sample volume final sample volume, initials of technician and date.

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Printouts of results are obtained for graphite furnace, and cold vapor analysis. A Run log cover page is prepared to reference the analysis date, instrument identification, Sample ID, concentration corrected final results (for Cold Vapor), identity of QC or spiked samples, percent recovery obtained, and any comments. This run log is attached the instrument's data system printout. Each data set is filed in the metals department. All ICP analytical information and results are stored in the LIMS database.

Data for organic extractions are recorded in the LIMS batching program. All details regarding the extraction are recorded. The data includes the following entries: extraction method; sample matrix, extraction date; surrogate spiking solution number and concentration; matrix spiking solution numbers and concentration; Sample identification number; sample amount; quantity of surrogate and matrix spike added; final extract volume; extract storage location and signature of chemist.

Analytical data from the GC and GC/MS instruments is generated by the computer data system. Data outputs include identification of the sample, identifications of compounds retention times, and comparisons to standards. Outputs are in tabular form (retention times, areas, mass listings, etc.) and in graphic form (chromatograms, TICs, etc.). Outputs are in a standard format specified for each analysis type. Data produced are compared to information concerning the sample history, sample preservation, QC Data, etc., to judge the validity of the results.

8.2 Data Review and Validation

Phoenix Environmental Laboratories, Incorporated performs data review and validation studies on all data packages generated. Data validation is the process whereby data are accepted or rejected based upon defined criteria. Information concerning the sample history, sample preparation, Quality Control data and other factors are used in the judgement of the validity of the results. A Quality Control Audit Report is generated daily and reviewed by the Laboratory Director, Quality Control Officer and Supervisors. This computerized report compares data against current Quality Control limits, historical data information, and client specified permit exceedences among other parameters. Quality Control information is judged against set criteria to accept or reject data. Criteria used to accept or reject data are dependent upon the methodology, the client's requirements, and the eventual use of the data. All quality control parameters including method blanks, surrogate spikes, matrix spikes and duplicates, sample duplicates, laboratory control samples (QCs), field blanks, trip blanks and storage blanks must meet acceptance criteria. Where applicable, sample flags or qualifier codes shall be used to qualify data. Either the supervisor or a second analyst of equal or higher experience and responsibility reviews data. This review ensures that the following requirements have been appropriately met:

Organic Section

The analyst and Supervisor review data to ensure the laboratory provides the following where appropriate:

- Calculates the recoveries of surrogate spikes and verifies that criteria are not exceeded:
- Verifies that there are no contaminants in associated blanks outside acceptable limits;
- Compares samples and duplicates for precision in data results;

- Reviews surrogate and spike recovery data to make sure they are within quality acceptance limits;
- Verifies calibration performance for acceptability;
- Reviews and verifies instrument tuning; and
- Reviews internal standard areas of response for acceptability.
- For GC analysis, the compounds identified fell within the daily retention time window. (The daily retention time window is defined as the absolute retention time of a mid-level standard + 3 standard deviations. The standard deviation is obtained from an initial check of 3 injections of standards within a 72-hour period.)

Upon meeting all technical criteria the sample data file is then reviewed by the Organic Team Leader to:

- Verify that holding time criteria have been met;
- Ensure surrogate recovery section has been completed and acceptance limits are not exceeded;
- Ensure that all analyte compounds have been properly recorded;
- Ensure accuracy of calculations on compound quantities; and
- Ensure confirmation by GC/MS has been performed and spectra are included.

The reviewer examines the entire sample data file to ensure that all data transcription and documentation included meet customer requirements. The Organic Team Leader performs a final technical review to verify that the completed package conforms to all Quality Control criteria.

Upon completion of review, the sample data files are forwarded to the Project Manager for final review and compilation of the entire data package.

All Other Sections

- Verify that holding time criteria have been met;
- Calibration met or exceeded a correlation coefficient of 0.9975.
- Standards in the calibration curve cover the expected concentration ranges of the samples including the detection limit. All sample results fell within the range of the standard curve.
- Initial and continuing calibration verification checks met the acceptance criteria defined in the method SOP.
- Method blanks were processed with each analytical batch and were acceptable.
- Results of duplicate samples and matrix spike duplicates were within the laboratory or contract-established precision control limits.
- Matrix spike recovery was within acceptable control limits (as defined by internal control charts).
- Laboratory control samples were analyzed according to frequency specified in the SOP or contract and the results obtained were within control limits.
- Calculations have been accurately performed.
- Data for the analyses provide a complete audit trail. Data notebooks and data sheets correctly reference the analytical method, the standard solutions used, internal numbers, original data values, sample results in correct units, calculation formula for all conversions, signature of the analyst, and date. Instrument printouts must identify the person responsible for the data generation and the date of the run.

The supervisor or other data reviewer signs the data sheet to document approval. If the complete review was performed by someone other than the supervisor, a spot check is performed by the supervisor. The supervisor checks a minimum of 10% of the data. No data may be reported without supervisor approval evidenced by signature on the data page. The Laboratory Director performs a final technical review to verify that the completed package conforms to all Quality Control criteria.

The reviewed data is entered or data transferred into the LIMS by either the analyst or the supervisor. For ASP-like deliverables, a tabulation of results is prepared by the supervisor or analyst and placed in the central project file. The tabulation is transcribed into the report format by assigned report writers. The report and complete project file go to the Section Manager for final check.

The Laboratory Director's review covers the following points:

- Transcriptions are checked for accuracy and use of appropriate units.
- QC data are reviewed to assure that internal specification and contract requirements have been met.
- Nonconformance reports, if any, are reviewed for completion of corrective action and impact upon results. Information contained in the nonconformance report may need to be included in the project narrative.
- Results make sense compared to historical information about the site and results for other parameters tested at the same time.

Upon completion of review, the reports are forwarded to the Project Manager for final review and compilation of the entire data package. A copy of the signed report package is retained in the project file for archiving.

8.3 Report Information and Storage

Laboratory reports shall include:

- A cover page, which lists the states in which current certification are held, along with the laboratory identification number for that state.
- The results of specific analysis of samples with corresponding surrogate recoveries, where applicable, date and time of analysis, and analytical methods used.
- The results of batch or site specific quality control associated with specific samples and analysis, which includes blanks, laboratory control samples, matrix duplicates and matrix spikes.
- The Chain of Custody and any correspondence regarding the samples received on Chain of Custody.
- Parameters where certification is not available or not held in a certain state and/or by NELAC will be notated on the report.
- Samples that represent potable water are reported with their corresponding state or Federal Maximum Contaminant Levels (MCL). Clients are notified of MCL exceedance within 24 hours of the lab obtaining valid data. Sub-contract laboratories are notified of this requirement in writing, when utilized.
- Samples that are subcontracted are clearly marked as such, and the subcontract labs certification number is noted on the report.

Data notebooks, instrument printouts, sample chain-of-custody logs, files, and contracts are retained for a period of 12 years. If contract requirements deviate from this procedure, the contract-specified holding time is followed.

Equipment usage and calibration logs that are not study-specific are kept for a minimum of 12 years. Original SOPs, current and outdated, are permanently archived.

Most of the laboratory operations are part of the LIMS system; the prep, distillation, and analytical runs are stored electronically. These analyses are transferred from these electronic files into the result tables of the LIMS system. Once all the results are entered, the final data report is generated, reviewed and released to the client through the laboratory website. All versions of the final report and any electronic deliverables are stored on the client server drive (Y). All of these electronic drives containing all of the files are backed-up nightly and stored on ioSafe disaster proof external hard drives. Once per week an encrypted copy is taken offsite and stored in a remote safe.

For the few analyses and operations that are not yet stored electronically, hard copy logbooks and hard copy printouts of raw analytical data or supporting documents are archived by instrument, analysis or department and stored in a secure offsite facility. The facility can only be accessed by PEL employees that have signed an access log, which is kept in the control of the Operations Manager. A description of what is being retrieved from the storage area is recorded. The employee is then responsible for returning the data and signing that is has been returned.

Should the laboratory change ownership or go out of business, records will still be retained for the period of time specified above.

8.4 Transcription

Transcription is a potential source of error. The majority of data reporting is electronic, which involves transferring reviewed data directly from the instrumentation into the LIMS system. Report generation is also done electronically, keeping transcriptions to a minimum.

8.5 Data Reduction

Data reduction includes all processes that change either the form of expression or quantity of data values. The size or dimensionality of the data set is reduced.

To validate all reduction operations, all calculations or manipulations of data are recorded in the data. A description of the formula used must be provided.

Phoenix Environmental Laboratories, Incorporated uses computers, computer data systems, and microprocessor controlled instrumentation to reduce raw data to final form, such as:

- HP Environquant GC & GC/MS Data processing system (includes EPA/NIST Mass Spectral Database)
- Perkin Elmer Turbochrom 4 Data system operating on personal computers
- Perkin Elmer AA Analyst 600 & WinLab Data system
- PSA Millennium Mercury Avalon Data System
- Spectro ICP Micro Evolution and Smart Analyzer Data Systems
- HP Chem Station GC/MS Data System
- Perkin Elmer Syngistix ICP MS Software
- IC Peak Net Data System

Calculation of results is performed by these systems based on standard curve responses and is printed with each sample response and/or summarized in tabular form at the end of each analysis set.

When data calculations using linear regression are performed with calculators, the correlation coefficient, slope, and y-intercept values are recorded in the data.

The procedure for correct use of significant figures and rounding of numbers is defined in a SOP. The rounding rules cited in the USEPA Handbook of Analytical Quality Control in Water and Waste Water Laboratories are followed for all manual rounding of numbers.

9.0 Data Quality Assessment

9.1 Introduction - Definition of Terms

Accuracy

Accuracy is defined as the degree of agreement of a measurement, X with an accepted true value, T. Two types of accuracy check samples are used, Laboratory Control Samples (Blank Spike) and the Matrix Spike. The formula used to calculate accuracy for the Laboratory Control Sample is:

Accuracy = (A/B) X 100

Where A = Concentration measured
and B = Concentration spiked

which is the same formula as is used for percent recovery. For calculating accuracy in Matrix Spike analysis, a correction for background concentration found in the unspiked sample must be made. The formula is:

Accuracy = ((A- B)/C) X 100

Where A = Spiked Concentration Measured
B = Unspiked Concentration Measured
and C = Concentration Spiked

Precision

Precision is a measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Analysis precision is assessed through comparison of duplicate samples or duplicate matrix spike samples.

The term expressing precision is Relative Percent Difference (RPD) and is calculated as follows:

$$RPD = ((A_1 - A_2)/((A_1 + A_2)/ 2))X\ 100$$

Where $A_1 = Rep_1$
and $A_2 = Rep_2$

where Rep_1 and Rep_2 are replicate analyses of the same sample. and,

$$RPD =(\ (\ MS- MSD\ )\ /((MS + MSD)/ 2))X\ 100$$

Where MS = the Matrix Spike sample result
and MSD = the Matrix Spike Duplicate Result

where the Matrix Spike and Matrix Spike Duplicate analyses are performed upon the same sample.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental or process condition.

Field sampling operations have a major impact on data representativeness. Factors including site selection, sampling tools, equipment cleaning procedures, sample preservation, and many others must be considered. Similarly, laboratory operations could impact representativeness if there were day-to-day fluctuations. Accuracy and precision results of the daily quality control samples provide a measure of representativeness associated with laboratory operations.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under correct normal conditions. To maximize completeness of laboratory analysis, it is essential to have a sufficient quantity of each sample to provide for original and repeat analyses should the original analysis fail to meet acceptance criteria. Our goal for completeness is 100%.

Comparability

Comparability expresses the confidence with which one data set can be compared with another. This indicator of quality is enhanced at Phoenix Environmental Laboratories, Incorporated by the following controls:

- Standardized EPA approved methodology for sample preservation, holding and analysis.
- Consistent reporting units for each parameter in similar matrices.
- NIST traceable standards when available.
- Frequent analysis of QC samples.
- Participation in interlaboratory performance evaluation studies.

9.2 Methods for Attaining Quality Control Requirements

Quality Control Samples

Data quality is evaluated by the performance of Quality Control (QC) sample analysis, including:

- Method Blanks
- Surrogate Spikes
- Matrix Spikes and Duplicates
- Sample Duplicate Analysis
- Laboratory Control Samples (LCS) and Laboratory Control Sample Duplicates
- Calibration Check Samples
- Field Blank Samples
- Trip Blank Samples
- Storage Blank Samples

The particular types and frequency of QC samples processed with production samples are determined by the requirements of the client. Most common needs are those presented in the various EPA Methods, EPA SW-846, New York Analytical Services Protocol (ASP), state requirements, project requirements, customer requirements, and those requirements specified in our SOPs.

Information obtained from the above listed Quality Control samples is used to assess the quality of the data generated and is useful in identifying problems in the sampling process, in the shipment of samples, in the storage of samples, in the analysis of samples and even help in identifying problems in the analysis of the samples caused by the samples themselves. Specifically:

Method Blanks

A method blank is defined as a volume of deionized laboratory water, or in some cases a purified solid matrix carried through the entire analytical process. Data obtained from these samples indicate possible contamination in the samples picked up during the analytical process.

Surrogate Spikes

Samples are spiked with a surrogate to monitor the preparation and analysis processes of the samples. If the surrogate material(s) are not recovered in sufficient quantity from the sample the preparation and/or analysis of the sample is suspect. In the processes that surrogates are used, they are spiked into all samples including blanks. Data from the analysis of surrogates is used to construct control charts. Tables containing the in house control limits are updated by the Quality Assurance department regularly and are located at the bench for the analyst's use.

Matrix Spikes and Matrix Spike Duplicates

Matrix Spike and Matrix Spike Duplicate analysis are performed to evaluate the effect of the sample matrix upon the methodology and the precision of the method with the particular matrix. If Matrix spike compounds are not adequately recovered or vary in recovery between duplicates some measure of matrix interference is suspected. Data from the analysis of matrix spikes is used to construct control charts. Tables containing the in house control limits are updated by the Quality Assurance department regularly and are located at the bench for the analyst's use.

Sample Duplicate Analysis

Sample duplicate analysis is used to assess sample preparation and analytical method precision.

Laboratory Control Samples (LCS) and Laboratory Control Sample Duplicates (LCSD)

Laboratory Quality Control Samples are used to assess the laboratories ability to perform an analytical method and to what level of precision. Data from the analysis of the LCS/LCSD is used to construct control charts. Tables containing the in house control limits are updated by the Quality Assurance department regularly and are located at the bench for the analyst's use

Calibration Check Samples

A Calibration Check Sample is used as a method of determining the accuracy of an instrument's calibration. If the source of the material is the same as that used for the calibration, a second check sample is also analyzed which is from a second source and of known quality and concentration. Each procedure details the acceptance limits.

Field Blank Samples

Analysis of field blank samples can give some measure of information into the possibility of contamination of samples occurring in the field during the sampling process.

Trip Blank Samples

Trip blank sample analysis is used to determine if sample contamination may have occurred during transit of the samples.

Storage Blank (Refrigerator Blank) Samples

Storage blank (Refrigerator Blank) sample analysis is used to determine if sample contamination may have occurred during the storage of the samples once they reach our laboratory facility.

Blind Quality Control Samples

The Quality Assurance Office periodically formulates blind samples for submission to the laboratory for analysis. The samples are produced by the QA Office from standard materials or from EPA ampules. Sample sets usually contain blanks, and replicates of known concentration. Analysis of the data produced from these sample are used to assess quality of data produced by the laboratory, particularly laboratory precision and accuracy.

Proficiency Samples

The Quality Assurance Office oversees the laboratories participation in routine Proficiency Testing Studies throughout the year. All NELAC certified PT analytes are analyzed for each matrix and technology certified, twice a year. The laboratory also participates in the annual EPA DMR QA study, Bacteria proficiency studies, and additional studies for new or non-NELAC analytes. Proficiency samples are analyzed as regular field samples, and are integrated into the laboratory using chain of custodies and SDG numbers.

Quality Control Charts

The QC requirements for accuracy and precision are mandated by the method and of course the clients' needs and the regulatory authority under which the work is being performed. Control Charts allow the laboratory to establish in house limits based on historical data as recommended in the Federal Register. The quality assurance department continually updates control charts based on current data points. The mean value, the warning limits and the control limits are determined for each chart.

Warning and control limits are based upon the following formula:

Upper Control Limit (UCL) = X + 3s
Upper Warning Limit (UWL) = X + 2s
Lower Warning Limit (LWL) = X - 2s
Lower Control Limit (LCL) = X - 3s

Where:
X = Mean Percent Recovery
s = Standard Deviation

Client uncertainty data is calculated using the warning limits from our control charts.

All QC sample results are tabulated immediately following analysis and compared to the in-house limits, the contract-mandated, the method-mandated, or client project-mandated control limits for precision and accuracy. Out-of-control results are cause for immediate generation of a Nonconformance report as described in Section 9.5 and possible re-extraction and/or re-analysis.

An analysis may be considered out of control whenever, as a minimum, any one of the following conditions is demonstrated by a control chart used to monitor that analysis.

- Any one point is outside of the control limits.
- Any three consecutive points are outside the warning limits.
- Any eight consecutive points are on the same side of the plotted mean.
- Any six consecutive points are such that each point is larger (or smaller) than its immediate predecessor.
- Any obvious cyclic pattern is seen in the data points.

Policy

The management and staff of Phoenix Environmental Laboratories, Incorporated makes every effort to generate data of the highest quality possible and continues to apply state-of-the-art analytical methodologies to ensure that our data continues to be of the best quality available anywhere.

Phoenix Environmental Laboratories, Incorporated makes every attempt to produce and deliver analytical data which has been demonstrated to meet contract-, method-, or client-required quality control acceptance criteria. Should anomalies occur in the processing and/or analysis of samples, which affect that objective, they are documented in the data and/or described in the report narrative.

9.3 Data Quality Objectives and Analytical Data Quality Levels

In the planning of projects for the investigation of environmental contaminants, Data Quality Objectives (DQOs) are established. Data Quality Objectives are qualitative and quantitative statements which specify the quality of data required to support decisions during remedial response activities. DQOs are applicable to all data collection activities including those performed for preliminary assessments/site investigations, remedial investigations, feasibility studies, remedial design, and remedial actions.
The level of quality and detail will naturally vary depending upon the intended use of the data. Therefore, a number of data quality reporting levels are available.

Phoenix Standard Report

A standard report includes the Sample Chain of Custody, the analytical results for the required analytes, along with reporting units, date analyzed and analyst's initials. It also includes a Quality Control section where batch QC is reported for Blank analysis, Laboratory Control Samples, Sample Duplicates and Matrix Spikes. If certain criterion is requested, a Sample Criteria Exceedance Report is also generated.

Phoenix Standard Report with General, CT-RCP, and MA-MCP Narration

This is a standard report, as above, with a Laboratory Quality Assurance Quality Control Reasonable Confidence Protocol (RCP) Narration and Checklist for Connecticut samples or Quality Control Requirements and Performance Standards in Support of Response Actions under the Massachusetts Contingency Plan (MCP) Checklist and Narration for Massachusetts samples.

Enhanced Phoenix Report – Full Data Packages

The Full Data Packages include a Phoenix Standard Report with a full data summary, which includes the following:

ASP B and Army Corps Data Packages

Organics:

- Surrogate recovery summary
- QC recovery summary
- Analytical sequence summary
- Instrument tuning logs
- Internal standard and retention time summary
- Project sample, blank sample, and QC sample raw data
- Calibration data
- Injection logs

Inorganic:

- Project sample results
- Calibration results
- Blank results
- Interference checks
- QC results
- Laboratory duplicate results
- ICP serial dilution results
- Instrument run logs
- All applicable raw data

New Jersey Reduced Deliverables Data Package

Provides a Full Data Package as above, but does not include calibration raw data for organics or instrument run logs and raw data for inorganics.

10.0 Corrective Action

10. 1 Introduction

The Quality Assurance Office is responsible for conducting periodic inspections (audits) of the quality systems, data generation, and support systems of the laboratory. The purpose of the internal audit is to assist management in identifying and correcting deficiencies and to reinforce acceptable practices. This ensures that services meet the requirements of the Laboratory Quality Manual as well as the requirements of the client.

These inspections help to ensure that the policies of the laboratory for production of high quality data are being followed, including laboratory standard operating procedures, instrument procedures, sample preparation procedures and data review policies. If discrepancies are found, corrective action is taken. Two types of audits are in place: Systems and Performance Audits. Additionally, there are routine data audits, independent audits, and audits for subcontracted services.

10.2 System Audits

A Systems Audit is an inspection and review of an entire data-generation and support system. Quality-related activities are reviewed, assessed, and compared against the Quality Assurance Program requirements for compliance. The audit includes the evaluation of personnel, facilities, Standard Operating Procedures (SOPs), and records. Systems Audits generally follow performance audits (usually by state or EPA auditors, required for certification and contract awards), and may be instituted as part of corrective action monitoring programs.

Systems Audits may also focus on a single area or aspect of laboratory operations. These inspections may consist of an in-process inspection of a particular analytical procedure, review of raw data for compliance to SOPs, or an inspection of the laboratory facility. On a quarterly basis, in-depth monitoring of data integrity is also performed on a final report. Any of these audits may be performed at any time at the discretion of the Quality Assurance Manager. Management may also direct the initiation of an audit for cause.

Systems Audits are documented in the form of an Audit Report. The Audit Report describes any findings of the audit, recommendations to correct the finding and identifies the person or persons responsible for correction implementation. A two-column format is used for the Audit Report where the left column is used to document responses by the responsible parties. A copy of the Audit Report is maintained in a chronological file while the original document is circulated to the Laboratory Supervisor, Laboratory Manager and the Laboratory Director. Once circulation is completed and all items are responded to, the Audit Report is filed by Quality Assurance. Follow-up audits will be performed to verify correction implementation. Audit Reports are considered confidential documents and shall not be shown to or discussed with those outside the company without the express consent of the Director of Laboratories and the Quality Assurance Manager.

If deficiencies are observed during a performance audit, the Quality Assurance Manager evaluates the audit report and initiates a follow-up Systems Audit, with emphasis on actions necessary to correct the deficiencies. A Corrective Action Report is completed, detailing all remedial actions to be taken, and issued to the Director of Laboratories and the Laboratory Manager for approval. If corrective action cannot be taken immediately, the anticipated date of action is provided. Once approved, the report is forwarded to the performance auditing agency or client.

Many of the objectives of a routine Systems Audit are similar to those a client or independent auditor would hope to accomplish during an On-Site Laboratory Evaluation and Data Audit. These goals include ensuring that:

- Necessary quality control (including corrective action measurement) is being applied,
- Adequate facilities and equipment are available to perform the client's required scope-of-work,
- Personnel are qualified to perform the assigned tasks,
- Complete documentation is available, including sample Chain-of-Custody,
- Proper analytical methodology is being applied,
- Acceptable data handling techniques are being used,
- Corrective actions identified in any previous on-site visits have been implemented, and
- The Laboratory Management continues to demonstrate a commitment to quality.

These objectives may be documented by completing a Laboratory Evaluation Checklist. In response to performance audits, any corrective actions taken are noted with reference to the auditor's deficiency report and the Standard Operating Procedure. Should a quantitative or qualitative error be noted in a Data Audit, a blind Performance Evaluation (PE) sample may be entered into the system to test affected parameters. Additionally, Laboratory Proficiency Tests may be scheduled if method performance is in question. Specifics of these two programs are outlined in the following sections.

10.3 Performance Audits

A performance audit is a planned independent check of the operation of a measurement system to obtain a quantitative measure of the quality of the data generated. In practice, this involves analysis of standard reference samples or materials that are certified as to their chemical composition or physical characteristics.

The Quality Assurance Office prepares and submits performance testing (PT) samples to the laboratory periodically. The fact that the samples are PT samples is not revealed to analysts or supervisors. These blind samples provide a check on all operations performed in the lab, including bottle preparation, sample holding, extraction, analysis, data validation, and reporting. The blind PE samples are prepared from EPA reference materials. Findings reported by the laboratory are compiled into a summary report by the assigned QA Specialist and issued to the Director of Quality Assurance and Laboratory Directors. Unacceptable results require investigation by the Laboratory Director, documentation of corrective action by the Laboratory Director, and follow-up review by the Quality Assurance Office.

10.4 Audits of Subcontractors

Analysis performed by subcontractors must conform to Phoenix Environmental Laboratories' Quality Control requirements. Subcontractors must meet the requirements of the Phoenix Environmental Laboratories' Quality Assurance Program or have in place an equivalent program of their own. Potential subcontractors will be reviewed by the Phoenix Environmental Laboratories for suitability.

The Quality Assurance Office will evaluate the Quality Assurance Program of the subcontractor through review of the laboratory's written Quality Manual, the Quality Assurance Project Plan (where applicable), Quality Control SOPs, typical SOPs, and latest applicable USEPA Performance Evaluation or NELAC Performance Testing Study results. If the results are not available, Phoenix Environmental Laboratories may submit blind PE samples to the subcontractor. An on-site audit of the facility will be performed as deemed necessary by the Laboratory Director or Director of Quality Assurance.

10.5 Nonconformance Event Corrective Action and Documentation

Documentation of analytical problems and corrective action taken is an essential part of the data record. Identification, implementation, and monitoring for the actions that could have prevented the analytical problem provide a method for improving the quality of laboratory performance. A Nonconformance report sheet (Figure 1) has been designed to record problems, corrective actions, impact on analytical results, and suggested preventive actions for the future.

The Nonconformance Report must show complete background information about the event, including date and shift; analysis and phase; the client name; the sample identification number; and a description of the event that occurred. The report further includes the corrective action taken; indication of the status of the system; an assessment of impact on analytical results; and suggestions for preventive action.

The Nonconformance Report should be initiated by the person experiencing or noticing the discrepancy and completed by his or her supervisor. For example, the initiator may provide the description of the event and corrective action taken; the supervisor adds the impact and preventive action.

Copies of the completed reports should be distributed to the Project Manager, the Laboratory Section Director, and the Director of Quality Assurance. If the event has caused any impact on the analytical results, the Project Manager will meet with the Quality Assurance or Laboratory Director and then communicate with the client, either personally or through the Client Services group. If the impact on analytical results affects drinking water potability or MCL exceedances (such as bacteria, or nitrate/nitrite), the client will be notified immediately (within 24 hours). Client notification of other issues will be made in a reasonable time frame, and usually within three to five working days.

The Laboratory Director should check that corrective action has been appropriate, confirm analytical impact, and ensure the implementation and monitoring of preventive action.

The Director of Quality Assurance should review the Nonconformance Reports for follow-up action. On a regular basis, the Director of Quality Assurance will meet with Project Managers and Laboratory management to evaluate corrective action and preventive action effectiveness. All effective preventive action will be documented for all appropriate laboratory sections. Supervisors of each area will be responsible for any SOP revision needed to reflect these preventive actions.

Initial preventive action plans, which prove to be ineffective, will cause a team to be formed to identify the root cause of the problem and the effective preventive action. This team will be led by the supervisor of the area where the initial nonconformance occurred and at least one member of the Quality Assurance Unit and management. Progress of this team and monitoring of the effectiveness of preventive action will be documented by the team leader and by the Director of Quality Assurance.

Figure 1
Nonconformance Report

Document #:

Phoenix Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06040
Tel. (860) 645-1102 Fax (860) 645-0823

Date Closed:

Corrective / Preventive Action Log

BASIS:	DESCRIPTION:	METHOD:
☐ Audit ☐ Complaint ☐ PT Failure ☐ Deficiency ☐ QC Failure ☐ SOP Departure ☐ Prevention		

DATA:
Type:
Samples:

RECORDED BY: DATE:

ROOT CAUSE: / PURPOSE:

INVESTIGATED BY: DATE:

POTENTIAL CORRECTIVE / PREVENTIVE ACTIONS:

RECOMMENDED BY: DATE:

ACTIONS PERFORMED:

Disposition of Data:
☐ Reanalyzed
☐ Rejected
☐ Qualified
☐ Recalled

PERFORMED BY: DATE:

FOLLOW-UP ACTIVITIES:

ASSESSED BY: DATE:

Closed by
Date Closed:

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11.0 Client Complaint Policy

In order to best meet the needs of our clients, Phoenix Environmental Laboratories has implemented a procedure for the prompt handling of client complaints. The project manager summarizes the nature of the complaint in their logbook located in the Client Services Department.

If the complaint includes a request for re-analysis or re-evaluation of the data, the complaint and a printout of the error report is provided to the QA/QC department and to the section supervisor. This is recorded in the logbook. If a non-conformance event is uncovered as a result of the re-analysis or re-evaluation, a non-conformance or error report is generated.

Whether a non-conformance or error report is generated or not, the Client Services Department responds promptly (usually within 24hours) to the Client.

12.0 Client Confidentiality

Confidentiality is an important aspect of the service that Phoenix Environmental Laboratories provides our clients.

All material containing client's analytical results, project specific information, and invoice information is considered strictly confidential. Reports containing any of this information are provided only to the client or his/her designee as provided on the chain of custody.

Additional requests for information are provided only after verbal authorization by the client.

13.0 Implementation Requirement and Schedule

The Quality Assurance Manual shall become fully effective on the first day of October 1995. Any questions regarding implementation should be addressed to the Director of Quality Assurance or the Laboratory Director.

14.0 References

Regulations

40 CFR 136.3e	Required containers, preservation techniques, and holding times
40 CFR 136	Guidelines establishing test procedures for the analysis of pollutants under the Clean Water Act
40 CFR 136 Appendix A	Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater
40 CFR 136 Appendix B	Definition and Procedures for the Determination of the Method Detection Limit – Revision 3.0
40 CFR 136 Appendix C	Inductively Coupled Plasma - Atomic Emission Spectrophotometer Method for Trace Element Analysis of Water and Wastes Method 200.7
40 CFR 141	National Primary Drinking Water Regulations
40 CFR 143	National Secondary Drinking Water Regulations
40CFR160	Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), Good Laboratory Practice Standards, Final Rule

Manuals

EPA 600/4-79-020	Method for Chemical Analysis of Water and Wastes (1983)
EPA 600/4-79-012	Quality Assurance Handbook for Analytical Quality Control In Water and Wastewater Laboratories (1979)
EPA 600/R-94-111	Methods for the Determination of Metals in Environmental Samples - Supplement I (May 1994)

EPA 600/R-93/100	Methods for the Determination of Inorganic Substances in Environmental Samples (August 1993)
EPA 600/4-88/039	Methods for the Determination of Organic Compounds in Drinking Water (Rev July 1991)
EPA 600/4-90/020	Methods for the Determination of Organic Compounds in Drinking Water Supplement I, (July 1990)
EPA 600/R-92/129	Methods for the Determination of Organic Compounds in Drinking Water Supplement II (August 1992)
EPA 600/R-95/131	Methods for the Determination of Organic Compounds in Drinking Water Supplement III (August 1995)
EPA 540/G-87/003	Data Quality Objectives for Remedial Response Activities, Development Process
EPA 540/G-87/004	Data Quality Objectives for Remedial Response Activities, Example Scenario: RI/FS Activities at a Site with Contaminated Soils and Groundwater.
EPA 815-B-97-001	Manual for the Certification of Laboratories Analyzing Drinking Water 4th edition (March 1997)
EPA 821-R-16-009	Approved Clean Water Act Test Methods: Organic Compounds (August 2017)
SW-846	Test Methods for Evaluating Solid Wastes, Revision 8, Update 5, July 2014
Standard Methods	Standard Methods for the Examination of Water and Wastes, 22nd Edition, American Public Health Association.

QAMS 004/80 Guidelines and Specifications for Preparing Quality Manuals, USEPA Office of Monitoring System and Quality Assurance, September 20, 1980

QAMS 005/80 Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, USEPA Office of Monitoring System and Quality Assurance, December 29, 1980

NEESA 20.2-047B Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program, June 1988

USATHAMA PAM 11-41 U.S. Army Toxic and Hazardous Materials Agency, Quality Assurance Program, January 1990.

Drinking Water Regulations and Health Advisories by Office of Drinking Water USEPA, April, 1990

Phoenix Environmental Laboratories, Incorporated

Quality Manual

Appendix A

Resumes of Key Personnel

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THE PEOPLE OF PHOENIX ENVIRONMENTAL LABORATORIES, INC.
Technical Staff Education and Experience

Phyllis Shiller
Laboratory Director

Responsibilities:	Technical Director of Laboratory Operations and Services. Manages laboratory personnel and staffing. Responsible for laboratory scheduling and maintenance of high sample throughput. Provides client interface and management of special projects, technical issues and regulatory matters. Works with QA/QC Manager to ensure all aspects of corporate quality control program are strictly adhered to.
Education:	University of Rhode Island B.S. Chemistry, 1986
Experience:	Thirty-four years of environmental laboratory experience, including positions as QA/QC Director, Inorganic, ICP/GFAA Specialist, Inorganic Manager of a large (CLP) laboratory, Operations Manager, and Laboratory Director.

Bobbi Aloisa
Vice President

Responsibilities:	Management of Client Services Operation. Provides client interface with laboratory. Responsible for scheduling report deadlines with the client. Responsible for the generation of reports including progress reports, final reports, and electronic deliverables. Provides second level of review for all reports. Provides immediate review of incoming projects for completeness. Manages program that furthers the laboratory's ability to achieve consistent high levels of performance and quality.
Education:	Manchester Community Technical College A.S. Science, 1994
Experience:	Twenty-seven years of environmental laboratory experience.

Greg Lawrence
Assistant Laboratory Director

Education:	University of Hartford, Hartford, CT Masters Business Administration, 1988 Keene State College, Keene, NH B.S. Chemistry, 1982
Experience:	Thirty-nine years of environmental laboratory experience, including the position of Laboratory Director since 1985. Background in Organic Instrumentation, AA Spectrometry and Quality Control.

Kathleen Cressia
QA/QC Officer
Microbiology Laboratory Director

Education:	Western Connecticut State University, Danbury, CT B.A. Earth Science/Biology, 1985
Experience:	Thirty-four years of environmental laboratory experience, including positions as Laboratory Director, Laboratory Operations Manager, QA/QC Manager, Director of Microbiology, Inorganic Manager, and Wet Chemistry Section Leader for a CLP Laboratory.

Peter LaBarre
Database Administrator

Education:	Eastern Connecticut State University, Willimantic, CT B.S. Computer Science, 1990
Experience:	Fourteen years of Laboratory Information Systems support.

Maryam Taylor
Project Manager

Education:	Nizam College, India B.S. Chemistry, 1978
Experience:	Twenty-six years of experience in the environmental laboratory field including GC/MS analyst, Organics Department Manager and Project Manager.

Alejandro Paredes
Project Manager

Education:	Universidad Rafael Landivar, Guatemala B.S. Marketing, 2004
Experience:	Twelve years in the environmental laboratory field, including GC/MS analyst and Data Specialist.

Helen Geoghegan
Project Manager

Education:	University of New Haven, New Haven, CT Master of Science in Environmental Science, 1995 University College Dublin, Dublin, Ireland B.S. Chemistry, 1986
Experience:	Thirty-one years of environmental laboratory experience, including the position of Co-Laboratory Director. Background in Organic and Inorganic Analysis, Quality Control, Data Validation, Technical Review.

Keith Aloisa
Organics Department Team Leader

Education:	Quinnipiac University, Hamden, CT B.S. Chemistry, 1993
Experience:	Twenty-six years of experience in the environmental laboratory field including Organic manager and QA Specialist.

Raman Makol
Organics Department Team Leader

Education:	Guru Nanak Dev University, India M.S. Chemistry, 1986 Guru Nanak Dev University, India B.S., Chemistry, 1984
Experience:	Thirty years of analytical and environmental laboratory experience as an analyst and R&D Specialist.

Harry Mullin
GC/MS Lead Analyst

Education:	Providence College, Providence, RI B.S. Biology, 1986
Experience:	Thirty-four years of experience in the environmental laboratory field including Organic Laboratory Manager.

Hongjie Li
GC/MS Analyst

Education:	University of Petroleum, Beijing, China M.S. Applied Chemistry, 1989 University of Alberta, Edmonton Alberta, Canada M.S. Environmental Engineering, 2000
Experience:	Seventeen years of experience in the environmental laboratory and R&D field.

Michael Hahn
GC/MS Analyst

Education:	University of Connecticut- Biological Sciences Embry-Riddle Aeronautical University- Avionics Engineering
Experience:	Thirty years of environmental laboratory experience.

Wes Bryon
GC / MS Analyst

Education:	Holyoke Community College, Holyoke, MA A.S. Environmental Science, 2000
Experience:	Twenty years of environmental laboratory experience.

Jeffery Bucko
GC Analyst

Education:	Eastern Connecticut State University B.A. History, 1991
Experience:	Twenty-six years of experience in the analytical laboratory field.

Adam Werner
GC, GC/MS Analyst

Education:	University of Connecticut, Storrs, CT B.S. Molecular & Cellular Biology, 2011
Experience:	Twelve years of experience in the analytical laboratory field.

Saadia Chudary
GC Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biomolecular Science, 2013 M.S. Biomolecular Science, 2015
Experience:	Seven years of environmental laboratory experience.

Chelsey Guerette
GC Analyst

Education:	University of Hartford, West Hartford, CT B.S. Chemistry, 2018
Experience:	Two years of environmental laboratory experience.

Emily Kolominsky
ICP Analyst

Education: Pharmaceutical College, Zhitomir, Ukraine
A.S. Pharmacology, 1978

Experience: Thirty-nine years of environmental laboratory experience.

Cynthia Pearce
ICP Analyst

Education: University of Florida, Gainesville, FL
B.S. Chemistry 1977

Experience: Thirty-two years of environmental laboratory experience.

Richard E. Schweitzer
GFAA Analyst

Experience: Thirty-three years of environmental laboratory experience.

Mike Hornak
Metals Analyst

Education: Quinnipiac University, Hamden, CT
B.S. Chemisty, 1989

Experience: Thirty-one years of environmental laboratory experience.

Tina Hall
Sample Preparation Analyst, Metals Analyst

Education: Hood College, Fredrick, MD
B.A. Biology 1995

Experience: Twenty-three years of environmental laboratory experience.

Rashmi Makol
Microbiology Team Leader

Education:	Kurukeshtra University, India B.S. Chemistry
Experience:	Twenty-one years of environmental chemistry and microbiology lab experience.

Roopesh Motiram
Inorganic /Microbiology Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biology, Chemistry minor, 2015
Experience:	Four years of experience in the environmental laboratory field

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Megan Trujillo
Microbiology Analyst / QAQC

Education:	University of Connecticut, Storrs, CT B.S. Biology, 2018
Experience:	Three years of environmental laboratory experience.

Lauren Johnson
Microbiology Analyst

Education:	Eastern Connecticut State University, Willimantic, CT B.S. Biology, 2018
Experience:	Two years of environmental laboratory experience.

Eric Geyer
Inorganic Team Leader

Education:	University of Connecticut, Storrs, CT B.S. Natural Resources, 1997
Experience:	Twenty-three years of environmental laboratory experience.

Kandi Della Bella
Inorganic & Microbiology Analyst

Education:	Saint Joseph College, West Hartford, CT B.S. Natural Science, 1996 M.S. Biology, 2007
Experience:	Thirteen years of environmental laboratory experience.

Greg Danielewski
Inorganic Analyst

Education:	Capital Community Technical College, Hartford, CT A.S. Chemical Engineering Technology, 1993
Experience:	Twenty-seven years of environmental laboratory experience.

Matt Fijolek
Inorganic Analyst

Education:	University of New England, Maine B.S. Marine Biology
Experience:	Fifteen years of environmental laboratory experience.

Jean Rawlings
Inorganic Analyst

Education:	Bucknell University, Lewisburg, PA B.S. Biology 1995
Experience:	Seventeen years of environmental laboratory experience.

Brian Sheriden
Inorganic Analyst

Education:	University of Connecticut, Storrs, CT B.S. Biology/English, 2001
Experience:	Fifteen years of environmental laboratory experience.

Dustin Harrison
Inorganic Analyst

Experience: Seventeen years of environmental laboratory experience.

Michael Tran
Inorganic Analyst

Education: University of Connecticut, Storrs, CT
B.S. Computer Science and Engineering, 2012

Experience: Four years of experience in the environmental laboratory field.

April Pasquale
Inorganic Analyst

Education: Marymount University, Arlington, VA
B.S. Biology, 2018

Experience: Three years of experience in the environmental laboratory field.

Michael McGuire
Inorganic Analyst

Education: Central Connecticut State University, New Britain, CT
B.S. Criminology, minor History, 2016

Experience: Two years of experience in the environmental laboratory field.

Thomas Budz
Inorganic Analyst

Education: Central Connecticut State University, New Britain, CT
B.S. Biology, minor Chemistry, 2017

Experience: Two years of experience in the environmental laboratory field.

Blake Antil
Inorganic Analyst

Education:	University of Connecticut State, Storrs, CT B.A. Marine Biology, 2018
Experience:	Two years of experience in the environmental laboratory field.

Linnea Skoglund
Inorganic Analyst

Education:	Westfield State University, Westfield, MA B.S. Biology, Chemistry minor, 2019
Experience:	Two years of experience in the environmental laboratory field.

Ashley Griffith
Inorganic Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biology, Criminology, 2019
Experience:	One year of environmental laboratory experience

Queenie Hsiao
Inorganic Analyst

Education:	University of Connecticut, Storrs, CT B.S. Biology, 2019
Experience:	One year of environmental laboratory experience

Dina Montagna
Sample Prep Day Supervisor

Education:	Springfield College, Springfield, MA B.S. Biology/Chemistry, 1999
Experience:	Twenty one years of environmental laboratory experience.

Ashraf Sheikh
GC/MS Prep Analyst

Education: South Gujarat University – Surat, India
B.S. Chemistry, 1990

Experience: Twenty-one years of experience in the environmental field.

Tara Banning
Sample Prep Evening Supervisor

Education: University of Connecticut
B.S. Biology, 2007

Experience: Twelve years of environmental laboratory experience.

Anvarhusen Sheikh
Sample Preparation Analyst

Education: Polytechnic Institute, Valsad Gujarat India
A.S. Chemical Engineering, 1983

Experience: Twenty years of environmental laboratory experience

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Lisa Luchini
Sample Preparation Analyst

Education: Central Connecticut State Universtiy
M.S. Biomolecular Science, 2010
B.S. Biomolecular Science, 2005

Experience: Six years of environmental laboratory experience

James Karabetsos
GC/MS Sample Preparation Analyst

Education:	University of New Haven, West Haven, CT B.S. Biology / Forensic Science, 2013
Experience:	Six years of environmental laboratory experience.

Juliannie Cerda
Sample Preparation Analyst

Education:	Inter American University of Puerto Rico B.S. Chemistry, 2009
Experience:	Six years of environmental laboratory experience.

Mary Tran
Sample Preparation Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biology, 2015
Experience:	Six years of environmental laboratory experience.

Christina Nieves
Sample Preparation Analyst / GC Assistant

Education:	University of New Haven, West Haven, CT B.S. Forensic Science, 2012
Experience:	Seven years of environmental laboratory experience.

Matthew Richard
Sample Preparation Analyst / GC/MS Assistant

Education:	Central Connecticut State University, New Britain, CT B.S. Biology and Psychology, 2014
Experience:	Five years of environmental laboratory experience.

Gregory Mercier
Sample Preparation Analyst

Education:	Eastern Connecticut State University, Willimantic, CT B.S. Environmental Earth Science, 2013
Experience:	Six years of environmental laboratory experience.

Madiha Naz
GC/MS Sample Preparation Analyst

Education:	Central Connecticut State University, New Britain, CT M.A. Biomolecular Science, 2014
Experience:	Five years of environmental laboratory experience.

Rowena Wagner
Sample Preparation Analyst

Education:	Trace Computer College, Laguna College, West Negros University, Philippines – Computer Programming Certificate
Experience:	Three years of environmental laboratory experience.

Dezmond Melo
Sample Preparation Analyst

Education:	Eastern Connecticut State University, Willimantic, CT B.S. Biochemistry, 2018
Experience:	Four years of environmental laboratory experience.

Katie Leonard
Sample Preparation Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biology, 2020
Experience:	Three years of environmental laboratory experience.

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Dillan Eamiello
GC/MS Sample Preparation Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Environmental Science, Chemistry minor, 2019
Experience:	Less than one year of environmental laboratory experience.

Jordan Reska
Sample Preparation Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biomolecular Sciences, 2013
Experience:	Two years of environmental laboratory experience.

Kira Wayman
Sample Preparation Analyst

Education:	University of Southern Mississippi, Hattiesburg, MS
Experience:	Two years of environmental laboratory experience.

Robert Looney
Sample Preparation Analyst

Education:	Eastern Connecticut State University, Willimantic, CT Environmental Earth Science major
Experience:	Two years of environmental laboratory experience.

Joe Sigan
Sample Preparation Analyst

Education:	Eastern Connecticut State University, Willimantic, CT B.S. Environmental Science, 2017
Experience:	Two years of environmental laboratory experience.

Maeve Cummings
Sample Preparation Analyst/ Bacteria Analyst

Education: Siena College, Loudonville, NY
B.S. Biology, 2018

Experience: Two years of environmental laboratory experience.

Natalie Tessier
Sample Preparation Analyst

Education: Central Connecticut State University, New Britain, CT
B.S. Biology, Chemistry minor, expected 2021

Experience: Three years of environmental laboratory experience.

Alex Purdue
Sample Preparation Analyst

Education: Norwich University, Northfield VT
B.S. Chemistry, 2019

Experience: One year of environmental laboratory experience.

Nicole McMeekin
Sample Preparation Analyst

Education: Central Connecticut State University, New Britain, CT
B.S. Biology, 2020

Experience: One year of environmental laboratory experience.

Paul Marshal
Air Sample Preparation Analyst

Education:	Central Connecticut State University, New Britain, CT B.S. Biology, 2017
Experience:	One year of environmental laboratory experience.

Jordan Spalla
Sample Preparation Analyst

Education:	Eckerd College, Petersburg, FL B.S. Marine Science, minor Environmental Science, 2018
Experience:	One year of environmental laboratory experience.

Joe Sims
Sample Preparation Analyst

Education:	Eckerd College, Petersburg, FL B.S. Marine Science, minor Environmental Science, 2018
Experience:	One year of environmental laboratory experience.

Sarah Keane
Sample Preparation Analyst

Education:	Asnuntuck Community College, Enfield, CT A.S. Environmental Science, 2020
Experience:	One year of environmental laboratory experience.

Michelle Lopes
Sample Preparation Analyst

Education:	Colby-Sawyer College, New London, NH B.S. Environmental Science, 2019
Experience:	One year of environmental laboratory experience.

Meredith Leo
Assistant Software Engineer

Education:	University of Connecticut, Storrs, CT B.S. Animal Science, minor Computer Science, 2011
Experience:	One year of environmental laboratory experience before moving to IT department.

Phoenix Environmental Laboratories, Incorporated

Quality Manual

Appendix B

Equipment List, Laboratory Overview & Certifications

Controlled Copy on Ivory Paper

PHOENIX ENVIRONMENTAL LABORATORIES, INC.
Major Equipment List

Organics GC

16 - Perkin Elmer Autosystem with dual Electron Capture Detectors

1 - Markelov HS 9000 Headspace Analyzer with Perkin Elmer Autosystem with F10

1 - Perkin Elmer Autosystem with Nitrogen Phosphorus Detector

11 - Perkin Elmer Autosystem with Flame Ionization Detectors

1 - Agilent 7890A Autosystem with PID and FID detectors, Centurion autosampler and Tekmar 3000 Purge and Trap concentrator

12 - PE Nelson 970 Data Interfaces

6 - PE Nelson 600 Series Link Interfaces

8 - PE Nelson Turbochrom 4.1 Data System

2 - Agilent 6890N Autosystem GC/MS with 7683 autosampler

1 - Agilent 7890B Autosystem with dual ECD detectors, with 7693 autosampler

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Organics GC/MS

2- Agilent 5973 MSD with 6890 GC, Arcon 8100 Autosampler, two Tekmar 3000 Purge and Trap concentrators, PT2 switching valve box, HP Chemstation and Enviroquant software

9- Agilent 5973 MSD with 6890 GC, 7683 injector, HP Chemstation and Enviroquant software Semivolatiles

2- Agilent 5975 MSD with GC, 7683B injector, HP Chemstation and Enviroquant software Semivolatiles

1- Agilent 5973 MSD with 6890 GC, Arcon 8100 Autosampler, two EST Encon Purge and Trap concentrators, PT2 switching valve box

2- Agilent 5975 MSD with 7890 GC, Centurion Autosampler, Encon Evolution purge and trap concentrator

6- Agilent 5973 MSD with 6890GC, Encon Evolution Purge and trap concentrator, Centurion Autosampler, Chemstation Enviroquant software

1- Agilent 5973 MSD with 6890GG, Centurion Autosampler, Encon Evolution purge and trap concentrator

1- Agilent 5977A MSD, 7890B GC, Centurion Autosampler, Encon Evolution purge and trap concentrator

1- Agilent 7980A GC with OI 4430 PID/FID Centurion Autosampler, Tekmar 3000 purge and trap concentrator

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Organics HPLC

2- Agilent 1100 series with Diode Array Detectors G131SB. G1316A Colum Thermostat, G1312A Binary Pump, G1367A Autosampler

2- Agilent 1100 series with FLD (1321A) Autosampler (G1313A), column thermostat (G1316a) Quarter Pump, (G1311a), Pickering PCX5100, Pickering vector post column derivatization unit

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Air Laboratory

1- Agilent 5975 with 7890 GC and HP Chemstation

1- Agilent 5977A with 7890 GC and HP Chemstation

1- Entech 7100AR Cryogenic concentrator- cold trap dehydration

1- Entech 7200 Cryogenic concentrator

1- Entech 7650 20 Minican Autosampler with 18 auxiliary positions.

1- Entech 7500A minican Autosampler with 9 auxiliary positions.

2- Entech 3100A canister cleaner accompanied with Thermoscience oven

1- Entech 3100D canister cleaner accompanied with Thermoscience oven

1- Entech 4600A Dynamic Dilutor

1- Entech 4700 Precision Dilutor

Metals

1- Spectro Blue 37 Channel Simultaneous Axial Plasma ICP Spectrometer with Autosampler and Smart Analyzer software

2- Spectro Arcos ICP-EOP with ESI SC Autosampler and Smart Analyzer Software

1- Perkin Elmer NexION 350X ICP Mass Spectrometer

2- Perkin Elmer AAnalyst 600 Atomic Absorption Spectrophotometer (AA) with graphite furnace, Zeeman background & AS 800 Autosampler

1- PSA Mercury Millennium System with Autosampler and mercury cold vapor detector.

2- OHAUS Model SPX223 balance

Prep Department

3- UTC Vacuum Solid Phase Extractor Manifolds

100- Liquid/Liquid Extraction Systems

7- Buchi Synacore Concentration Systems with V-855 Vacuum Controllers

6- Zymark TurboVap II Automated Sample Concentration Workstations (6 and 24 position)

1- Vacuum and Pressure Filtration System, 11 positions

2- Branson DHA1000 Ultrasonic Cleaners

2- VWR 250D Ultrasonic Cleaners

25- Millipore Zero Headspace Extraction Chambers

3- Millipore TCLP Rotary Extractors ZHE, 12 positions

1- Multi Position TCLP Rotation Extraction Systems

12- Dionex ASE200 Accelerated Solvent Extractors

40- Radley Manual Soxhlet Extractors- 5 position

2- Questron Vulcan 84 AutoBlock Digester

5- Environmental Express HotBlocks Digesters, 54 Position

1- Milestone Ethos UP Microwave Digester

1- IEC Centra-8 Centrifuge

6- Tekmar TM600-2 Dual Horn Sonic Disruptors

6- Mettler PB802S/PB1502S/PB3002 Balances

1- EM Series EK-1 Balance

1- Mettler Analytical AE240 Balance

1- PlasLabs 863-CG Dessicator

1- Blue M DC336F Oven

1- VWR 1300U Oven

2- GlasCol 3D Separatory Funnel Shaker, 8 position

1- GlasCol 3D Separatory Funnel Shaker, 4 position

2- Thermo Scientific 40 position block digester

3- MARS 6 Microwaves

WET LAB

1- Lachat Quikchem 8000 Dual Channel Wet Chem Autoanalyzer with 360 Position Autosampler.

2- Lachat Quikchem 8500 Four Channel Wet Chem Autoanalyzer with 360 Position Autosampler.

2- Tekmar LOTIX TOC Analyzer with 30 position Autosampler

1- Tekmar Apollo TOC in soil Analyzer

1- HACH DR5000 Spectrophotometer

2- Beckman Coulter DU 720 Spectrophotometer

2- Hach Sension 7, Conductance Meter

1- Yamato DX600 Drying Oven

4- Precision Scientific Pensky-Martens Flash Point Testers

1- Orion 710A Meter

1- Thermo Scientific Heratherm Drying Oven

1- Mettler PJ360 Top Loader Balance

1- Mettler AE240 Analytical Electronic Balance

1- Man-Tech AM197 Automated Liquid Handler (pH, Alkalinity, Conductivity, Turbidity)

2- Mettler XS-104 Analytical Electronic Balance

1- Mettler PB5001-S Top Loader Electronic Balance

3- LabCrest Midi Distillation Systems, 10 position

3- AIM 500 Automated Block Digesters, 28 position

2- Dionex DX120 Ion Chromatograph with Autosampler

2- Beckman Coulter CU720 Spectrophotometer

1- Yamato DX400 Drying oven

1- Thermolyne 48000 Furnace

1- Thermolyne 1300 Furnace

2- Hach COD reactor, 25 position

2- Horizon SpeedVap II 9000 Solvent Evaporation System

1- VWR 750HT Ultrasonic Cleaner

1- GlasCol 3D Separatory Funnel Shaker, 8 position

1- CAI SmartBlock 226 COD Digester, 100 position

1- Hydro System Reverse Osmosis 500 gallon water system

2- Hach TL2300 Turbidimeter

1- VWR B30PCI pH meter

2- Barnstead Nanopure Diamond DI Water System

1- Tekmar Dohrman Apollo 9000 TOC Analyzer w/ Model 183 Boat Sampler for Solids

1- Mantech Gilson 215 Liquid Handler

1- Mantech T10 Turbidimeter

Microbiology

4- VWR 2020 BOD Incubators, High Volume

2- VWR 2030 BOD Incubators, High Volume

1- Sheldon Manufacturing SR120P Incubator, High Volume

2- YSI 52 Oxygen Meter (BOD)

1- ManTech AM300 series dual probe, 90 position BOD analyzer

1- Baush & Lomb and Spencer Microscope

3- Precision Coliform Incubator Water baths

2- VWR Bacteriological Incubators

1- Market Forge Sterilmatic Autoclave

1- Vacuum Filtration System, 3 position

1- Fisher Scientific Isotemp Bacteriological Incubator

1- Thermo Scientific HeraTherm Bacteriological Incubator

1- Reihert-Juns Quebec Darkfield Colony Counter

1- Spectroline EA-160 UV light (366 nm)

1- American UV Company UV box (254 nm)

1- IDEXX Quanti-Tray Sealer

1- IDEXX Quanti-Tray Sealer PLUS

2- Insignia Fridge

PHOENIX ENVIRONMENTAL LABORATORIES, INC.

GENERAL INFORMATION & CONDITIONS

HOURS OF OPERATION/PRIOR NOTIFICATION

Hours of Operation: Sample receiving hours are 7:00 a.m. to 7:00 p.m. Monday through Friday; and 9:00 a.m. to 1:00 p.m. on Saturdays. Laboratory operation hours are 6:00 a.m. to 11:00 p.m. Monday through Friday and a limited Saturday schedule. Prior notification is required for delivery of emergency samples.

SAMPLE PICKUP

Phoenix Environmental Laboratories, Inc. offers courier service throughout our service area of Connecticut, New York, Massachusetts, Rhode Island, Vermont, Maine and New Hampshire. Pickups should be scheduled 24 hours in advance. Please contact Phoenix Client Services for sample pickup or emergency response.

TURNAROUND TIMES

Phoenix Environmental Laboratories, Inc. shall make its best effort at meeting all client specified turnaround times. Phoenix shall not however be liable for late delivery of services except as provided by written agreement prior to sample receipt.

SURCHARGE FOR EXPEDITED WORK

Normal turnaround is 5 working days. Results required in less than five working days are assessed a surcharge for accelerated turnaround. Please contact the Sales Department for available turnaround times and applicable charges.

EXPEDITED WORK/RUSH PROJECTS

A computer generated progress report or verbal results will be made available within the agreed time period with the written report available within (1) day following the progress report. Client requirements for "same day" written reports must be approved prior to sample delivery.

DUE DATE

Due date is defined as the date of analysis completion with verbal or computer generated sample progress reports results available "same day" for expedited rush work. Completed written reports are available by 5 p.m. the following day and are mailed first class, U.S. Postal Service.

SAMPLE RECEIPT

Samples must be received at Phoenix before 3:00 p.m. to be considered as received on that day. Samples received after 3:00 p.m. shall be considered as having been received on the next working day for purposes of calculating turnaround time. Phoenix Environmental Laboratories, Inc. reserves the right to reject samples deemed unsuitable.

SAMPLE HOLDING TIME/PRESERVATION

Customers must deliver all samples to Phoenix within holding time or where short holding times are not required, a maximum of two days from sample collection. It is the client's responsibility to assure that all samples are preserved and delivered in accordance with published protocol.

DOCUMENTATION

All samples submitted to Phoenix Environmental Laboratories, Inc. must be accompanied with a completed Chain-of-Custody form.

SAMPLE DISPOSAL/STORAGE

Phoenix will responsibly dispose of most unused samples, while reserving the right to return unused samples to the client. Please consult our sample custodian at time of delivery for additional information. Sample storage will not extend past 30 days from final report date except by previous arrangement.

SUBCONTRACTED SAMPLES

A limited number of analysis such as radionuclides are subcontracted to licensed laboratories, which Phoenix maintains a contractual agreement. Subcontracted samples maybe subject to extended turnaround times.

RECORD RETENTION

Phoenix shall retain all pertinent records for a period of ten (10) years from sample receipt, except in the case of Lead and Copper testing, where records are retained for twelve (12) years. There may be a minimal charge for the retrieval of these records from archives, should a client request this service.

CERTIFICATIONS

Phoenix Environmental Laboratories, Inc. participates, on an annual basis in many different certification and proficiency programs. Some states extend reciprocal certification to Phoenix Environmental Laboratories, Inc.

Phoenix Environmental Laboratories Inc. holds certifications in the following states:

Connecticut (Lab. Registration #PH-0618)

Maine (Lab. Registration #CT-007)

Massachusetts (Lab. Registration #MA-CT007)

New Hampshire (Lab. Registration #2136 and #2058)

New York / NELAC (Lab. Registration #11301)

New Jersey (Lab. Registration #CT003)

Rhode Island (Lab. Registration #63)

Vermont (Lab. Registration #VT11301)

Pennsylvania (Lab. Registration #68-03530)

Utah (Lab. Registration #CT00007)

Phoenix Environmental Laboratories, Incorporated

Quality Manual

Appendix C

Organizational Chart

Controlled Copy on Ivory Paper

Phoenix Environmental Laboratory Staff

January 2021

Peter Labarre
Meredith Leo
IT

Kathy Cressia
Megan Trujillo
QA/QC

Phyllis Shiller
Laboratory Director

Greg Lawrence
Assistant Laboratory Director

Client Services Department

Bobbi Aloisa
Vice President/Manager

Loreen Fay
Project Mngr / Asst to VP

Sarah Bell
Project Manager

Makrina Nolan
Project Manager

Helen Geoghegan
Project Manager

Lisa Arnold
Project Manager

Makrina Nolan
Project Manager

LIMS
Shannon Whilhelm
Lori Bailey
Christine Paradise

Sample Custodians
Monica Pellerin
Kayla Tomkiel
Stefanie Lesight
Krystal Delgado
Krystal Houle

Organic Department

Raman Makol
GC/MS Team Leader & HPLC

Keith Aloisa
GC/MS Team Leader & Air

Harry Mullin
GC/MS Lead Analyst

GC/MS Analysts:
Jane Li
Michael Hahn
Wes Bryon
Adam Werner

GC Analysts:
Adam Werner
Jeff Bucko
Saadia Chudary
Chelsey Guerette

VOA Assistants:
Ashraf Sheikh
Madiha Naz
James Karabetsos
Dillan Eameillo
Juliannie Cerda

GC & SV Assistants
Mary Tran
Christina Nieves
Paul Marshall
Matthew Richards

Metals Department

Emily Kolominski
ICP Analyst

Richard Schweitzer
AA Analyst

Cynthia Pearce
ICP-MS Analyst

Tina Hall
Analyst

Mike Hornak
Analyst

Sample Preparation Department

Dina Montagna
Day Team Leader

1st Shift Analysts:
Lisa Luchini
Katie Leonard
Joe Sigan
Amber Williams
Correnna Garner
Alexandria Nista

Tara Banning
Night Team Leader/Lims

2nd Shift Analysts:
Anvar Sheikh
Greg Mercier
Dez Melo
Jordan Reska
Kira Wayman
Sarah Keane
Alex Purdue
Natalie Tessier
Nicole McMeekin
Jordan Spalla
Joe Sims
Michelle Lopes

3rd Shift Analysts:
Rowena Wagner
Maeve Cummings
Robert Looney

2nd/3rd Shift Assistant
Brad Foster

Microbiology Department

Kathleen Cressia
Micro Lab Director

Rashmi Makol
Micro Team Leader

Lauren Johnson
Analyst

Roopesh Motiram
Analyst

Maeve Cummings
Analyst

Classical Chemistry

Eric Geyer
Team Leader

1st Shift Analysts:
Greg Danielewski
Kandi Della Bella
Jean Rawiling
Matt Fijolek
Michael McGuire
Blake Antil
Queenie Hsiao
Ashley Griffith
Linnea Skoglund

2nd Shift Analysts:
Brian Sheridan
Dustin Harrison
Michael Tran
April Pasquale
Thomas Budz
Meredith Weigert
Kevin Bell

Phoenix Environmental Laboratories, Incorporated

Quality Manual

Appendix D

Standard Operating Procedure Table of Contents

Controlled Copy on Ivory Paper

SOP No.	SOP Title/Comment	Dist. #	Previous Version	Current Version	Date Finalized
Sampling					
101.0	Drinking Water Sampling Procedure		3 (12/3/09)	4	10/28/2015
102.5035	Soil Prep for VOA 8260		2.2 (9/23/19)	2.3	12/12/2019
103.0	Sample Acceptance Policy	1	1 (10/21/08)	2	2/16/2015
104.Temp	Temperature		0 (4/19/05)	1	6/6/2007
105.5030	Water Prep for VOA 8260		1 (7/25/13)	1.1	10/20/2016
106.Air	Air Sampling			O	10/3/2019
121.0	Sample Container Preservation	1	8 (10/9/12)	8.1	3/18/2015
Sample Preparation					
203.SONC	Sonication Extractions		10.1 (3/15/18)	10.2	5/1/2019
204.552.2	Haloacetic Acids		8 (11/4/14)	8.1	1/20/2017
205.TMD.DISS	Metals Digestion-Dissolved		5.3 (7/26/17)	5.4	6/12/2019
206.paint filter	Paint filter free liquids test		2 (6/21/12)	3	11/15/2019
208.EPH	Extractable Petroleum Hydrocarbons		6.4 (10/8/19)	6.5	10/23/2019
213.sep508	Separatory extraction PCB 508		3.2 (6/20/16)	3.3	1/12/2018
214.515.3	Herbicide Ext of Drinking Water		5 (12/2/13)	5.1	3/21/2017
217.Sep Herb	Herbicide ext by methylation		4.2 (3/21/2017)	4.3	2/5/2020
219.TMD.dw	Metals Digestion Drinking Water		6 (12/27/16)	6.1	7/27/2017
220.Form	Formaldehyde		3 (3/26/2014)	3.1	11/6/2017
224.TMD.wm	Metals Digestion Wastewater Matrix		10 (1/4/17)	10.1	7/23/2019
226.wastedilutions	Waste dilutions for oil matrix		4.1 (2/13/15)	4.2	4/22/2015
231.TMD.sm	Metals Digestion in Soils/Wastes		6.1 (4/22/15)	6.2	7/28/2017
234.%sol	% Solids		1 (3/22/00)	2	4/11/2006
235.ASE-SM	Soil Extraction by PFE		9.2 (1/25/19)	9.3	9/23/2019
236.HGSM	Mercury digestion (soil matrix)		3.2 (3/22/17)	3.3	8/27/2019
237.HGWM	Mercury digestion (water matrix)		5.1 (3/22/17)	5.2	8/27/2019
238.TMD.3051A	Microwave digestion metals SM/Oils		2.3 (1/27/16)	2.4	2/26/2016
239.sepext	Separatory extractions (water matrix)		6.3 (1/10/19)	6.4	9/23/2019
240.liq/liq	Continuous liquid-liquid extraction		12.1 (15/1/19)	12.2	9/23/2019
242.TCLP	Toxicity Characteristic Leaching		1.2 (4/3/15)	1.3	7/17/2019
243.SPLP	Synthetic Precipitation Leaching		0 (11/15/01)	1	1/21/2010
245.SepSIM	Separatory extraction WM SIM		1 (1/11/2006)	1.1	1/10/2019
246.sox Wipes	Soxhlet extraction of wipes		3 (11/12/13)	3.1	1/25/2017
247.Soncherb	Sonication Ext for Herbicides		5 (2/1/2012)	6	1/10/2020
250.ASE care	ASE cell cleaning procedure		3 (6/9/14)	4	12/31/2014
251.Soxhlet	Soxhlet Extraction procedure		4 (11/12/13)	4.1	11/17/2016
253.Baking Chem	Baking Chemicals			O	7/7/2008
255.ASE-SM SV-SIM	Semivolatiles in Soil by SIM		O (3/19/09)	1	2/23/2017
258.ZHE Clean	ZHE Cleaning Procedure	1		O	1/3/2011
259.PUFsoxhlet	Soxhlet Extraction for PCB Air-PUF		1 (8/19/11)	2	11/12/2013
260.HgDW	Mercury digestion (drinking water)		O (8/11/15)	1	3/22/2017
261.525.3	Preparatory SPE 525.3		1 (1/14/16)	1.1	7/14/2016
262.Carbo	Carbo cleanup for Pests	O	7/31/2019	1	2/25/2020
263.ASTMext	ASTM extraction			O	8/1/2019
264.Dioxane	SPE for 1,4-Dioxane			O	1/2/2020
265.3546	Microwave digestion organic soils		1 (4/30/20)	2	5/28/2020
266.sox shutdown	Soxhlet shutdown for weekends			O	9/30/2020

SOP No.	SOP Title/Comment	Dist. #	Previous Version	Current Version	Date Finalized
Wet Chemistry					
301.IC.DX120	Ion Chromatography DX120		5.2 (12/15/16)	5.3	4/27/2017
302.Lachat	Lachat Autoanalyzer		3 (1/26/05)	4	3/12/2007
303.2310B	Acidity		1.1 (12/18/14)	1.2	3/7/2018
304.4500NH3 G	Ammonia/TKN		8.4 (7/26/17)	8.5	7/26/2019
305.2320B	Alkalinity		6 (6/11/07)	6.1	3/12/2018
306.5210B	BOD/cBOD		8.6 (6/5/19)	8.7	7/26/2019
307.4500CL G	Chlorine		3 (9/9/09)	3.1	11/6/2019
308.2510 B	Conductivity		5 (6/21/12)	5.1	3/12/2018
309.335.4/4500CN	Cyanide-Total, Amenable & Free		10 (4/25/13)	10.1	2/3/2015
310.2120 B	Color		4 (2/5/15)	4.1	3/22/2018
311.5220 D	COD		4 (7/19/12)	4.1	3/12/2018
312.4500 O G	DO electrode		2.1 (1/29/18)	2.2	6/5/2019
313.1010	Flashpoint		3 (7/13/09)	4	8/2/2012
314.3500 Cr B	Hexavalent Chromium WM		4.2 (3/31/15)	4.3	3/14/2018
315.3060A	Hexavalent Chromium SM		7 (7/24/14)	7.1	5/5/2017
316.5540 C	MBAS		2.2 (3/14/18)	2.3	8/22/2019
317.2150 B	Odor		5 (11/13/12)	6	9/20/2013
318.1664	Oil & Grease		8 (1/29/14)	8.1	7/29/2016
319.SM4500H+B	pH and Corrosivity		5.1 (1/17/17)	5.2	3/15/2018
320.420/9066	Phenols		5 (5/10/12)	5.1	2/3/2015
321.4500P E	Phosphorus		5.1 (10/4/16)	5.2	3/15/2018
322.React	Reactivity		2 (9/10/09)	2.1	9/30/2016
323.2540 C	Solids, Dissolved (TDS)		3 (11/10/09)	3.1	3/22/2018
324.2540 D	Solids, Suspended (TSS)		5.1 (3/22/18)	5.2	8/22/2019
325.2540 B	Solids, Total (TS)		3 (1/15/10)	3.1	3/22/2018
326.9030	Sulfide, Total (distil followed by Titr.)		2.1 (1/12/17)	2.2	1/10/2020
330.2130 B	Turbidity (NTU)		3 (12/27/06)	3.1	3/16/2018
331.2540E	Solids, Fixed & Volatile (FS/VS)		2 (12/1/14)	2.1	3/22/2018
332.2350B	Chlorine Demand		1 (4/5/99)	2	3/22/2000
336.353.2	Nitrate by Lachat		3.2 (5/10/17)	3.3	6/9/2017
339.377.1	Sulfite		O (5/5/00)	1	9/7/2016
340.2520 B	Salinity		1 (7/1/03)	2	3/22/2006
341.SO4grav	Sulfate, gravimetric		1 (4/5/99)	2	4/2/2001
343.4500-S2 D	Sulfide, Total (colormetric)		5 (5/10/12)	6	4/1/2015
344.TOCSM	TOC soil (sm)		2.3 (12/3/2019)	2.4	6/12/2020
345.Fl2	Fluoride by electrode		3.1 (2/4/15)	3.2	3/16/2018
346.4500Cl-E	Chloride Automated Ferricyanide		3 (2/28/07)	3.1	3/16/2018
347.VFA	Volatile Fatty Acids		1 (1/13/03)	2	10/4/2011
352.CO2	Free Carbon Dioxide			O	11/30/2005
353.AVS/SEM	Acid Volatile Sulfide/SEM metals			O	11/6/2004
354.cyanate	Cyanate by NH3 probe			1	2/16/2007
355.OP Lachat	Orthophosphate Lachat		1 (2/23/07)	1.1	3/16/2018
356.5910B	UV-254		3 (5/12/12)	3.1	9/23/2019
357.2540F	Settleable Solids		O (6/21/07)	1	3/21/2018
358.MetalsDW	Phoenix Metals DW procedure		O (8/14/07)	1	4/26/2013
359.4500CN WAD	Weak & Dissociable Cyanide			O	10/31/2007
360.PCT	PC Titrator (pH, Alk, Cond, Turb)		2 (6/21/12)	2.1	3/7/2018
361.SpecGrav	Specific Gravity			O	5/11/2011
362.9071B	Oil & Grease in Soil / Solids		1 (4/7/15)	1.1	5/9/2018

SOP No.	SOP Title/Comment	Dist. #	Previous Version	Current Version	Date Finalized
363.5310B	TOC Lotix by 5310B		O (4/18/17)	1	3/21/2018
Bacteria					
401.E.Coli MF	E.coli MF		7.1 (2/14/17)	7.2	5/23/2019
403.9222D	Fecal coliform MF		5.6 (7/31/19)	5.7	11/13/2019
405.9230A	Fecal Streptococcus MF		3 (3/20/09)		Archived
406.9215B	Heterotrophic Plate Count		8 (6/28/12)	8.1	7/26/2017
407.9223B	Total coliform DW by Colilert		7.1 (2/14/17)	7.2	5/23/2019
408.9222B	Total coliform MF		8.3 (5/23/19)	8.4	7/31/2019
410.TColiQ/EColiQ	Total coliform Colilert MPN		1 (7/20/12)	1.1	5/23/2019
411.Enterolert	Enterococcus MPN		1.1 (1/23/15)	1.2	5/23/2019
412.FecalQ	Fecal coliform Colilert MPN		O (2/2/17)	1	9/27/2017
413.SRB	Sulfate Reducing Bacteria			1	9/27/2017
414.m-ColiBlue24	Total Coliform/E.Coli MF			O	11/4/2020
450	Disposal of sample cultures		4 (5/6/09)	4.1	5/23/2019
451	Cleaning of UV equipment		0 (6/21/01)	1	3/20/2009
452	Autoclave sterility check		5.2 (2/13/18)	5.3	11/26/2019
454	Air Monitoring		0 (6/25/01)	1	5/8/2009
457	UV Box Check		1 (5/14/07)	2	5/6/2009
458	InHouse DI Water Monitoring		O (12/28/09)	1	2/18/2016
Metals					
501	Metals by GFAA		6.4 (8/8/19)	6.5	1/10/2020
503	Mercury by CV		8.1 (7/30/15)	8.2	8/27/2019
506	Metals by ICP		1.4 (1/10/20)	1.5	3/31/2020
507	Hardness by Calculation		2 (12/20/07)	3	2/18/2016
508	Metals by ICP-MS		1.4 (9/12/19)	1.5	4/8/2020
Organic Instrumentation					
601.8270/625.1	SVOA by GC/MS		12.4 (6/12/18)	12.5	7/26/2019
602.624.1	VOA by GC/MS		9 (11/7/2017)	9.1	4/10/2018
603.552.2	Haloacetic Acids		8 (2/17/15)	8.1	9/17/2019
605.CTETPH	CT ETPH by GC/FID		5 (10/22/14)	5.1	1/19/2016
611.504/8011	EDB, DBCP		8.4 (5/15/17)	9	1/4/2019
613.508	PCB in drinking water		5.1 (5/10/16)	5.2	1/12/2018
614.515.3	Herbicide in drinking water		9 (10/22/14)	9.1	3/8/2017
617.531.2	Carbamates by HPLC		5.3 (9/4/18)	5.4	6/15/2019
619.EPH	EPH by GC/MS		3 (4/11/11)	4	3/10/2020
620.VPH	VPH by GC/MS		4 (4/26/2011)	4.1	5/9/2018
621.8081	PESTS by GC		6.7 (5/13/19)	6.8	8/28/2019
622.8082	PCB by GC		10.3 (4/20/17)	10.4	12/7/2017
626.8141	OP Pesticides		2 (8/6/13)	2.1	11/13/2014
627.8151	Herbicides		8 (10/22/14)	8.1	10/28/2016
630.68	PCB's by 680		4.2 (2/7/2017)	4.3	4/10/2018
633.Glycol	Glycols		4.2 (2/16/17)	4.3	5/16/2017
634.DRO	Diesel Range Organics		5.1 (2/4/2015	5.2	1/19/2016
635.GRO	Gasoline Range Organics		6 (9/29/16)	6.1	6/4/2019
640.NJ TPH	NJ QAM-025		1 (6/26/2015)	1.1	1/20/2016
642.FORM	Formaldehyde HPLC		3 (3/26/14)	3.1	3/20/2017
643.Alcohol	Alcohols FID headspace		4.1 (5/3/16)	4.2	6/28/2019
644.SV-SIM	SVOA by Selective Ion Monitoring		3 (11/3/14)	3.1	2/2/2016
645.TO14-15	VOCs in Air		5.1 (3/17/17)	5.2	7/12/2017

SOP No.	SOP Title/Comment	Dist. #	Previous Version	Current Version	Date Finalized
646.1,4-dioxane	1,4-Dioxane		2.4 (6/12/19)	2.5	1/2/2020
647.NJLLTO-15	NJ Low Level TO-15 Air		4.4 (11/20/19)	4.5	11/20/2019
651.524.2	Volatiles in DW by 524.2 5mL		3 (MDB 2/3/15)	3.1	3/10/2017
652.NJEPH	New Jersey EPH		1.6 ()	1.7	3/10/2020
653.8260C/D	VOA by GC/MS		2.3 (7/8/19)	2.4	12/12/2019
654.549.2	Diquat & Paraquat		1.1 (3/24/17)	1.2	6/4/2019
655.547	Glyphosate by 547		1 (1/8/16)	1.1	3/20/2017
656.525.3	525.3		1.2 (9/6/16)	1.3	3/21/2017
657.Fluridone	Fluridone by 525.3			O	10/24/2017
658.608.PEST	Pesticides by 608.3		O (11/3/17)	1	8/28/2019
659.608.PCB	PBC by 608.3			O	11/3/2017
General					
701	Glassware Cleaning		1 (2/19/99)	2	8/17/2011
702	Laboratory Nonconformance		1 (7/23/99)	2	12/5/2012
703	General Waste Disposal		2 (12/3/09)	2.1	6/12/2019
704	Final Report Review		1 (2/13/01)	2	12/6/2012
705	Significant Figures and Rounding			1	9/11/2000
706	Eliminating Transcription/Calc Errors			O	11/20/2002
707	Transmission of Test Results			O	1/4/2002
708	Avoid Deterioration/Damage			O	1/4/2002
709	Raw Data Review			1	12/9/2002
710	Sample Log-in		1 (2/12/01)	2	8/24/2012
711	Purchasing			O	1/24/2005
712	Decon sampling equipment			O	12/15/2006
713	SOP update procedure		O (4/4/11)	1	11/4/2014
714	Manual Integration Policy		1.1 (3/23/16)	1.2	5/11/2017
715	Stocks & Standards Tracking				DRAFT
716	Exceedance Notifications		1.1 (9/13/17)	1.2	9/23/2019
717	Data Integrity Plan			O	5/10/2017
718	MDL Determination			O	11/15/2019
Safety					
801	Employee Right to Know	1	1 (8/21/00)	2	12/8/2009
802	Emergency Evacuation Plan	1		1	6/10/2004
803	Laboratory Hood	1		1	8/22/2000
804	Safety Committee	1	1 (8/22/00)	2	7/9/2003
805	Hazardous Chemical Procedures	1		1	1/8/2003
806	Laboratory Safety Equipment	1	1 (7/7/04)	2	6/2/2006
807	Chemical Hygeine Plan	1	2 (2/11/10)	3	3/25/2013
808	Spill Control Procedures				Draft
809	First Aid Procedures	1		1	9/13/2000

APPENDIX C

COMMUNITY AIR MONITORING PLAN

COMMUNITY AIR MONITORING PLAN

MASTER CLEANERS
2312 WESTERN AVENUE
GUILDERLAND NEW YORK

Brownfield Cleanup Agreement No. C401072-11-21

PREPARED FOR:

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION
OFFICE OF ENVIRONMENTAL QUALITY REGION 4
1130 NORTH WESTCOTT ROAD
SCHENECTADY, NEW YORK 12306-2014
AND
FOUNDRY VILLAGE LLC.
450 LOUDON ROAD
LOUDONVILLE, NEW YORK 12211
AND
CHARLES BOHL INCORPORATED
2314 WESTERN AVENUE
GUILDERLAND, NEW YORK 12084

PREPARED BY:

NORTHEASTERN ENGINEERING TECHNOLOGIES PLLC
P.O. BOX 2167
BALLSTON SPA, NEW YORK 12020

DATED:

MAY 12, 2022
REVISED September 23, 2022

"..... providing integrated geo-environmental, engineering and geotechnical services ....."

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Appendix B Fugitive Dust And Particulate Monitoring From DER-10 Technical Guidance For Site Investigations And Remediation

LIST OF ACRONYMS

Brownfield Cleanup Program	BCP
Community Air Monitoring Program	CAMP
Division of Environmental Remediation	DER
Health and Safety Plan	HASP
micrograms per cubic meter	µg/m3
New York State Department of Environmental Conservation	NYSDEC
New York State Department of Health	NYSDOH
Northeastern Engineering Technologies, PLLC	NET
parts per million	ppm
Supplemental Remedial Investigation Work Plan	SRIWP
Volatile Organic Compound	VOC

1.0 INTRODUCTION

Northeastern Engineering Technologies, PLLC (NET) has developed this Community Air Monitoring Plan (CAMP) to protect the community from any potential airborne releases that could result from invasive field activities associated with the implementation of the Supplemental Remedial Investigation Work Plan (SRIWP) at the Mater Cleaners Brownfield Cleanup Program (BCP) Site No. C401072 located at 2312 – 2316 Western Avenue Guilderland, New York (hereinafter termed the "Site"). This CAMP has been prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) Program Policy Division of Environmental Remediation (DER)-10/Technical Guidance for Site Investigation and Remediation, dated May 3, 2010.

DER-10 (NYSDEC, 2010) includes a Generic CAMP from the New York State Department of Health (NYSDOH) as Appendix A. The generic CAMP is sufficient to cover most sites, including the ground intrusive and non-intrusive activities that will be undertaken during the implementation of the SRIWP. The CAMP is intended to protect off-site receptors and those not directly involved with the implementation of the SRIWP from potential airborne contaminant releases that may result from ground intrusive activities. For this reason, CAMP monitoring will be focused at the upwind and downwind perimeter of the Site and will be in addition to any monitoring specified in the Health and Safety Plan (HASP) to protect on-Site workers during SRIWP activities.

SRIWP activities that are subject to the CAMP include the proposed soil boring / monitoring well installation work, the sewer line test pit excavation program and all other soil and groundwater sampling services. This CAMP presents the continuous and periodic monitoring that will be conducted during all ground intrusive investigation activities conducted at the Site.

2.0 COMMUNITY AIR MONITORING METHODS

2.1 Particulate Air Monitoring

Continuous particulate monitoring will be conducted during all ground intrusive activities at the Site in accordance with the Fugitive Dust and Particulate Monitoring from DER-10 Technical Guidance for Site Investigation and Remediation (Appendix B). Dust and particulate monitoring will be conducted near the approximate upwind and downwind perimeters of the exclusion zone, when possible, or where dust generating operations are apparent. Dust monitoring may be suspended during periods of precipitation and snow cover.

Particulate air monitoring will be conducted with a Dust Trak II Model 8530 (or a similar device). This instrument is equipped with an audible alarm (indication of exceedance) and is capable of measuring particulate matter less than 10 micrometers in size (PM-10). It will continually record emissions (calculating 15-minute running average concentrations) generated during field activities. The dust monitoring devices will be checked and recorded periodically throughout the day of intrusive activities to assess emissions and the need for corrective action. Particulate monitoring response and action levels include:

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (μg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 μg/m3 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 greater than 150 μg/m3 above the upwind level, work must be stopped, and a reevaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 μg/m3 of the upwind level and in preventing visible dust migration.

2.2 Volatile Organic Compound Air Monitoring

Continuous and periodic volatile organic compound (VOC) air monitoring will be conducted during SRIWP activities. VOC air monitoring will be conducted using a RAE Systems MiniRAE 3000 VOC instrument (or a similar photoionization detector device) to provide real-time recordable air monitoring data.

During non-ground intrusive groundwater sampling activities, periodic VOC air monitoring of the work zone will be conducted, only. VOC readings will be collected upon arrival at the individual monitoring well, upon removal of the well cap, during purging/sampling and upon leaving the sampling location.

During ground intrusive activities VOCs will be monitored and recorded at the upwind and downwind perimeter of the exclusion zone. Upwind concentrations will be measured before field activities commence and periodically throughout the day to establish background conditions. The downwind VOC monitoring device will also be checked periodically throughout the day to assess emissions and the need for corrective action. VOC monitoring response and action levels include:

- 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 must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If the organic vapor level remains sustained above 5 ppm at the perimeter of the work area, activities must be shut down and work will be re-evaluated.

2.3 Meteorological Monitoring

Meteorological monitoring will take place on a daily basis during ground intrusive SRIWP activities. It will consist of recording the temperature, wind direction, and general atmospheric conditions (i.e., rain, snow, etc.) at the start of each workday. As work and weather conditions change throughout the day, the locations where the particulate and VOC air monitoring devices are set up may be adjusted accordingly.

APPENDIX A

NYSDOH GENERIC CAMP

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required 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.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. 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 must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. 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 must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can 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.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using 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 must 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.

1. 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 must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can 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.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

APPENDIX B

FUGITIVE DUST AND PARTICULATE MONITORING FROM DER-10 TECHNICAL GUIDANCE FOR SITE INVESTIGATIONS AND REMEDIATION

Appendix 1B
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

APPENDIX D

HEALTH & SAFETY PLAN

HEALTH & SAFETY PLAN

PROJECT INFORMATION

A. Project Site: Master Cleaners

B. Project Activities:

- o Drilling/Monitoring Well Installation
- o Groundwater Sampling
- o Soil Sampling Sampling

C. Location: 2312 - 2316 Western Avenue Guilderland, New York

D. Name and Address of Owner/Lead Contacts:

Foundry Village LLC
450 Loudon Road
Loudonville, New York 12211

Charles Bohl Incorporated
2314 Western Avenue
Guilderland, New York 12084

E. Emergency Contacts & Project Phone Numbers:

1.	Town of Guilderland Fire Department (911)	(518) 456-5000
2.	St. Peter's Hospital	(518) 525-1550
3.	Northeastern Engineering Technologies PLLC	(518) 884-8545
4.	Northeastern Environmental Technologies Corporation	(518) 884-8545
5.	Phoenix Environmental Laboratories	(860) 645-1102
6.	NYS Department of Environmental Conservation – R4	(518)-356-2045
7.	State Police Department (911)	(518) 382-5263
8.	Underground Facilities Protection Organization	(UFPO)1-800-962-7962

F. History and Nature of Site

The Site is located at the southeast corner of the intersection between NYS Route 20 (aka Western Avenue) and Foundry Road in the Town of Guilderland, Albany County, New York. The Site consist of two contiguous parcels of land identified by the Town of Guilderland as Tax Map No.'s 40.17-2-11.1 (3.2 acres) and 40.17-2-12 (0.42 acres). The respective addresses associated with the tax map listings are 2314-2316 Western Avenue and 2312 Western Avenue.

The 2314 - 2316 Western Avenue (Tax Map No. 40.17-2-11.1) portion of the Site is improved by one two-story (5) unit wood framed residential apartment building completed atop of a concrete foundation and full basement; one two-story concrete block and wood framed garage completed at grade with improved concrete floor surfaces and two second floor residential apartments; one single story concrete block and wood framed garage completed at grade with improved concrete floor surfaces; one single-story wood framed storage barn completed at grade, portions of which are improved by concrete floor surfaces; and an approximate 7,000 ft^2 remnant concrete foundation ruin for a commercial garage.

The 2312 Western Avenue (Tax Map No. 40.17-2-12) portion of the Site is improved by one single-story concrete block and wood framed structure completed with a slab on-grade foundation. The structure was most recently operated as Master Cleaners & Dyers Inc. a commercial dry-cleaning facility.

Based upon the investigations conducted to date, the primary contaminants of concern for the Site is the chlorinated dry-cleaning compounds of concern (COC) Tetrachloroethylene (PCE)and it's breakdown daughter compounds. A summary of know contaminants in the on-site soil and groundwater are summarized below.

- Soil – The chlorinated COCs have been detected in subsurface soils at concentrations above the 6 NYCRR Part 375 Restricted Residential SCOs in areas primarily beneath, adjacent to and down gradient of the former Master Cleaners dry-cleaning facility. PCE was detected at concentrations up to 21,000 parts per million (ppm) in shallow soils within a building sump. PCE-related breakdown products are also present in deeper soils (± 6 -16 feet below grade) including TCE at concentrations up to 110 ppm, cis-1,2-Dichloroethene (cis-1,2-DCE) up to 70 ppm, trans-1,2-Dichloroethene (trans-1,2-DCE) up to 0.31 ppm, and Vinyl Chloride up to 3.2 ppm.

- Groundwater – The chlorinated COCs have been detected in groundwater samples collected from the network of (21) on site monitoring wells at concentrations above the NYSDEC 6 NYCRR Part 703 groundwater standard. Total COC concentrations have been identified within the network of monitoring wells ranging from ± 1 – 200,000 ug/L. The most significant groundwater exceedances (above 10, 000 ug/L) have been documented to exist beneath the former Master Cleaners dry-cleaning facility and extending ±500 feet to the south, mimicking the flow groundwater.

- Soil Vapor & Indoor Air – PCE was detected in soil vapor at concentrations up to 3,860 micrograms per cubic meter (ug/m3), TCE up to 1,140 ug/m3, cis-1,2-DCE up to 1,050 ug/m3, trans-1,2-DCE up to 61.5 ug/m3, and vinyl chloride up to 2.81 ug/m3.

The HASP describes protection standards, practices and procedures pertaining only to this supplemental remedial investigation work plan (SRIWP). The HASP is written with the intent of developing the awareness of site personnel to the health and safety hazards, which may exist, thereby avoiding unnecessary risks. The HASP establishes mandatory safety practices, procedures and personal protection standards and applies to all field personnel associated with the SRIWP work. All personnel who perform project activities associated with the SRIWP will familiarize themselves with this HASP and comply with its requirements. Personnel will sign and date the "Tailgate Safety" form prior to entering any area on site suspected of being contaminated with hazardous materials (or any other such restricted areas - See Attachment A).

Note:

1. All information contained herein shall be reviewed by on site personnel prior to entering the work zone.

2. This HASP applies to all NETPLLC and NETC personnel and its assigned representatives only. Outside agent/contractors are responsible for their own internal Health and Safety Plan(s) prior to entering the site.

G. Project Objectives:

Information developed at the Site thus far suggests that the chemical impacts associated with prior commercial dry-cleaning activities at the Site include chlorinated volatile organic compounds (CVOCs). NETC has developed this HASP to manage impacts encountered at the site (if any) with the goal of protecting human health and the environment.

H. Site/Waste Characteristics

Waste Types: Liquid__X__Solid__X___Sludge_____Gas__X
Characteristics: Corrosive_____Ignitable_____Radioactive ____Volatile _X
Toxic _X_ Reactive __ Unknown _____

I. Field Work Description:

Field activities include: Direct push soil boring installation, groundwater monitoring well installation, soil sampling and groundwater monitoring and sampling.

J. Project Work Tasks:

Task 1: Drilling/Monitoring Well Installation
Task 2: Soil Sampling
Task 3: Groundwater Sampling

Comments:

Based on site conditions a modification to the scope of work may be deemed necessary. Any modification to the scope of services outlined in this HASP will first be endorsed by the DEC and/ or its assigned representatives.

Project Team Members:

Project Engineer:	Keith Rupert PE
Project Coordinator & Safety Officer (PCSO):	Jeff Wink PG
Qualified Environmental Professionals:	Jeff Wink PG, Robert Gray PG
Field Technician	Matthew Wink

K. Hazard Evaluation

The suspected hazards which may exist at the Master Cleaners site during site activities can be grouped into three categories; chemical; heat stress; and physical hazards associated with the operation of machinery

Chemical Hazards

Chemical compounds previously identified at the site can be categorized as chlorinated based hydrocarbons. All previous site assessment services have been performed in level "D" protection. On this basis, continuous respiratory protection is not indicated for most field activities. However, the necessity of respiratory protection will be based on continuous gas monitoring to be performed during all invasive sampling activities.

Cold Exposure

Field activities during SRIWP will be conducted during the spring / summer months. Therefore, cold exposure is not expected to be of concern. Cold exposure prevention and symptoms are further discussed in Section T.

Heat Stress

Field activities during SRIWP will be conducted during the spring / summer months. Therefore, heat stress may be of concern. Heat Stress prevention and symptoms are further discussed in Section T.

Physical Hazards

Physical hazards exist during the operation of earth moving / drilling machinery. These types of accidents may involve a wide range of bodily injuries and will be managed using conventional first responder first aid pursuant to EMS protocol as outlined in Sections S.

L. Personnel & Responsibilities

Listed below are key personnel involved with the project. Their responsibilities are also included:

1. PROJECT COORDINATOR / SITE SAFETY OFFICER

The project coordinator / site safety (PCSO) officer will direct the site investigation. After the project starts and the PCSO has had time to evaluate the potential for hazardous site conditions, he or she may determine that a member of the project team may assume site safety officer duties. The primary responsibilities of the PCSO are:

- Assuring that all personnel are aware of the potential hazards of the site as well as the proper and improper procedures for handling those hazards, should they occur, including all health and safety provisions and standards in this HASP.
- Assuring that the proper personnel protection equipment is available and utilized properly by all site personnel.
- Assure that site personnel observe the appropriate work practices procedures.
- Monitoring the performance of personnel to ensure that mandatory health and safety procedures are adequate and correcting any performances that do not comply with the HASP.
- Preparation and submittal of any and all project reports including progress, accident incident and contractual.

2. SITE PERSONNEL

Site personnel will be those individuals involved in field operations. Their primary responsibilities will be:

- Perform all required work safely.
- Familiarize them with and understand the HASP, including proper use of personal protection equipment.
- Report any unsafe conditions to supervisory personnel.

o Be aware of signs and symptoms of potential exposure to Site contaminants and weather stress/exposure. Based on the limited scope to the SRIWP on site personnel will be responsible for multi tasks as designated by the PCSO.

M. Emergency Services

Emergency services (fire, police, ambulance, and local hospitals) will be notified as applicable to activities at the site. Emergency telephone numbers, will be conspicuously posted next to the field telephone. All field personnel will be made aware of the location of the site telephone and the directions to the closest emergency facility.

All field personnel will be trained in the recognition of heat stress related to working in hot weather conditions. No person will work alone in the field; the buddy system will be strictly enforced and each will visually monitor his buddy as often as possible. Heat stress is discussed in more detail in Section T.

Water and first aid supplies will be strategically located on site for immediate access by on-site personnel. In the event of skin or eye contact with hazardous materials, the affected personnel will be immediately rinsed and brought to a physician. Subsequent to any emergency incident, a report describing the incident and those persons involved will be written and submitted to the PSOC.

N. Health & Safety Training

All field personnel will have received a "Health and Safety Training Course" for hazardous waste operations mandated by OSHA (29 CFR 1910.120). Appropriate personnel will receive the additional 8-hour supervisor's training.

Prior to starting work, the PCSO will conduct a training session to assure that all field personnel understand their safety responsibilities. All personnel will be instructed on potential health and safety hazards.

Specifically, the following topics will be covered in the initial training session:

- Potential routes of contact with contaminants.
- Types, proper use, limitations and maintenance of applicable protective clothing and equipment.
- respiratory protection using air-purifying respirators equipped with organic vapor and acid gas cartridges. This will include use, maintenance, storage, and limitations of use.
- Proper decontamination procedures and adherence to work zone boundaries.
- Proper waste/cuttings handling and disposal procedures.
- Reporting of accidents and availability of medical assistance.
- Recognition of symptoms and signs which indicate overexposure to contaminants or other hazards.

Each morning prior to the commencement of the day's work, on-site personnel will review the scheduled work for the day and health and safety procedures to be utilized with all team members. Additional training sessions will be conducted whenever any changes in health and safety hazards or procedures warrant it.

O. Standard Operating Safety Procedures

Standard operating safety procedures include precautions and operating practices that all responding personnel should follow. These include:

1. PERSONAL PRECAUTIONS

- No contact lenses may be worn on-site.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated contaminated.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- No facial hair which interferes with a satisfactory fit of the mask-to-face-seal is allowed on personnel required to wear respirators.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, sit or place equipment on drums, containers, or the ground.

- Medicine and alcohol can increase the effects from exposure to toxic chemicals. Unless specifically approved by a qualified physician, prescribed drugs should not be taken by personnel where the potential for absorption, inhalation or ingestion of toxic substances exists. Alcoholic beverages should be avoided during off-duty hours, if possible.

2. OPERATIONS

- All personnel entering the site must be thoroughly briefed on anticipated hazards, equipment to be worn, safety practice to be followed, emergency procedures, and communications.

- Any required respiratory protection and chemical protective clothing must be worn by all personnel entering areas designated for wearing protective equipment.

- Personnel on-site must use the buddy system at all times.

- Visual contact must be maintained between field and safety personnel.

- During continual operations, on-site workers act as safety backup to each other. Off-site personnel provide emergency assistance.

- Personnel should practice unfamiliar operations prior to performing the actual procedure.

- Entrance and exit locations shall be designated and emergency escape routes delineated by the PCSO.

- Communications using radios, hand signals, signs, or other means must be maintained between personnel at all times. Emergency communications will be prearranged by the PCSO in case of radio failure, necessity for evacuation of site, or other reasons.

- Personnel and equipment in the contaminated area should be minimized, consistent with effective site operations.

- All field personnel should make full use of their senses to alert themselves to potentially dangerous situations which they should avoid, e.g., presence of strong and irritating or nauseating odors.

- Field personnel should be familiar with the physical characteristics of the site, including:
  + wind direction in relation to contamination zones;
  + accessibility to associates, equipment, and vehicles;
  + communications;
  + operation zones;
  + site access; and
  + nearest safety shower and eyewash station.

- Procedures for leaving a contaminated area must be planned and implemented in accordance with the HASP prior to going on site.

- All visitors to the job site must comply with the HASP procedures. Personal protective equipment may be modified for visitors depending on the situation. Any modifications must be approved by the site PCSO.

P. Personal Protection Program

1. PROTECTIVE EQUIPMENT

Protective clothing and respiratory protection will help prevent on-site workers from coming in contact with contaminants. The selection of protective equipment will be based upon the types, concentrations, and routes of exposure that may be encountered. The appropriate level of protection for initial site entry will be based upon a conservative assessment of the best available site contamination information.

Based upon known facts relative to the site, Level D protective equipment is indicated during on-site work involving drilling and sampling. During these activities, the minimum required personal protective equipment for personnel within the work zone (Hot Zone) will consist of the following:

- o Hard-hat
- o Safety glasses (when full-face respirator is not indicated)
- o Steel-toe work boots
- o Tyvek suit (optional) or equivalent coverall clothing
- o Gloves
- o Safety glasses
- o Hearing protection
- o Use of the full face APR (equipped with organic vapor and acid gas cartridges) will be required when 5 PPM vapor is recorded on the Photoionization detector (PID) or a published TLV is documented within the ambient air of the work zone, after which use of the respirator will be mandatory.

2. FIELD MONITORING

During all drilling operations, monitoring of breathing space in proximity to the drilling equipment will be conducted with a PID calibrated to read 1:1 for Benzene. The results of PID monitoring will be used to advise personnel regarding existing conditions and to determine policy relative to the use of protective equipment. Monitoring will also be conducted during all drilling operations to detect any release of volatile organic compounds (VOC). This monitoring will be used to protect personnel from unsafe and/or unhealthful conditions. During other on-site activities not involving heavy equipment, sampling or the potential exposure to hazardous materials, Level D equipment is optional at the discretion of the site PCSO. Additional personal monitoring may be instituted based on the results of the initial field services.

Q. Site Control - Work Zones

1. CONTROL AT THE SITE

The site will be controlled to reduce the possibility of: (1) contact with any contaminants present and (2) removal of contaminants by personnel or equipment leaving the site. The possibility of exposure or translocation of substances will be reduced or eliminated by:

- Setting up security and physical barriers to exclude unauthorized personnel from the general area.
- Minimizing the number of personnel and equipment on-site consistent with effective operations.
- Establishing work zones within the site.
- Establishing control points to regulate access to work zones.
- Conducting operations in a manner to reduce the exposure of personnel and equipment and to eliminate the potential for airborne dispersion.
- Implementing appropriate decontamination procedures.

Three contiguous work zones are recommended:

Zone I: Exclusion Zone
Zone II: Contamination Reduction Zone
Zone III: Support Zone

Zone I: Exclusion Zone

The Exclusion Zone, the innermost of three areas, is the zone where contamination could occur. This zone will generally correspond to the immediate work zone surrounding the soil removal zone or drilling equipment targeted for the site. All people entering the Exclusion Zone must wear prescribed levels of protection. An entry and exit checkpoint will be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equipment into and out of the zone. This will assist in verifying the procedures established to enter and exit are followed.

The outer boundary of Zone I, the Hotline, has been established to be a 25 foot radius from the test bore / excavation. The Hotline will be defined by marker cones or similar barriers. During subsequent site operations, the boundary may be modified or adjusted as more information becomes available.

All personnel within the Exclusion Zone must wear the required level of protection. Personnel protective equipment is designed based on site-specific conditions including the type of work to be performed and the hazards that might be encountered. Different levels of protection may be justified within the Exclusion one as determined by the site PCSO after reviewing the specific operations.

Zone II: Contamination Reduction Zone

Between the Exclusion Zone and the Support Zone is the Contamination Reduction Zone which provides a transition between contaminated and clean zones. Based on the nature of this field services this will be a flexible zone based on the location of the sampling points but will generally correspond with the sites property line. At this time, the Contamination Reduction Zone is considered to be that area outside the storm water silt fence that surrounds the site. In the event gross contamination is encountered a designated site-specific contamination zone and associated reduction corridors will be established by the designated PCOS.

Unless otherwise specified by the PCSO, during drilling operations personnel entering Contamination Reduction Zone will be required to wear the prescribed personnel protective equipment, as required.

Zone III: Support Zone

The Support Zone, the outermost part of the site, is a non-contaminated or clean area. Support equipment is located in the zone; traffic is restricted to authorized site personnel. Since normal work clothes are appropriate within this zone, potentially contaminated personnel clothing, equipment, and samples are not permitted, but are left in the Contamination Reduction Zone until they are decontaminated.

R. Decontamination Procedures

Contaminated equipment and materials leaving the site must be decontaminated or isolated appropriately. All materials will be assumed contaminated if they have been used within the Exclusion Zone. Procedures for decontamination will consist of high pressure cleaning for the earth moving equipment, drilling and sampling equipment. Decontamination procedures may also call for large quantities of water, soap and brushes, and a collection system for the contaminated wash water. Requirements for decontamination will be limited by using disposable sampling equipment. The number of vehicles entering the site will be restricted to an absolute minimum. Only authorized vehicles will be allowed to enter the Contamination Reduction Zone.

Water will be available to team members for rinsing off contaminated material. Tyvek outer clothing will be discarded. The decontamination area will be set up to decontaminate clothing and equipment of team members leaving the Exclusion Zone on an as needed basis. Decontamination will consist of a thorough soap and water wash. Personal decontamination will become necessary only after personnel encountering gross contamination.

In order to minimize contamination of sample handlers and laboratory personnel, sample bottles will be tightly capped in the field, label secured and placed in the appropriate transportation container(s).

S. Emergency Information

1. EMERGENCY SITUATION

All on site activities present a potential risk to on-site personnel. During routine operations, risk is minimized by establishing good work practices, staying alert, and using proper personal protective equipment. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

Emergency conditions are considered to exist if:

- Any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on site; or
- A condition is discovered that suggests the existence of a situation more hazardous than anticipated.

2. EMERGENCY PROCEDURES

a) General: The following emergency procedures should be followed: In the event of emergency, the appropriate contacts identified in the emergency phone numbers list at the front of this HASP shall be notified. This list should be posted conspicuously at the site and next to the site telephone

- Personnel on site should use the "buddy" system (teams).
- Buddies should prearrange hand signals or other means of emergency signals for communications in case of being out of hearing range.
- Visual contact should be maintained between "teams" in order to assist each other in case of emergencies.
- In the event that any member of the field crew experiences any adverse effects or symptoms of exposure while on site, the entire crew should immediately halt work and act according to the instructions provided by the PCSO.

- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of personnel and reevaluation of the hazard and the level of protection required.
- In the event an accident occurs, the PCSO will complete an Accident Report Form (see Attachment A). Follow-up action shall be taken to correct any situation that caused the accident.

b) Personal Injury: In case of personal injury at the site, the following procedures will be implemented:

- On-site personnel administer treatment to an injured worker.
- The victim will be transported to the nearest hospital or medical center. If necessary, an ambulance will be called to transport the victim.

c) Chemical Exposure: If a member of the field crew is exposed to hazardous chemicals, the procedures outlined below will be followed:

- Another crewmember (buddy) will remove the individual from the immediate area of contamination.
- Precautions will be taken to avoid exposure of other individuals to the chemicals.
- If the chemical is on the individual's clothing, first rinse the clothing if possible, and then the clothing should be removed if it is safe to do so.
- If the chemical has contacted the skin, the skin will be washed with copious amounts of water.
- In case of eye contact, an emergency eyewash will be used.
- If necessary, the victim will be transported to the nearest hospital or medical center. The nature of the injury may require that an ambulance should be called to transport the victim.
- All chemical exposure incidents must be reported in writing by the PCSO on an Accident Report Form.

d) Escape Routes: Flags will be positioned at various other locations to indicate wind direction. In the event of an sudden release of fire, all personnel will move away from the immediate area in an upwind direction and then to the site exit point. Personnel downwind of the incident will first move to the perimeter of the site and then upwind to a safe distance.

e) Signal for Evacuation: In the event of a sudden release or fire requiring immediate evacuation of personnel, the signal for evacuation will be three quick horn signals. The horns will be kept in a conspicuously visible location for quick access by all on site personnel.

f) Other Signals: All equipment will be equipped with a fire extinguisher. It will also be the operator's responsibility to practice fire prevention measures such as periodically cleaning the equipment to keep it free of accumulated oil/grease or other combustible materials. In the event of a drill equipment fire or any other fire which cannot be controlled with available fire extinguishers, the local fire department will be summoned.

T. Thermal Exposure Monitoring

1. GENERAL : Adverse weather conditions are important considerations in planning and conducting site operations.

a) HEAT STRESS

Heat stress can result when the protective clothing decreases natural body ventilation. This can occur even when temperatures are moderate. Various levels of personal protection require low permeability disposable suits, gloves and boots, which prevent most natural body ventilation. Discomfort due to increased sweating and body temperature (heat stress) will therefore be expected at the work site. Some signs and symptoms of heat stress are:

- o Heat Rash - Continuous exposure to heat or humid air
- o Heat Cramps - Inadequate electrolyte replacement
  - muscle spasm
  - pain in the hands and feet
- o Heat Exhaustion - Inadequate blood circulation
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- o Heat Stroke - Temperature regulation fails and the body temperature rises to critical levels
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

b) Monitoring

- o Heart Rate - Radial pulse will be recorded during a 30-second period as early as possible in the rest period.
- o If the heart rate is >110 beats/minute at the beginning of the rest period, the next work cycle will be shortened by one-third and the rest period will remain the same.
- o If the heart rate is still >110 beats/minute at the next period, the following work cycle will be shortened by one-third.
- o Strip thermometers will be used if deemed necessary to record an individual's temperature at time intervals as follows:

Ambient Air Temperature	Interval
>70oF	every 3 hours
>80oF	every 2 hour
>90oF	every 1/2 hour

- o If normal temperature exceeds 99.6oF (37.6oC), the next work cycle will be shortened by one-third.
- o If oral temperature still exceeds 99.6oF (37.6oC) at the beginning of the next rest period, the following work cycle will be shortened by one-third.
- o No worker will be permitted to wear a semi-permeable garment when his/her oral temperature exceeds 100oF (38.1oC).

Recommendations to reduce heat stress:

- o Drink plenty of fluids (to replace loss through sweating)
- o Make adequate shelter available for taking rest breaks to cool off.

For extremely warm weather, follow these additional recommendations:

- o Wear cooling devices to aid in ventilation (the additional weight may affect efficiency.
- o Install portable showers or hose down facilities to cool clothing and body.
- o Shift working hours to early morning and early evening avoiding the hottest time of the day.
- o Rotate crews wearing the protective clothing.

c) COLD EXPOSURE

Prolonged exposure to cold will occur without proper protection, and the effects of cold exposure can be felt in temperatures above freezing as well as below freezing. Exposure to cold can cause severe injury (frostbite) or an overall drop in body temperature. Fingers, toes, and ears are most susceptible to frostbite. Both the outdoor temperatures and wind velocity play a part in cold weather injuries. Wind chill is used to describe the chilling effect of moving air in combination with low temperatures. Cold exposure is a serious threat to the site personnel that remove protective clothing and expose perspiration soaked underclothing to the cool air. Water conducts heat 240 times faster than air, thus rapidly cooling the body and wet clothing.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperatures - its symptoms are usually seen in 5 stages:

- o shivering
- o apathy, listlessness, sleepiness and rapid body cooling
- o unconsciousness, glassy stare slow pulse and respiratory rates
- o freezing of the extremities (most sensitive to freezing first are the fingers, toes and ears)
- o death

U. Record Keeping

1. PERSONNEL EXPOSURE

A site log with a required sign-in, sign-out procedure will document the time spent by each team member on the site. This information will be supplemented by periodic air monitoring in the work zone air.

2. PROTECTIVE EQUIPMENT

A checklist will track all protective equipment brought into the field each day. This will ensure that decontamination is performed in the field that any additional preparation, such as sanitizing face masks (if deemed necessary), is performed in the decontamination area prior to reuse. Any equipment malfunction must be noted on the checklist and repaired before reuse. Other routine maintenance checks will be scheduled and recorded on a regular basis to ensure that protective equipment is effective at all times.

3. INCIDENT REPORTS

Any chemical release to air, water, or soil must be reported to the PCSO. Any exposure to personnel resulting from such a release or from protective equipment failures must be reported immediately to the PCSO and / or other designated personnel as well as in writing within 24 hours.

4. MONITORING EQUIPMENT

All air monitoring equipment will be calibrated each day. Logs will be maintained for each calibration.

V. Sample Handling , Transportation & Shipment

1. HANDLING

All samples will be properly labeled and placed in clean containers before being removed from the site. To minimize the hazards to laboratory personnel associated with sample handling, sample volumes sent to the lab will be no larger than necessary and all sample containers will be sealed prior to shipment.

2. TRANSPORT

All samples collected at the site will be taken to a pre designated sample bank to be established / designated by the PCSO for preparation for shipment to appropriate laboratories. No samples, specimens, or other materials will be removed from the site other than those, which will be transmitted to the sample bank, or to designated disposal areas. All samples will be properly packaged following the sampling protocols to preserve the integrity of the sample and to prevent the inadvertent escape of contaminants. In addition, all samples will be placed in a suitable container before transport to prevent leakage.

2. SHIPPING

Shipping containers and labeling procedures will follow established protocols. Samples will be packed in ice chests filled with packing material and "Blue Ice". Department of Transportation regulations for sealing and marking the ice chests will be followed. At this time it is anticipated that all samples will be shipped by NETC to Phoenix Envir or other laboratory subcontractor designated for this work.

ATTACHMENT A

TAILGATE SAFETY MEETING FORMS

TAILGATE SAFETY MEETING

Date: _____ Time: _____ Job Number: _____

Client: _____

Job Location: _____

Type of Work: _____

Chemical Used: _____

SAFETY TOPICS PRESENTED

Protective Clothing / Equipment: _____

Chemical Hazards: _____

Physical Hazards: _____

Emergency Procedures: _____

Hospital / Clinic: _____ Phone Number: _____

Hospital Address: _____

Special Equipment: _____

Other: _____

ATTENDEES

NAME PRINTED	SIGNATURE

Meeting conducted by:

NAME PRINTED	SIGNATURE

INJURY REPORT FORMS

Employee's Report of Injury

(To be completed by the employee only.)

Employee's name: _____ Male__ Female__
Last First Middle

Date of birth: ____/____/____ Home telephone # (_____) _____

Home address: _____

City: _____ State: _____ Zip Code: _____

Present classification: _____ How long employed here: _____

Social Security No.: _____-_____-_____ Weekly salary: _____

Location of accident: _____
Address Area (loading dock, bathroom, etc.)

Date of accident: _____ Time of accident: _____

Describe fully how accident occurred: (including events that occurred immediately before the accident):

_____

_____

_____

_____

Describe bodily injury sustained (be specific about body part(s) affected): _____

_____

_____

Recommendation on how to prevent this accident from recurring: _____

_____

Name of supervisor: _____ Phone# _____
Last First

Name(s) of witness(es): _____ Phone# _____
(Attach witness(es) report(s))

When did you report the accident to your supervisor? _____

To whom did you report the injury? _____

Do you require medical attention? Yes:_____ No:_____ Maybe:_____

Name of your treating physician: _____ Phone# _____

Signature of employee: _____ Date: _____

Form may be copied as needed

Accident Witness Statement

(To be completed by accident witness)

Injured employee's name: _____
Last First Middle

Name of witness: _____ Ph# _____
Last First Middle

Job title of witness: _____ How long employed here?_____

Home address of witness: _____

City: _____ State: _____ Zip Code: _____

Location of accident: _____
Address/Name of building Area (bathroom, etc.)

Date of accident: _____ Time of accident: _____

Describe fully how accident occurred: (including events that occurred immediately before the accident):

_____

_____

_____

_____

_____

Describe bodily injury sustained (be specific about body part(s) affected): _____

_____

_____

Recommendation on how to prevent this accident from recurring:_____

_____

Name of Witnesse's Supervisor: _____ Ph#_____
Last First

Signature of Witness: _____ Date: _____

Form may be copied as needed

Supervisor's Accident Investigation

(To be completed by the employee's supervisor or other responsible administrative official)

Location where accident occurred		Employer's Premises: Yes ☐ No ☐ Job site: Yes ☐ No ☐	Date of accident or illness
Who was injured?		☐ Employee ☐ Non-Employee	Time of accident a.m. ☐ p.m. ☐
Length of time with firm	Job title or occupation	Name of dept. normally assigned to	How long has employee worked at job where injury or illness occurred?
What property/equipment was damaged?			Property/equipment owned by:
What was employee doing when injury/illness occurred? What machine or tool was being used? What type of operation?			
How did injury/illness occur? List all objects and substances involved.			
Part of body affected/injured?		Any prior physical conditions? If so, what? Yes ☐ No ☐	
Nature and extent of injury/illness and property damaged (be specific)			

PLEASE INDICATE ALL OF THE FOLLOWING WHICH CONTRIBUTED TO THE INJURY OR ILLNESS

____ Failure to lockout	____ Improper maintenance	____ Poor housekeeping
____ Failure to secure	____ Improper protective equipment	____ Poor ventilation
____ Horseplay	____ Inoperative safety device	____ Unsafe arrangement or process
____ Improper dress	____ Lack of training or skill	____ Unsafe equipment
____ Improper guarding	____ Operating without authority	____ Unsafe position
____ Improper instruction	____ Physical or mental impairment	____ Other _____

Supervisor's corrective action to ensure this type of accident does not recur: _____

_____

_____

_____

Was employee trained in the appropriate use of Personal Protective Equipment/Proper safety procedures? ... Yes ___ No ____

Was employee cautioned for failure to use Personal Protective Equipment/Proper safety procedures? ..... Yes ___ No ____

Did employee promptly report the injury/illness? ..... Yes ___ No ____

Is there modified duty available? ..... Yes ___ No ____

Supervisor's name	Supervisor's signature	Phone#	Date

Form may be copied as needed