Remedial Investigation Work Plan

New York City Economic Development Corporation
Parcel D, Bronx, New York
Site No. C203100

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 11th Floor
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Submitted by:

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Appendices

Abbreviations and Acronyms

AA	Alternatives Analysis
AOCs	Areas of Concern
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAMP	Community Air Monitoring Plan
CH4	Methane
COCs	Constituents of Concern
Con Ed	Consolidated Edison Company of New York
CPP	Citizen Participation Plan
CY	Cubic Yards
DD	Decision Document
DO	Dissolved Oxygen
EDD	Electronic Data Deliverable
FCD	Food Center Drive
FER	Final Engineering Report
FSP	Field Sampling Plan
ft bgs	Feet Below Grade Surface
GEI	GEI Consultants, Inc. P. C.
GPR	Ground Penetrating Radar
H2S	Hydrogen Sulfide
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCN	Hydrogen Cyanide
HDR	HDR, Inc.
HPFDC	Hunts Point Food Distribution Center
IRM	Interim Remedial Measure
ISS	In-Situ Stabilization
MGP	Manufactured Gas Plant
NOAA	National Oceanic and Atmospheric Administration
NOAA	National Oceanic and Atmospheric Administration
NYCEDC	New York City Economic Development Corporation
NYCRR	6 New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O2	Oxygen
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration

PAHs	Polycyclic Aromatic Hydrocarbons
PM-10	Respirable Particulates
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QEA	Qualitative Exposure Assessment
QEA	Qualitative Exposure Assessment
RI	Remedial Investigation
RIR/RAWP	Remedial Investigation Report /Remedial Action Plan
RIWP	Remedial Investigation Work Plan
SB	Soil-Bentonite
SCGs	Standards, Criteria, and Guidance
SCOs	Soil Cleanup Objectives
SIR	Site Investigation Report
VOCs	Volatile Organic Compounds

Certification

I, Kevin McCarty P.G., certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Report Remedial Investigation Work Plan (RIWP) 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-10).

Signature

Date

1. Background and Site Description

1.1 Introduction

GEI Consultants, Inc. P. C. (GEI) has prepared this Remedial Investigation Work Plan (RIWP) on behalf of the New York City Economic Development Corporation (NYCEDC) for the property located within Food Center Drive in the borough of Bronx, with the County of Bronx, New York (Site). The Site is located north of 400 Food Center Drive (FCD), which is within a larger tax lot containing multiple parcels of land and properties and is identified on NYC Tax Map Block 2781, Lot 500. The Site (Site No. C203100) was accepted into the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) with NYCEDC, i.e., the Applicant, participating in the BCP as a Volunteer pursuant to a Brownfield Cleanup Agreement (BCA).

Information regarding the Site conditions was obtained from the *Investigative Report for Parcel D, Bronx, NY* prepared by Lawler, Matusky & Skelly Engineers, LLP prepared in October 2005 and the *Preliminary Alternatives Analysis Report Parcel D, Bronx, NY*, dated July 2010 prepared by HDR, Inc. (HDR).

The site location map is provided within **Appendix A** as **Figure 1**.

1.2 Objective of the RIWP

The objective of this RIWP is to obtain valid data to evaluate and define the nature, extent, and degree of impacts previously identified onsite. Offsite data which includes soil, groundwater and soil vapor will also be collected in order to perform an Qualitative Exposure Assessment (QEA) that will determine the impacts of onsite contamination to offsite areas. The data generated during the field investigation will be used to determine what risks, if any, that the onsite impacts present to public health and to the environment. Additionally, the RIWP has been designed to provide data needed to perform a remedial alternatives analysis for the Site and recommend remedial actions for the site.

1.3 Background

Historically, the Site was part of the Consolidated Edison Company of New York (Con Ed) Manufactured Gas Plant (MGP) that operated from 1926 until the early 1960s. Gas operations included a coke/oven gas plant, a carbureted water gas plant, a light oil plans, and a liquid petroleum production area. In total, approximately 46 buildings or structures existed on the former Con Ed MGP facility that were actively involved in gas production. The facility stopped

production in the early 1960s and was demolished in early 1968. Portions of the former MGP have been divided into parcels (A through F) for purposes of investigation.

The Site (Parcel D) is located in a commercial and industrial area on the northeastern portion of the Hunts Point former MGP in the Borough of Bronx, New York City, Bronx County, New York (**Figure 1**). The property is approximately 7.2-acres, set along the waterfront at the confluence of the Bronx and East Rivers. A single small structure exists on the Site which is a Con Ed gas metering station that sits on an easement that traverses the northern portion of the Site from the water's edge to the western boundary. A large underground active natural gas pipeline traverses the Site from the east to west and eventually connects. The remainder of the parcel is an unimproved vacant lot over grown with vegetation. The Site is bounded to the north by a produce distribution warehouse, to the east by the Bronx River, to the south by a food distribution warehouse (BCP 400 Food Center Drive Site # C203101) and to the west by Food Center Drive and railroad spur (BCP Railroad Right-of-way Site # C203103). The area is currently zoned M3-1 (manufacturing). M3 zoning districts are designated for areas with heavy industries that generate noise, traffic, or pollutants. Typical uses include power plants, solid waste transfer facilities and recycling plants, and fuel supply depots (New York City Department of City Planning 2013 – NYC.gov).

1.4 Description of Local Hydrogeological Conditions

Information available from prior investigations that is available in historic NYSDEC files indicates the Site is comprised almost entirely from filled land. The Site stratigraphy consists of a 10 to 15-foot thick layer of fill material. The shoreline appears to consist of a band of sandy fill material which appears to have been dredge material specifically placed within the Bronx River prior to filling the remainder of the Site. The interior of the parcel contains a large, fairly uniform deposit of MGP waste material that has been identified as purifier bed material and coal tar. The remainder of the fill consists of a mixture of sand, construction and demolition material (brick, concrete, stone, wood, etc.), coal and coal ash, slag and cinders. Much of this material is believed to have been placed during the MGP operations and may have come from the MGP facility.

The fill material is underlain by a confining, native clay layer which is believed to be the surface of the former tidal wetland and shallow embayment. Much of Hunts Point is similarly filled with this same clay layer immediately beneath it.

Groundwater is encountered approximately 5 feet below grade surface (ft bgs) on Site. Groundwater in the shallow material is considered isolated from the deeper aquifer by the clay layer. This primarily allows free lateral movement which is impeded in a number of locations within Hunts Point as a result of significant underground utilities and the backfill associated with the utilities. Within Site D there is only one underground utility located along the northern

boundary. This is an underground Con Ed natural gas pipe line but it is believed to be buried several feet below the surface and may not intersect the water table. Groundwater flows to the east to the Bronx River and may in certain areas proximate to the river or be impacted by tidal influences. Other studies within Hunts Point have shown that the deeper aquifer beneath the clay layer is also connected to the river and tidal impacts can be measured but with different intensities than the shallow fill material.

1.5 Previous Report Findings

In accordance with the DER-10, this RIWP incorporates a summary of relevant Environmental Site Investigations, which provide the basis for identifying the areas of concern (AOCs) and the principal constituents of concern (COCs) on the Site.

1.5.1 Investigative Report, LMS (2005)

Following a review of the Site history of the entire Hunts Point peninsula, it was determined that a former manufactured gas plant operated over the area during the early to mid-portion of the last century. In order to evaluate the conditions left by those operations the entire area was divided into separate parcels and entered into the New York State Department of Environmental Conservation Voluntary Cleanup Program (NYSDEC VCP). An investigative workscope was prepared and approved in 2004 for Site D. The investigation was conducted shortly after and the report presented in October 2005. The observation and examination of subsurface conditions at the Site included the performance of a Ground Penetrating Radar (GPR) study to assess and attempt to identify the limits of the MGP waste, installation of test borings and groundwater monitoring wells.

During the Site investigation, a large amount of MGP-related waste material was noted to be visible and exposed at the surface. The waste observed included a large area of Prussian Blue purifier waste near the central area of the Site and several smaller areas of coal tar along the western end. Forty-seven test probes and seven piezometers were installed across the Site. Visual identification of waste as well as the results of the GPR survey was used to identify the limits of the major waste deposits.

The Site investigation assessed the following objectives:

- To identify and provide mitigation for potential hazards to Site workers during future development construction;
- To identify subsurface conditions to quantify and assess possible hazardous conditions; and
- To identify specific soil, groundwater and waste that would require further treatment, handling and/or disposal.
- To provide data that would allow an evaluation of remedial technologies.

The results of the Site historical review, GPR survey, sampling, analysis and data evaluation were summarized in the final Investigation Report for Parcel D (SIR), dated October 2005. The SIR showed a large portion of the Site was impacted by coal tar and purifier waste, which exists both above and below the water table elevation. A significant area of the surface exhibits the characteristic Prussian blue color that is indicative of oxidized and precipitated purifier bed waste material. The waste is exposed over the surface of an area larger than 1 acre and extends from the surface, impeding vegetation growth at some locations, to a maximum depth of approximately 15 feet.

Based on information gathered during this investigation, the estimated volume of in-situ MGP waste (defined as purifier or coal tar type material) was estimated at approximately 46,000 cubic yards (CY). Based on the average depth to groundwater (5 to 10 ftbg) and the average thickness of the MGP waste (approximately 12 feet) it was estimated that approximately 50% (23,000 CY) of the MGP waste is located above the groundwater table. The estimated volume of coal tar waste was 3,000 CY, approximately six-percent of the total waste identified. These estimated volumes will be further evaluated during the subsequent Remedial Investigation Work Plan (RIWP) and remedial design for the Site.

1.6 Proposed Future Use of Site

NYCEDC representing the City of New York plans to lease or develop the parcel in part, whole or in combination with other lands within Hunts Point Food Distribution Center (HPFDC) to either with a tenant who will redevelop the Site or as a development under NYCEDC. The goal of the redevelopment is to enable and enhance the growth of the City's wholesale food industry in a manner that is consistent with and complementary to the surrounding market use. The development may contain or consist of a resiliency-based project that will support the Hunts Point Food Distribution Center during power shortages associated with severe weather events.

A draft redevelopment plan with details, including surface coverings, will be submitted to NYSDEC and New York State Department of Health (NYSDOH) when available. The submission will provide information on engineering controls that will be incorporated as part of the development. Plans showing site utilities and infrastructure, including storm drainage, will be submitted to the appropriate New York City agencies for review and approval. Any modifications will follow final approvals and Site Management Plan requirements following the approved Decision Document (DD).

1.7 Project Organizational Structure and Responsibility

GEI will coordinate with NYSDEC to conduct the RIWP.

The drilling subcontractor will be responsible for all drilling activities to include, but not be limited to, compliance with all applicable Occupational Safety and Health Administration (OSHA) regulations, personnel health and safety, installation of soil borings and groundwater monitoring wells associated with the RIWP, and any other specified tasks outlined in this RIWP.

GEI will be responsible for project management, subcontractor oversight, RIWP compliance, determination of corrective measures when needed, monitoring for health and safety, perimeter-air monitoring activities (Community Air Monitoring Program-CAMP), collection of analytical samples, and maintenance of Site sampling and meteorological logs. GEI will also serve as the Site Health and Safety Officer.

The following are the key personnel or agencies involved with RIWP activities at the Site:

NYSDEC:	Ronnie E. Lee, P.E. Environmental Engineer 2 Remedial Bureau B, Section C Division of Environmental Remediation NYSDEC 625 Broadway Albany, NY 12233-7016
Drilling Subcontractor:	Preferred Environmental
GEI:	Gary Rozmus, P.E. Program Manager 110 Walt Whitman Road, Suite 204 Huntington Station, NY 11746 (631) 479-3510 Kevin McCarty P.G. Project Manager 1385 Broadway, 20th Floor New York, NY 10018 (212) 845-9965 Ms. Jaimie Wargo Quality Assurance Officer 455 Winding Brook Drive Glastonbury, CT 06033 (860) 368-5300
Remedial Party Contact:	Ms. Tracey Bell New York City Economic Development Corp. 110 William Street New York, NY 10038

Resumes of key GEI personnel for this project are included in **Appendix B**.

2. Scope of Work

All field work will be performed in accordance with the Field Sampling Plan (FSP) methods included in **Appendix C**. Analytical sampling will be performed in accordance with the Quality Assurance Project Plan (QAPP) included in **Appendix D**. A Community Air Monitoring Plan (CAMP) will be implemented during field activities and is included in **Appendix E**. The locations of proposed sampling points for the RIWP are depicted in **Figure 2** and **3**.

The RIWP scope of work includes the following general tasks:

- Mobilization and Site Access
- Site Preparation
- Odor and Fugitive Dust Control
- Monitoring Well Installation and Development
- Monitoring Well Sampling
- Groundwater Model
- In-Situ Stabilization and Soil-Bentonite Wall Treatability Study
- Material Handling
- Site Restoration
- Survey
- Reporting

2.1 Execution of the RIWP

Site work is anticipated to be performed between the hours of 7am-5pm, Monday through Friday. During working hours, the drilling subcontractor will make every effort to minimize potential community impacts. These include, but are not limited to, noise and traffic concerns associated with the execution of the RIWP.

2.2 Mobilization and Site Access

The selected drilling subcontractor will submit a Site-specific Health and Safety Plan (HASP) meeting the minimum requirements of GEI's HASP, which is included in **Appendix F**. All work will be performed in accordance with OSHA, state, and industry safety standards. All onsite personnel performing intrusive activities that have the potential to come in contact with impacted materials will have the requisite 1910.120 OSHA Hazardous Waste Operations and

Emergency Response (HAZWOPER) Training as well as Site-specific training prior to intrusive activities. All personnel performing work associated with this RIWP will be required to have both general and Site-specific training. The general training includes all applicable OSHA and state required training, such as 40-hour HAZWOPER and the 8-hour Refresher Training. Supervisory personnel will also have supervisory training. Site-specific training will include a review of potential Site hazards, required personal protective equipment (PPE), and Site warning and evacuation procedures.

The drilling subcontractor will apply for and obtain all necessary Federal, State, and local permits associated with the RIWP. These permits may include, but are not limited to, traffic routing, road opening, construction/zoning, etc.

Access to the Site is provided by NYCEDC.

The drilling subcontractor will be responsible for contacting the New York City One Call Center to request that all utilities on the Site be located and marked. GEI will also collaborate with Con Ed in determining existing and abandoned utilities within the Con Ed easement.

The drilling subcontractor will mobilize all necessary labor, equipment, supplies, and materials to complete the RIWP. Lay down areas for equipment, supplies and materials, the appropriate exclusion zone(s) and support area(s) will be identified to conduct the planned activities safely and effectively. All equipment will be decontaminated prior to arrival on the project site and will also be decontaminated prior to leaving the project Site.

2.3 Site Preparation

Site preparation activities necessary to provide support for the work include the establishment of work zones, support facilities, decontamination facilities, and installation of temporary security measures around work areas will be performed. The work area may change daily based on the locations of the sampling points.

2.4 Odor and Fugitive Dust Control

In accordance with NYSDEC and NYSDOH requirements, a CAMP will be implemented at the Site during ground intrusive activities. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., offsite receptors, including businesses, on-and-offsite workers not involved with Site RIWP activities) from potential airborne contaminant releases as a direct result of intrusive RIWP activities.

Air monitoring stations will be placed up-wind and downwind of intrusive work areas (i.e., soil boring and monitoring well locations). Volatile Organic Compounds (VOCs), Hydrogen Sulfide (H_2S), Hydrogen Cyanide (HCN), methane (CH_4) and respirable particulates (PM-10) will be

monitored at the up-wind and downwind stations on a continuous basis. In addition, to the fixed stations, VOCs, H_2S, HCN, CH_4, Oxygen (O_2) and particulates will be monitored in the work zone using hand held equipment.

2.5 Soil Sampling

Soil samples will be collected using the direct push method (Geoprobe®) with a 3-inch macro core sampler. Probes will be advanced through waste material and into the lower lying soil units to provide full depth information on the surface of the underlying clay and other native units with respect to fill and groundwater.

- Native Perimeter Soils
- Identify native soil layers in perimeter delineation borings.
- Target soils from the 5-20 ftbg interval.
- Collect a minimum of 100 lbs. per each dominant soil type identified and submit for geotechnical analysis.

- Native Clay Beneath Purifier Waste
- Minimally disturbed clay cores preserved in the macro core sleeve and collected from a minimum of four locations from beneath the purifier beds.
- Cores to be submitted for geotechnical analysis.

Three (3) additional borings will be installed offsite to observe potential offsite impacts originating from Site and will be advanced using the Geoprobe® direct push method to depths ranging from approximately 15-20 ftbg depending on observed soil conditions in the field as determined by GEI Field Personnel. These locations will also be converted into temporary monitoring wells. Continuous sampling will be conducted until the desired depth is reached. If impacts to soil are observed at depth, the boring may be advanced further to identify vertical extent of contamination until un-impacted soils are observed, or a confining layer or bedrock refusal is reached. Prior to the advancement of soil borings, all locations will be cleared for utilities and subsurface infrastructure to a depth of 5 ftbg using minivac, air knife, or by hand. Continuous sampling will be conducted until the desired depth is reached.

Soil samples and groundwater samples collected from the temporary monitoring wells will be analyzed for Target Compound List Volatile Organic Compounds (TCLVOCs) by 8260C, Target Compound List Semi-Volatile Organic Compounds (TCLSVOCs) by 8270D, for Target Analyte List Metals (TAL Metals) by 6010B and 7471A, for Polychlorinated Biphenyls (PCBs) by 8082A, for Pesticides by 8081B, and Total Cyanide analysis by 9012B.

Soil will be inspected for visual and olfactory impacts and screened with a Photo Ionization Detector for VOCs. Only one (1) soil sample will be collected either from an interval where impacts are noted or one-foot above the water table if no obvious signs of impacts are observed.

A summary of analyses and methods for soil can be found in **Table 1** in the QAPP.

2.6 Monitoring Well Installation and Development

The RIWP proposes the installation of nine (9) permanent groundwater monitoring wells on the Site and three (3) flush-mounted groundwater monitoring wells on the property north of the Site (Dairyland) and to the west (Baldor Foods). The proposed monitoring well locations are shown on **Figure 2**. Of these 9 monitoring on-Site wells, four (4) will be screened in the shallow overburden, with a maximum depth of 20-feet, four (4) will be screened in the deep overburden with a maximum depth of 40-feet, one (1) will be screened in till with a maximum depth of 50-feet, and one (1) will be screened in bedrock with a maximum depth of 60-feet.

The monitoring wells will be constructed with 2-inch ID, threaded, flush-joint, PVC casing and approximately 10 feet of 0.02-inch slot screens. The annulus around the screens will be backfilled with silica sand having appropriate size for the subsurface conditions (e.g., Morie No. 2).

Following installation, each monitoring well will be developed by the driller. Monitoring wells may be developed using a high flow pump and will be monitored for drawdown and recovery. Development of monitoring wells will be completed no sooner than 24 hours following installation. Development water will be discharged on the ground in the vicinity of the well or in the closest location to allow water to infiltrate. The objective is to prevent runoff and groundwater from leaving the Site.

In addition, three (3) groundwater samples will be collected from temporary points shown on Figure 2. Each temporary sampling point will be installed using the same methodology of as monitoring wells and with a temporary PVC casing installed approximately 5-9 ft into the water table. Sampling will be performed following removal of drilling equipment and purging of the casing of three volumes. No development will take place for the temporary points. Following sampling, the casing will be removed and the hole backfilled with inert material that can include sand, bentonite, cement grout with unimpacted fill. The temporary wells will be located in the upgradient areas or the Site in the Dairyland parking lot to the north of Site D, in the railbed area of the RR ROW BCP Site to the west of Site D and in the Krasdale parking lot (BCP Site 400 FCD) to the south of Site D.

The locations of the proposed wells and groundwater samples and rationale for placement are listed below:

MW-107S – Located on the eastern side of the Site in close proximity to the Bronx River. The well will be screened in the shallow overburden material.

MW-107D – Located adjacent to MW-107S and screened in the lower organic silt and clay layer.

MW-108D – Located along the norther Con Ed gas easement in the central portion of the Site. This well is screened in the lower clay and organic silt layer.

MW-109S – Located in the center of the Site, this well is screened in the waste material.

MW-109D – Located in the center of the Site (with MW-109S), this well is screened in the clay and organic silt.

MW-109DD – Located in the center of the Site (with MW-109S & D), this well is screened in the lower glacial till layer.

MW-109BR – This well is located in the center of the Site (with MW-109S, D & DD), this well is screened in the upper fractured bedrock.

MW-110S – This well is located in the Northwest corner of the Site screened in the shallow fill material.

MW-110D – This well is located in the Northwest corner of the Site (with MW-110S) screened in the organic silt and clay.

MW-111S – This well is located offsite in the Dairyland parking lot and is screened in the shallow overburden.

MW-112S – This well is located offsite to the west in the southern portion of the Baldor Foods (BCP 155 FCD #C203098) parking lot.

MW-113S – This well is located offsite to the west in the northern portion of the Baldor Foods (BCP 155 FCD #C203098) parking lot.

The locations of the proposed temporary wells for use in the Qualitative Exposure Assessment (QEA) are listed below:

TW-1 – Is located north of Site D within the adjacent Dairyland parking lot just south of MW-111S.

TW -2 Is located west of the Site in the BCP RR ROW Site.

TW-3 – Is located south of the Site in the Krasdale parking area.

2.7 Monitoring Well Sampling

Groundwater samples will be collected from the three (3) shallow overburden monitoring wells and four (4) deep overburden monitoring wells following installation at the Site. Sampling of monitoring wells will be performed following development and after the water level has stabilized as follows: All wells will have field parameter readings recorded during sampling including; pH, oxidation reduction potential (ORP), specific conductance and dissolved oxygen (DO).

The following three (3) monitoring wells (MW-108D, MW-110D and MW-110S) will be analyzed for benzene, toluene, ethylbenzene, and xylenes (collectively referenced as BTEX) by 8260C, for the 16-priority pollutant polycyclic aromatic hydrocarbons (PAHs) by 8270D, for total cyanide by 9014, and for free cyanide by 9016.

Four (4) monitoring wells will be analyzed with an expanded analyte list to include analyses for wells listed above and total dissolved solids, total organic carbon, alkalinity, priority pollutant metals, and major ions. These four (4) monitoring wells include the well pair between the MGP-related waste footprint and the river (MW-107S and MW-107D), and the monitoring well pair closest to the center of the Site MGP-related waste footprint (MW-109S and MW-109D).

Emerging Contaminants (EC) sampling of groundwater will be performed in a select group of monitoring wells from Site D. Under this RIWP, four of the wells are recommended for sampling (MW-111S, MW-107S, MW-110S and MW-109S). The wells will be combined with monitoring wells from adjacent and surrounding BCP Sites within Hunts Point to gather an overall condition of the larger area. A list of the specific wells to be sampled will be proposed to NYSDEC for review following installation of all BCP monitoring wells. Analysis that will be performed will include EPA method 537 or ISO 25101. Data will be provided with full category B deliverables and a Data Usability Summary Report (DUSR) will be prepared for the EC sampling. Other groundwater samples will not be submitted for DUSR because of the known levels of contamination and this data will not be used to support a No Further Action scenario.

Sampling will be performed as per the NYSDEC Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) protocol provided by NYSDEC. The protocol is included with the FSP. Sampling for ECs will be performed on a different schedule from standard RI groundwater sampling due to the rigid protocols required for that specific sampling methodology and the proposal for specific wells from a larger group of Hunts Point BCP Sites.

QA/QC samples will be collected according to the QAPP. Additional lab analyses may be included based on field observations. Groundwater samples will be properly transported to a NYSDOH ELAP-certified laboratory under chain of custody procedures.

2.8 Groundwater Model

As a component of the groundwater and hydrogeological evaluation, GEI will perform 4-hour pump tests at the deep overburden, till and bedrock wells and measure the water level response at the adjacent shallow overburden wells. GEI will perform slug testing at several of the newly installed wells to estimate hydraulic conductivity of the representative material encountered. After the new wells are installed and developed, GEI will perform one round of synoptic gauging for the entire monitoring well network.

The proposed monitoring well network will include monitoring wells on adjacent BCP properties as well to provide a broader understanding of the overall groundwater surface across the Hunts Point peninsula. Additional monitoring wells that will be included in the evaluation will be BCP sites of Krasdale and the Meat Market (400 FCD and 355 FCD), located to the southeast and southwest of the Site, respectively.

GEI will incorporate the new monitoring wells, aquifer testing results, and synoptic gauging data into the groundwater model. Initial and refining model runs will be performed, as well as confirmation of acceptable convergence for model results, and required calibration and tracking adjustments. This will allow an overall, general evaluation for an estimate of the flux for total and free cyanide through the native clay layer to be made. The clay is believed to underlie the entirety of the Site, which will also be confirmed during the drilling program.

The objectives of the model are to:

- Predict groundwater mounding and flow deflection around the proposed Site In-Situ Stabilization (ISS) mass in the shallow and deep overburden;
- Predict changes to local groundwater stagnation in the shallow and deep overburden based on the presence of the proposed Site ISS mass and low-permeability Soil-Bentonite (SB) barrier wall.
- Predict groundwater stagnation in the deep overburden beneath the proposed ISS mass on the Site.

- Predict total and free cyanide concentrations in the deep overburden downgradient of the proposed ISS mass on the Site.

2.9 Soil Vapor Sampling

The scope of work proposed for the characterization of soil vapor onsite and offsite focuses on the potential for offsite migration as well as the potential for onsite migration of contaminants from offsite sources. The results of soil vapor and air sampling will assist in evaluating future onsite engineering controls.

The following scope of work is proposed to characterize the soil vapor at the Site:

- Install six (6) soil vapor points in the immediate vicinity (approximately 5ft) from monitoring well or groundwater sampling locations. Three (3) of the soil gas points will be installed in locations adjacent to the temporary groundwater monitoring points (TW-1, TW-2 and TW-3) in order to assess soil vapor for the offsite Qualitative Exposure Assessment (QEA). Initially proposed locations for the remaining three (3) soil vapor points include; MW-109S, MW-107S and MW-108D). If existing wells or offsite soil vapor points are found to exist, they may be used;

- Purge and collect soil vapor samples from six (6) points; and

- Analyze soil vapor samples for contaminants of concern including: benzene, toluene, ethylbenzene, xylene, and naphthalene.

The locations of the proposed samples and rationale for placement will be evaluated based upon data available from investigation reports for adjacent sites. When locations have been determined a figure will be prepared and submitted to NYSDEC.

Each soil vapor probe will be installed approximately 2 ft below the ground surface using dedicated 1/8" Teflon tubing. The tubing will be implanted into the hole and the annular space sealed with bentonite to prevent ambient air from entering the area around the probe. Once the seal is secure, a "T" fitting and valve will be connected on the above-surface end of the tubing. A syringe will be used to purge the vapors in the probe and tubing of three volumes. As required by the NYSDOH, a helium (He) tracer will be used as part of the sampling process and all testing will follow the NYSDOH Soil Vapor Guidance. If greater than 10% He is detected during the screening process, this will indicate excessive leakage and will require the point to be resealed or reinstalled after which tracer gas testing will be performed. Prior to sample collection, the He vapor will be screened using a field meter and the measurement recorded at each soil vapor sampling location. A multi-gas meter will also be used to measure the

concentration of O_2, CO_2, and CH_4 in each probe, to assess the subsurface chemistry (e.g. redox state). Following this procedure, the soil vapor samples will be collected in clean, batch certified, two (2) liter Summa™ canisters at flow rates no greater than 200 ml/min. A slight vacuum should remain in the Summa canister prior to shipment to the lab in order to show no leakage has occurred.

2.10 In-Situ Stabilization and Soil-Bentonite Wall Treatability Study

In addition to the groundwater model wells described above in Section 2.5, the installation of probes throughout the Site will be completed to evaluate the location, depths and limit of the purifier bed material. The completion of the probe installation will also provide additional delineation information for the limits of coal tar identified during the initial investigation. The proposed delineation boring locations and sampling transects are shown on **Figure 3**, located in **Appendix A**. This work will all include survey for all locations with GPS and will be followed by a topographic survey as described below in Section 2.12.

Soil probes will be advanced through MGP-related waste material and into the lower lying confining clay unit to provide full depth information on the surface of the underlying clay with respect to fill and groundwater. Samples will be collected from coal tar, purifier waste and clay and will be submitted for geotechnical and/or laboratory analysis. The evaluation will provide preliminary information that will be used in the initial evaluation for remedial alternatives.

Current options for future treatment or remediation of the MGP-related material includes thermal treatment, incineration, landfilling and ISS. Samples will also be collected from the purifier bed material and submitted for a treatability ISS assessment. Current experiences from the treatment of adjacent properties impacted with similar MGP-related wastes will be used to supplement this proposed evaluation.

Due to a large volume of MGP-related waste at this Site being dry and located above the water table, a wider range of treatment options may be viable compared to the surrounding properties. It has been historically noted that a majority of MGP-related waste at surrounding properties is located near or below the water table.

2.11 Material Handling

Investigation derived waste will be placed on the ground surface in the area and vicinity of where it was generated. Groundwater from sampling and pump testing will be disposed of on the ground surface where it will not negatively impact the specific testing being performed.

2.12 Site Restoration

The Site is currently not developed and is completely overgrown. No restoration will be performed within the Site.

2.13 Survey

All monitoring wells and soil boring locations will be surveyed by a licensed surveying firm.

Following completion of the RIWP activities, a New York State Licensed Land Surveyor will survey all monitoring wells and soil probe locations. The elevation of each completed element will be determined to ±0.01 foot. All locations and elevations will be tied to the New York State Plane Coordinate System.

Monitoring wells installed within the Site will be surveyed for both horizontal location (northing and easting), ground level and top of casing elevation. GEI will retrieve tidal elevation data from the nearest National Oceanic and Atmospheric Administration (NOAA) tidal monitoring station. The surveyor will gauge the water level in the river and record the time of this measurement so that monitoring well elevations, river level, and the NOAA tidal data can be analyzed to a common datum.

2.14 Reporting

Reporting is discussed in Section 5.

3. Quality Assurance/Quality Control (QA/QC) Protocols

QA/QC protocols are included in **Appendix D**.

4. Health and Safety Protocols

Health and safety protocols are detailed in the HASP, which is included in **Appendix F**.

5. Data Evaluation and Remedial Investigation Report

The soil, soil vapor and groundwater sample results will be compared to 6 New York Codes, Rules, and Regulations (NYCRR) Part 375 Commercial Use Soil Cleanup Objectives (SCOs), NYSDOH and NYSDEC guidance values, and the New York State Ambient Water Quality Standards and Guidance Values for Class GA Groundwater, respectively. The remedy anticipated for the Site will not address the historic fill material within the Site but will be directed primarily at the MGP waste, specifically the coal tar and purifier waste. The remaining material will also likely exceed Commercial SCOs and the comparison to those criteria will primarily be beneficial in determining where significant reduction in contaminants and mobility may be applicable.

5.1 Data Evaluation

The purpose of the data evaluation is to determine the extent of onsite soil and groundwater impacts and to assure that data obtained during the implementation of the RIWP are adequate in quantity and quality, and applicable to project objectives. In order to make this determination, the data will be reviewed for the quality of data coverage, compatibility of data collection methods, and completeness, with respect to meeting project objectives.

To facilitate the interpretation of data generated during the remedial investigation activities, the data will be tabulated in data summary tables. Figures showing sampling locations with the corresponding analytical results will be prepared to enhance the overall understanding of Site conditions in regard to the magnitude, location, and flow and transport of contamination.

5.2 Geologic/Hydrogeologic and Water Quality Characteristics

Geologic and hydrogeologic characterization will incorporate the results of subsurface evaluation and sampling activities, groundwater sampling and monitoring activities, as well as general hydrogeologic and hydraulic features of the Site. The characterization will set forth conclusions regarding the direction, gradients, and potential fluctuations or anomalies of shallow groundwater in the immediate vicinity of the Site.

5.3 Qualitative Exposure Assessment

The purpose of the Qualitative Exposure Assessment (QEA) is to document how people may be exposed to site contaminants and to identify and characterize the potentially exposed population and under reasonably anticipated future use of the Site.

The exposure assessment must evaluate the five elements associated with exposure pathways and describe how each of these elements pertains to the site being evaluated. The exposure pathway elements that must be addressed, include: (1) a description of the contaminant source(s) including the location of the contaminant release to the environment (any waste disposal area or point of discharge) or if the original source is unknown, the contaminated environmental medium (soil, indoor or outdoor air, biota, water) at the point of exposure; (2) an explanation of the contaminant release and transport mechanisms to the exposed population; (3) identification of all potential exposure point(s) where actual or potential human contact with a contaminated medium may occur; (4) description(s) of the route(s) of exposure (i.e., ingestion, inhalation, dermal absorption); and (5) a characterization of the receptor populations who may be exposed to contaminants at a point of exposure. In addition to human exposure, the QEA will also address the potential for fish and wildlife impacts from site contaminants and the potential for onsite contamination to impact adjacent parcels (offsite areas). The offsite QEA will evaluate data collected from the investigation (onsite and offsite) as well as existing data from offsite sampling in order to evaluate potential impacts.

5.4 Additional Field Investigations

Additional field investigations may be required as the data is developed during the implementation of the site investigation. Conditions that would warrant additional investigation include data gaps, further delineation of groundwater or soil contamination, or additional data necessary to evaluate or determine the effectiveness of a potential remedial alternative technology.

If additional investigation is required, a supplemental work plan may be prepared and submitted to the NYSDEC for review and approval for implementation during the course of this site investigation. If supplemental investigation is meant to further the determinations presented in the Remedial Action Work Plan (RAWP), this information may be provided in this later submittal.

As part of the remedial investigation, up to three (3) groundwater samples will be collected from temporary points installed offsite in up and downgradient locations in order to perform the QEA. Each temporary sampling point will be installed using the same or similar methodology as monitoring wells and with a temporary PVC casing installed approximately 5-9 ft into the water table. Sampling will be performed following removal of drilling equipment and purging of the casing of three well volumes. No development will take place for the temporary points. Following sampling, the casing will be removed and the hole backfilled with inert material that can include sand, bentonite, cement grout or unimpacted fill. In addition, a soil sample will be collected and analyzed along with the installation and sampling of a soil vapor point. Analyses for soil and groundwater will include volatile organics, semi-volatile organics, metals and cyanide. A soil vapor point will be installed in the same location or immediately adjacent to

each boring/well and it will be analyzed for BTEX and naphthalene. Existing data from adjacent sites will be evaluated to determine if this will satisfy the off-site sampling requirements. Data that is proposed to be acceptable will be submitted to NYSDEC for review and acceptance for use in the offsite qualitative exposure assessment. Soil vapor sampling will also be performed within the Site boundary in order to assess the conditions prior to implementing any part of the remedial action. Testing will be performed in a manner similar to the offsite analyses.

5.5 Remedial Investigation Report/Remedial Action Work Plan

The results, along with supporting documentation, will be provided to the NYSDEC in the form of a Remedial Investigation Report /Remedial Action Plan (RIR/RAWP). This RIWP investigation incorporates specific remedial testing efforts directed at remedy design and in order to provide a comprehensive data set and Report, the information will be combined. Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements. All data generated as part of the remedial investigation (RI) will be submitted to NYSDEC in the appropriate Electronic Data Deliverable (EDD) format. The RIR/RAWP will contain a description of the source, as well as characterizations of the geologic, hydrogeologic, soil, and water quality. Additionally, if needed, the RIR/RAP will contain a remedial action alternative analysis as well as the proposed remedial alternative. The RAWP is further described in Section 6 below.

Additionally, an Alternatives Analysis (AA) will be prepared and submitted along with the RAWP in order to allow NYSDEC to make a determination on the proposed remedy and prepare a Decision Document (DD).

Based on the findings of the RI, a list of remedial action objectives will be developed with the requirement for the selected remedial measures to be protective of human health and the environment under the proposed future use scenario. Proposed SCOs for the property will also be presented based on the proposed future use of the Site. SCOs will be based on published standards, criteria, and guidance (SCGs) and other NYSDEC and NYSDOH accepted values. SCOs are at this time not anticipated to be met as the entire Site is filled with historically generated material as well as highly contaminated MGP-related waste. The Commercial SCOs will be presented in order to evaluate imported material, engineering controls and other restrictions on groundwater use.

5.6 Interim Remedial Measures

Preliminary results from the RI will be used to evaluate the necessity for an immediate response associated with a particular medium, route of exposure, or potential sensitive receptor. The Interim Remedial Measure (IRM) will be selected with the understanding that the measure should be compatible with the overall project objectives and long-term remedial action goals.

If an IRM is deemed necessary, an IRM work plan will be submitted to the NYSDEC in the RIR/RAWP, which describes the proposed measure, justification for its selection, and a schedule for the activities associated with its implementation. Depending on specific circumstances and conditions at the Site following complete implementation of IRMs, the activities associated with the IRMs may be determined to constitute complete remediation.

6. Remedial Investigation Report/Remedial Action Work Plan

Should an IRM be the only remedial work required, an evaluation of the remedial action objectives, alternatives scoping and analysis of remedial action alternatives will be performed to support that conclusion that the IRM is appropriate and that no other actions are needed.

6.1 Remedial Alternatives Scoping

Objectives of the Remedial Alternatives Evaluation

The overall objective of the remedial alternatives evaluation process is to select a remedial action. The selected remedial action will exhibit the following characteristics:

- Protection of public health and the environment;
- Attains federal and state public health and environmental requirements identified for the Site;
- Utilizes permanent solutions and alternative treatment technologies to most practical extent within proven technological feasibility and availability;
- Utilizes treatment to permanently reduce the toxicity, mobility, volume, or extent of contamination; and
- Minimizes costs.

6.2 Analysis of Remedial Action Alternatives

Remedial Investigation Report/Remedial Action Work Plan

Upon completion of the RI results and findings, as well impacted soil excavation, the need for further remediation will be evaluated. A Draft RIR/RAWP will then be submitted to NYSDEC for comment and approval. As previously mentioned, an AA will also be prepared to allow evaluation and selection of the preferred remedial alternative for the Site.

7. Citizen Participation Activities

GEI will prepare the Citizen Participation Plan (CPP) for the Site following receipt from NYSDEC of the local community notification list. GEI will:

- Establish a Community Information Repository at the local library and local community board;
- Participate in public meetings that the NYSDEC and NYCEDC deem necessary to apprize the community of the current or proposed activities;
- Disseminate the approved fact sheets to the Site Contact List.

A description of the plan is presented below.

7.1 Description of Citizen Participation Activities

This section describes the specific citizen participation activities that are to be carried out during the implementation of the RIWP.

7.1.1 Citizen Participation Plan

The CPP will be deposited in the designated document repository. In addition to the CPP, previously prepared documents, such as the Phase I report, Phase II report, Consent Order, and HASP will be filed in the repository.

7.1.2 RIWP

The Final RIWP will be placed on file in the document repository as well.

7.1.3 Remedial Investigation Report

The Draft RIR will be placed in the information repositories and the public will be so notified of this with the fact sheet.

7.1.4 Interim Remedial Measures

If an IRM is to be implemented, the public will be involved as part of the Citizen Participation Process.

7.1.5 Remedial Action Work Plan

Remedial alternatives, beyond impacted soil excavation and in-situ stabilization of purifier waste as an IRM are not anticipated to be warranted for the Site, but may be evaluated based on the information generated during the implementation of this RIWP, which will be summarized and presented in the RIR/RAWP.

If additional remediation beyond the impacted material removal and in-situ stabilization of purifier waste is required because other impacts are identified which require remediation, then the following steps may be needed.

Should an IRM be the only remedial work required, an evaluation of the remedial action objectives, alternatives scoping and analysis of remedial action alternatives will be performed to support that conclusion that the IRM is appropriate and that no other actions are needed.

If further remediation is determined to be needed, a Draft RAWP will be prepared which details the proposed remedial action plan. NYSDEC will issue a DD, and the DD will be placed in the document repository. An NYSDEC fact sheet will be distributed to the media on the Contact List to announce the availability of the DD for public review and comment. A fact sheet and notice of public meeting, if necessary, will be distributed by a mailing. Public comments will be solicited to aid in the preparation of the Final RAWP. The public meeting will be conducted, if required. Following the public comment period, NYSDEC will issue a DD, at which time the RAWP will be finalized.

7.1.6 Post Remedial Action

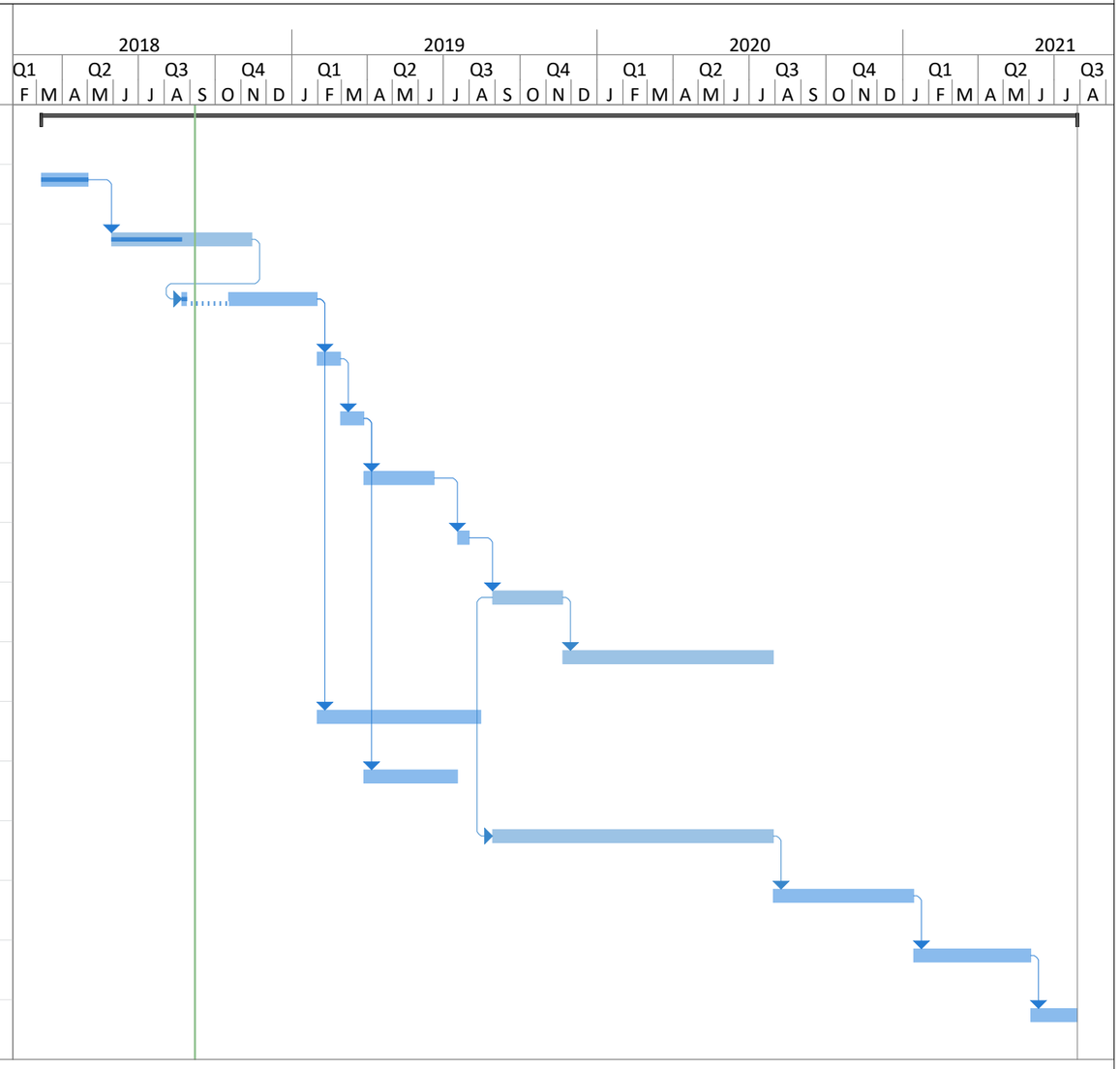
Following completion of the remedial action, or actions, two Fact Sheets will be prepared. The first will summarize the Final Engineering Report (FER) and the second will announce the issuance of the Certificate of Completion. The two sheets will be combined if the FER and Certificate of Completion issuance occur close in time.

8. Schedule

The project schedule for implementation of the RIWP activities is presented below. The schedule may be affected by regulatory review time periods, contractor response timeframes, timeframes necessary to negotiate access agreements with property owners, community issues, permit review and approval timeframes, or other unknown factors. In addition, if the scope of the proposed RIWP changes as a result of negotiating access or regulatory review, then revisions to the work plan, and plans and specifications or change orders with the drilling subcontractor and/or GEI may be required and the schedule presented herein, may be impacted. Every effort, however, will be made to keep the project on the anticipated schedule.

Hunts Point - Site D Project Schedule
NYCEDC

ID	Task Name	Duration	Start	Finish	Predecessors
1	**SITE D**	**44.3 mons**	**Wed 3/7/18**	**Wed 7/28/21**	
2	Investigation and Reporting	2 mons	Wed 3/7/18	Tue 5/1/18	
3	Bench Scale Testing	6 mons	Wed 5/30/18	Tue 11/13/18	2FS+1 mon
4	Treatability Study Reporting/ AAR/RAWP/GW Model/Design	4 mons	Wed 8/22/18	Wed 1/30/19	3FS-1 mon
5	NYCEDC Review Period	1 mon	Thu 1/31/19	Wed 2/27/19	4
6	Con Ed Review Period	1 mon	Thu 2/28/19	Wed 3/27/19	5
7	NYCEDC Procurement (Site F & Site D)	3 mons	Thu 3/28/19	Wed 6/19/19	6
8	Mobilization	0.5 mons	Thu 7/18/19	Wed 7/31/19	7FS+1 mon
9	DSM Wall Construction - Site D	3 mons	Thu 8/29/19	Wed 11/20/19	8FS+1 mon
10	ISS Construction & Implementation	9 mons	Thu 11/21/19	Wed 7/29/20	9
11	Redevelopment Design	7 mons	Thu 1/31/19	Wed 8/14/19	4
12	Contracting	4 mons	Thu 3/28/19	Wed 7/17/19	6
13	Construction	12 mons	Thu 8/29/19	Wed 7/29/20	9SS
14	Final Engineering Report	6 mons	Thu 7/30/20	Wed 1/13/21	13
15	Environmental Easement	5 mons	Thu 1/14/21	Wed 6/2/21	14
16	Certificate of Completion	2 mons	Thu 6/3/21	Wed 7/28/21	15

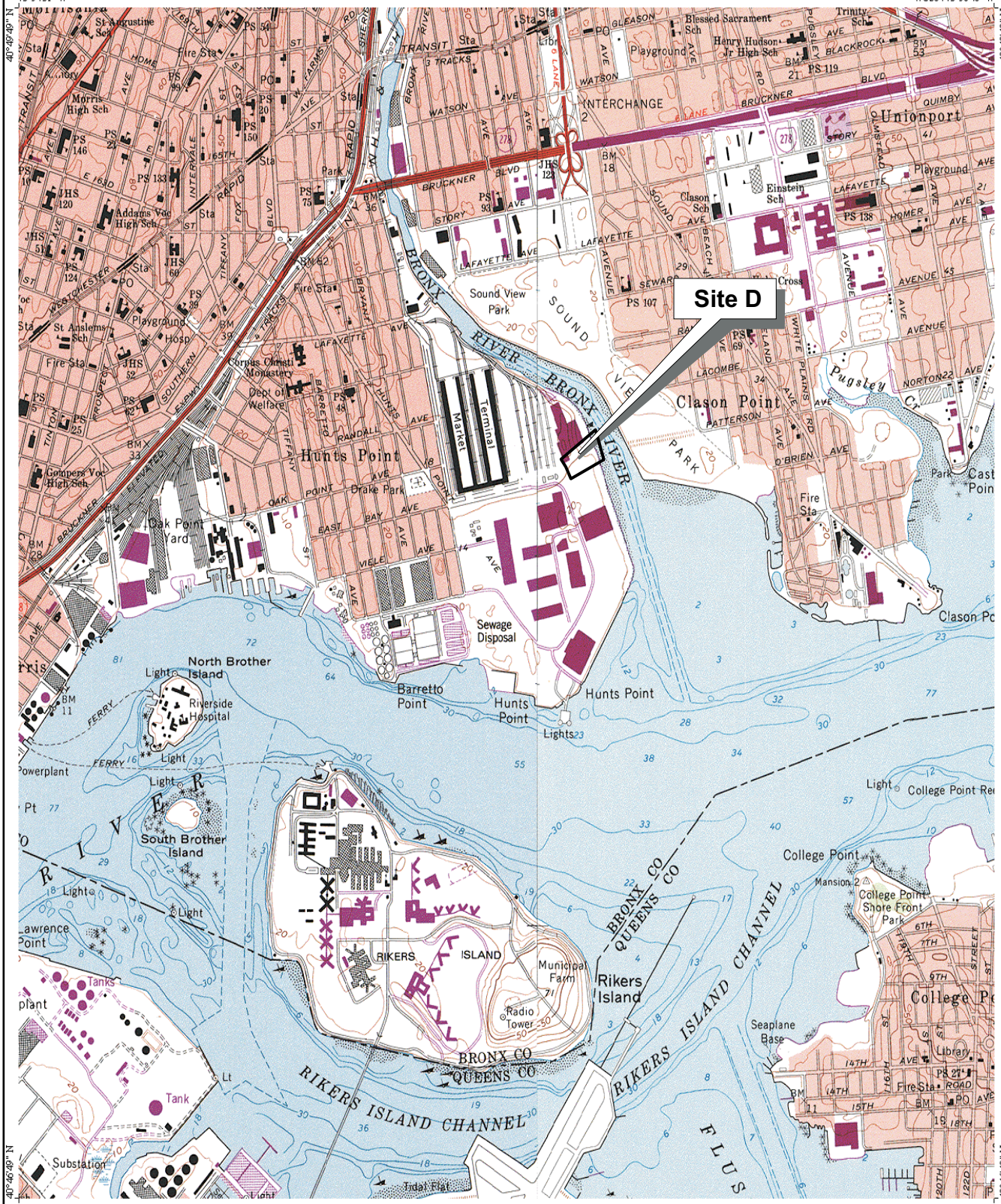


Project: Hunts Point - Site D
Date: Fri 9/7/18

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	Manual Progress
Summary	Inactive Task	Duration-only	Finish-only	

Appendix A

Site Figures



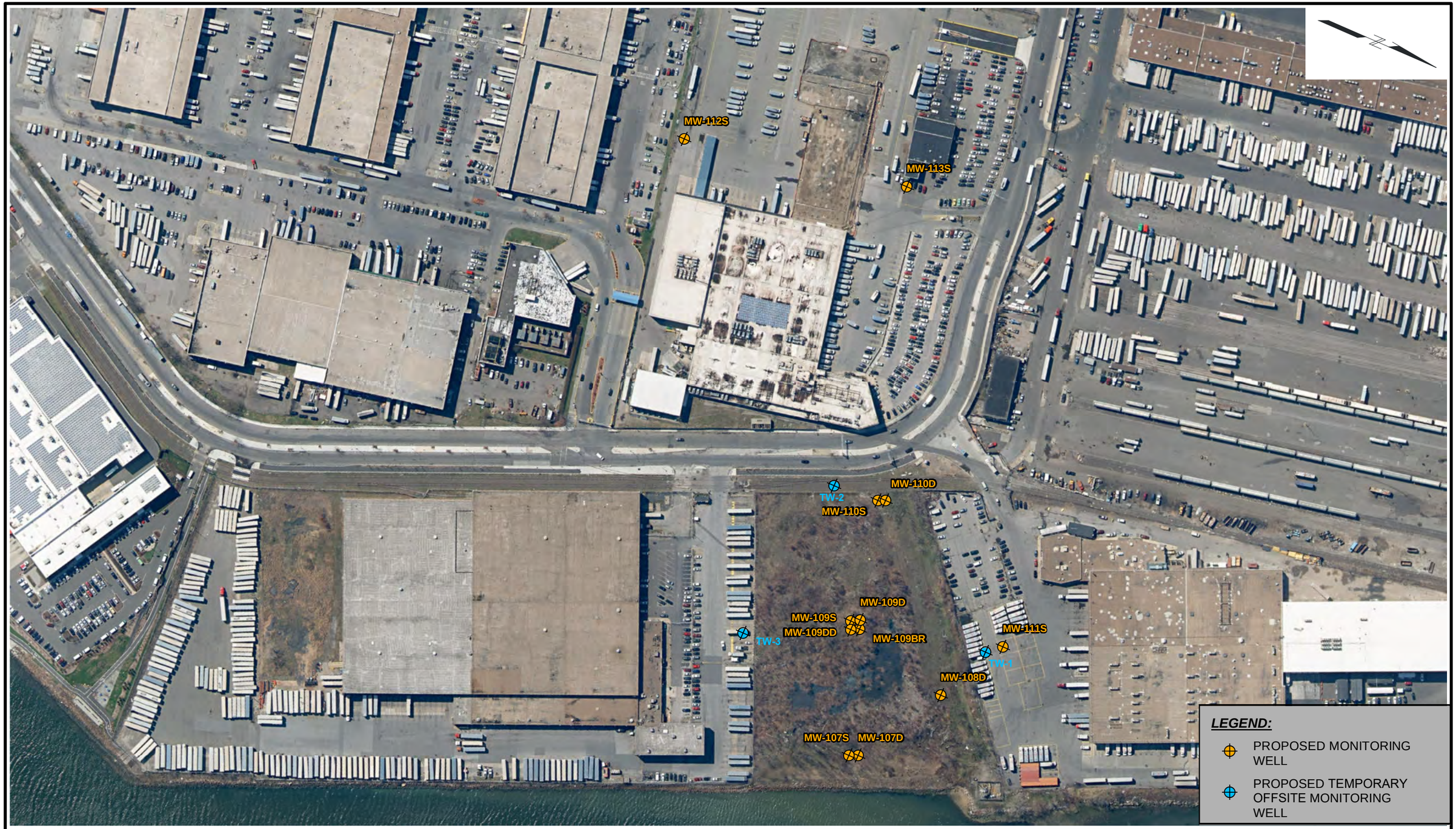
Map source: USGS 7.5 minute quadrangle series, Central Park, NY-NJ, 1966, photorevised 1988.

GEI Consultants, Inc., P.C.
1385 Broadway
20th Floor
New York, NY 10018
(212)-687-8282

Site D Location

Hunts Point • Bronx • New York

Figure 1



SOURCE:
1. 2015 ESRI WORLD IMAGERY.

0 200 400

SCALE: 1" = 200'

Hunts Point
Bronx, New York

NYC Economic Development Corporation
New York, New York

GEI Consultants

PROPOSED WELL LOCATIONS

March 2018 Fig. 2

J:\Projects\Integral\Hunts Point\Proposed MW Locations June 2017.mxd

SOURCE:
1. 2015 ESRI WORLD IMAGERY

0 200 400

SCALE: 1" = 200'

Hunts Point
Bronx, New York

NYC Economic Development Corporation
New York, New York

GEI Consultants

PROPOSED LOCATIONS

May 2018 Fig. 3

J:\Projects\Integral\Hunts Point\Site D Proposed Locations.mxd

Appendix B

Key GEI Personnel Resumes

Gary Rozmus, P.E.
Senior Consultant

resume

Gary Rozmus is a recognized leader in the environmental services and Brownfield redevelopment marketplace. His expertise is in Site assessment (Phase I, II and II ESAs, soil vapor intrusion and RI/FS); remediation; Brownfield redevelopment and risk-based closure (including area-wide and site specific planning and redevelopment); environmental compliance; regulatory interaction and negotiations; permitting; impact assessments; hazardous materials management (including asbestos containing materials-ACM, lead-based paint and other building and facility hazardous materials); GIS mapping and inventory; hazardous and non-hazardous waste management; litigation support; design, construction and facility decommissioning and demolition environmental services; stormwater and wastewater management; natural resource assessments; landfill closure; emergency incident/derailment consulting response; sustainable environmental design; and real estate transaction and support.

EDUCATION
M.S., Civil Engineering, Polytechnic Institute of New York
B.S., Civil Engineering, Manhattan College

EXPERIENCE IN THE INDUSTRY
43 years

EXPERIENCE WITH GEI
4 years

REGISTRATIONS AND LICENSES
Professional Engineer, NY No. 056744

CERTIFICATIONS
e-RAILSAFE Badge: e-VERIFILE.COM, Inc

MTA Metro-North Railroad Roadway Worker Procedures Training

PREVIOUS EXPERIENCE

Vice President in charge of national and regional business development and client and project management to private and public clients. Directed the corporate Brownfield Redevelopment and Transit and Rail environmental services business development groups. Developed and implemented strategic business development plans, served as client manager/point of contact and senior project manager or project manager on numerous projects.

Major clients and projects include:

Freight Railroads

CSXT: provided services to CSXT since the 1980's. This includes its corporate environmental, real estate (RPI) and law departments. These projects include the transfer of the NYC Highline to New York City for development as a promenade park and the sale of the Staten Island north shore line and St. George's railyard to NYC. The railyard has been redeveloped from a Brownfield site to a NY Yankees minor league ballpark. Hundreds of projects were performed and grew account to generate $3-4 million in annual consulting fees.

Norfolk Southern: provided services under a master services contract to the environmental, real estate and design and construction groups. These projects include the investigation and closure of sites in central NY, real estate leasing support services and facilities engineering assistance. Projects ranged up to several hundred thousand dollars.

Amtrak: provided services under a master services contract and on design and construction projects. These projects included conducting environmental compliance audits of major shop facilities, preparing environmental compliance plans and programs, facility design and bridge design. Projects ranged up to several hundred thousand dollars.

Transit Railroads

Directed and provided senior project management support for national transit client programs including Long Island Railroad (LIRR), Metro North Railroad (MNR), NYC Transit Authority, New Jersey Transit (NJT), SEPTA and WMATA. Led the efforts to win general environmental services contracts with LIRR, MNR and NJT and led efforts to win environmental services work as part of design and construction projects with total fees in the millions of dollars range.

Public and Private Sector Clients

Directed and provided senior project management services to public clients including NYC Mayor's Office of Environmental Remediation, NYC Economic Development Corporation; Triborough Bridge and Tunnel Authority, NYS and NYC DOT, other NYC agencies, other NY municipalities; and private clients including attorneys; manufacturers/distributors-e.g. Duracell and Frito Lay, developers, communication companies and construction contractors. As Senior Vice President and principal, led the environmental services area for primarily private clients.

- Awarded an ACEC Diamond Award and ACEC National Recognition Award for developing the NYC SPEED portal (Searchable Property Environmental E-database)
- Secured and directed a multi-year Brownfield consulting services contract through the NYCEDC for the NYCMOER. Led a team of environmental planners and GIS specialists in developing the NYC SPEED portal which mapped the entire City of NY and identified vacant Brownfield sites and environmental/Phase I data for each site as well as many other informational features
- Secured and managed area-wide Brownfield contracts under eight NYSDOS Brownfield Opportunity Area (BOA) grant awards.

PROJECT EXPERIENCE

City of Mt. Vernon Canal Village Brownfield Opportunity Area (BOA) and Local Waterfront Revitalization Plan (LWRP) Study, Mt. Vernon, NY. Environmental Project Manager for the Canal Village combined BOA and LWRP project to develop a redevelopment plan for the 251-acre waterfront area which includes the industrial area in the southeast corner of the City. This area lays along the eastern edge of the city limits that coincide with the Hutchinson River and its southern boundary with the Bronx, New York City. Because this planning effort has been made possible by two separate grants being combined—New York State's BOA and LWRP programs—there are two separate project boundaries which overlap. The work will serve as a BOA Nomination Report and as a neighborhood master plan for the Canal Village and the Hutchinson River Waterfront. This project included a study of the transportation and pedestrian network; industrial sector and regional relationships; strategic redevelopment sites investigation; public outreach; climate change impacts, habitat restoration, waterfront redevelopment plans, and green infrastructure opportunities; economic and market conditions study; urban design and open space considerations; and priority/catalytic redevelopment site selections.

City of Newburgh Brownfield Opportunity Area (BOA) Project, Newburgh, NY, City of Newburgh. Environmental Task Leader for the study to create a strategy for revitalizing and redeveloping the Census Tract area of the city of Newburgh, New York. This work included analysis of local, regional, and national markets to determine best land use revitalization, inventory and analysis of brownfield sites, existing land use patterns and zoning, transportation systems and infrastructure, and natural resources and environmental features. Tasks included community outreach and participation in the BOA process and the development of a redevelopment master plan.

Remedial Investigation/Remedial Analysis, Elmira, NY, Norfolk Southern Railway Company. Project Principal responsible for project oversight of the development of a remedial investigation work plan, remedial investigation report, and remedial alternatives analysis for a former rail yard in accordance with the site's voluntary cleanup agreement with the New York State Department of Environmental Conservation. Investigative efforts included surface and subsurface soil sampling, groundwater sampling, and soil gas investigation.

Newtown Creek Brownfield Opportunity Area, Brooklyn, NY, Greenpoint Manufacturing and Design Center. Project Manager responsible for providing services related to the Newtown Creek Brownfield Opportunity Area in Brooklyn, New York. Tasks included planning, developing a public engagement strategy, attending meetings, analyzing existing conditions of the study area, developing conceptual design guidelines, completing an economic analysis, developing a geographic information system (GIS) database, and preparing project recommendations and a draft nomination plan document.

Site Remediation, Redevelopment, and Legal Support Services, Huntington, NY, Town of Huntington. Project Manager responsible for site remediation, redevelopment, expert witness, and legal support services for the Town of Huntington in the Huntington Station Brownfield Opportunity Area. The Town had obtained a property under eminent domain that had been contaminated under prior usage involving a solid waste transfer station. Acted as Senior Project Manager in charge of evaluating remedial and redevelopment alternatives and costs that would meet New York Department of State brownfield future use standards and requirements. In addition, our firm was retained to assist the Town and legal counsel in litigation between the Town and the prior owner for cost recovery purposes.

Planning Work for Brownfields Opportunity Area Nomination Study, Huntington, NY, Town of Huntington. Project Manager responsible for planning work for the preparation of a Brownfields Opportunity Area nomination study to receive New York Department of State approval for the development of the Huntington Station area.

Brownfield Cleanup Program and Vacant Properties Database, New York, NY, New York City Mayor's Office of Environmental Remediation. Assistant Project Manager assisting with the development of a database for a Brownfield Cleanup Program (BCP) to promote the redevelopment of potentially contaminated and under-used sites. The City's BCP is the first municipal program of its kind in the country, and it is intended to facilitate the fast and efficient cleanup and reuse of contaminated sites. One of the 10 brownfield initiatives is the creation of a database of historical site uses across the city that can be used to identify potential brownfield sites. This vacant property database assists in the rapid redevelopment of these sites and allows the City to measure long-term progress toward the plan's goals.

On-Call Environmental Services, Various Locations, National Railroad Passenger Corporation (Amtrak). Contract Manager/Program Director providing on-call environmental service, which included conducting assignment audits of various facilities, designing a chemical storage and equipment washing facility at the Bear Delaware shop, and preparing spill prevention control and countermeasure (SPCC) plans for various facilities. Services also included permitting and plans; derailment and emergency response; SPCC and hazardous waste contingency; geographic information systems (GIS) services; hazardous waste and RCRA; air emissions permitting, compliance, and reporting; wastewater and stormwater; due diligence investigations; remedial investigations and feasibility studies; remedial design, oversight, and operation; wetlands assessments and mitigation; environmental management system, compliance audits, and environmental training; asbestos, lead-based paint, and mold services; environmental impact statement and National Environmental Policy Act services; industrial hygiene; and brownfield redevelopment.

Long Beach Brownfield Opportunity Area Study, Long Beach, NY, City of Long Beach. Project Manager responsible for providing professional planning services for the preparation of an approvable Brownfield Opportunity Area pre-nomination study for the revitalization of the bayfront area consistent with New York State Department of State and New York State Department of Environmental Conservation requirements. The project area was along Reynolds Channel on the southern shore of Long Island that is programmed for mixed-use redevelopment, including mid-rise residential development and a waterfront promenade.

Babylon Train Wash Facility, Babylon, NY, MTA Long Island Railroad. Senior Environmental Project Manager responsible for providing services for the conceptual, preliminary, and final designs and construction services for the unmanned, automatically operated, single-direction Babylon Train Wash Facility. The facility is designed to accommodate electric and diesel-hauled trains and consists of a single-story unit masonry building adjacent to the steel-framed wash bay with metal clad siding.

Coes Neck Phase II Site Assessment, Bethpage, NY, Nassau County. Project Manager responsible for reviewing and evaluating the Coes Neck Phase II site assessment report on behalf of surrounding community groups.

Construction-Phase Services, Long Island City, Queens County, NY, MTA Long Island Railroad. Senior Environmental Project Manager responsible for providing construction-phase services for the demolition and reconstruction of Long Island City Diesel Yard in Long Island, New York. Construction-phase responsibilities included reviewing submittals, investigating field conditions, and resolving technical issues.

Environmental Services, NY, Confidential Client. Assistant Project Manager responsible for providing remediation assistance and other environmental services, including a document review and site visit; ongoing interim remedial measures (IRMs); operation and maintenance and reporting; an IRM engineering assessment; meetings and communications; troubleshooting and repair of the soil vapor extraction systems and groundwater extraction treatment system; record of decision-related services; and oil spill assistance.

Phase I Environmental Site Assessment, Hempstead, NY, Planned Parenthood of Nassau County. Project Manager responsible for performing a Phase I environmental site assessment.

Remedial Investigation/Remedial Alternative Analysis, Brooklyn, NY, Frito-Lay, Inc. Senior Project Manager responsible for providing project oversight and technical and policy assistance for a remedial investigation and alternatives analysis. The remedial investigation was conducted in accordance with New York State Department of Environmental Conservation (NYSDEC) DER-10 Guidelines. The work included a remedial investigation work plan, remedial investigation report, and supplemental remedial investigation work plan and the implementation of the supplemental remedial investigation and remedial alternatives analysis. Our firm prepared the brownfield applications and successfully worked with the NYSDEC case manager to gain acceptance into the Brownfield Cleanup Program.

General Engineering Services, Suffolk County, NY, Metron Development Services. Assistant Project Manager responsible for performing general engineering services for project development.

Hudson Line Overpass Improvements, Westchester County, NY, MTA Metro-North Railroad. Senior Environmental Project Manager responsible for providing construction supervision and inspection services for the rehabilitation of the Hudson Line stations from Hasting-on-Hudson to Ossining in Westchester County, New York. The goal of the project was to rehabilitate Hudson Line historic station overpasses and platforms, including canopies, stairs, and amenities.

Croton-Harmon Maintenance Facility Replacement Priority Repairs, Croton-on-Hudson, NY, MTA Metro-North Railroad. Senior Environmental Project Manager responsible for designing multiple fixed-facility improvements, including the preparation of design-build construction documents for a new wheel truing facility; the study and design of facility modifications and improvements to support the new M-7 fleet; and preparation of construction documents for roof and facade repairs and plumbing renovations inside and outside of the main shop facility. The new facility is a 12-bay, pre-engineered, 8,250-square-foot passenger-train maintenance facility incorporating vehicle pits for wheel-truing equipment, 3-ton bridge crane, and storage areas.

Acquisition Due Diligence Assessment and Environmental Health and Safety Compliance Audit, Fulton, NY, Crompton Corporation. Senior Project Manager responsible for a pre-acquisition due diligence assessment and regulatory compliance audit of a plastic extrusion equipment plant constructed in the early 1900s. A site survey was conducted and historical records reviewed to identify potential areas of environmental concern. Company environmental and health and safety files and practices were reviewed to assess the current status of regulatory compliance.

On-Call Services, Northport, NY, Village of Northport. Project Manager responsible for providing on-call services, including environmental, civil, geotechnical, structural, electrical and mechanical engineering, architectural, and construction management services.

Harmon Maintenance Facility Replacement, Phases I, II, and IV, Croton-on-Hudson, NY, MTA Metro-North Railroad (MNR). Environmental Task Leader for the various phases of the replacement of a rail

maintenance facility. Responsibilities include providing leadership for the environmental tasks involved with the facility design and master planning efforts for the yard. Phase I included structural and facilities design, preparation of a master plan for the yard, and leadership for environmental design tasks at the yard. Our firm teamed with a construction company on a design-build contract to construct the Phase II improvements to the yard. Phase II consisted of the design and construction of several new facilities in the northern portion of the site and clearing a portion of the site for the major facilities to be constructed in Phase III and thereafter. In addition, our firm has designed a new wheel-truing facility, priority repairs to the main shop, and work to be performed at Metro-North's Ossining Substation, approximately 2 miles south of the Harmon site. Our firm was also selected to prepare the design-build documents for Croton-Harmon Yard and Shop Phase IV, Stage I, which is the latest stage of the $1.0 billion multiyear reconstruction of the century-old Harmon Shop. The Phase I, II, and IV work included assistance needed to address the environmental issues of concern, which are described below:

- Assistance to Metro-North's legal counsel in determining that the project was categorically exempt from the State Environmental Quality Review Act and National Environmental Policy Act, resulting in overall design cost savings
- Development and implementation of guidelines, which address the management of soils generated during investigation or excavation that will allow the reuse of soils on site
- Development and implementation of a geographic information system (GIS)/key database to store the chemical and geological data generated at the site
- Treatment and management of dewatering fluids discharged to the local publicly owned treatment works in accordance with permission requirements
- Asbestos, lead-based paint, and polychlorinated biphenyl (PCB) abatement
- Tank closure and construction
- Air permitting compliance
- Modifications to the facility stormwater discharge permit to include changes to the postconstruction wastewater stormwater management system
- Coverage for construction stormwater discharges under the New York State Department of Environmental Conservation State Pollutant Discharge Elimination System permit program GP-02-01
- Design of new environmental systems for the site, such as a spill control system for a new 400,000-gallon fuel oil storage tank and a fuel pad oil-water separator. Coordinated requirements with regulatory agencies.

In accomplishing these tasks, our firm took a proactive approach, and together with MNR, contacted regulatory agencies at the beginning of the project to introduce them to the project concepts and involve them in decision-making processes. We also involved the other design discipline team leaders in the process.

Croton-Harmon Maintenance Facility Replacement, Phase II, Croton-on-Hudson, NY, MTA Metro-North Railroad. Environmental Task Leader for Phase II of the replacement of the Croton-Harmon Maintenance Facility. Responsibilities included providing leadership for the environmental tasks involved with the facilities design and master planning efforts for the yard. Our firm provided design and construction assistance under a design-build contract for the Phase II work. Tasks included assisting Metro-North's legal counsel in determining that the project is categorically exempt from the requirements of New York's State Environmental Quality Review Act and the National Environmental Policy Act, which resulted in overall design cost savings; developing guidelines that address the management of soils generated during investigation or excavation activities, which allowed the reuse of petroleum-contaminated soils on site; developing and implementing a geographic information system (GIS)/key database in which to store chemical and geological data generated at the site; obtaining approval for dewatering fluids to be accepted by the local publicly owned treatment works, resulting in cost and time savings for the management of contaminated groundwater; designing new environmental systems for the site, such as a spill control system for a new 400,000-gallon fuel oil storage tank and a fuel pad oil-water separator, and coordinating the associated requirements with the regulatory agencies; obtaining coverage under New York's State Pollutant Discharge Elimination System (SPDES) Permit GP-02-01

for stormwater discharges during construction; modifying the facility's industrial stormwater SPDES permit; and modifying the facility's groundwater monitoring well network.

North White Plains Station Access and Parking Improvements, White Plains, NY, MTA Metro-North Railroad. Environmental Task Leader/Site Planning Coordinator for the preparation of an environmental impact statement pursuant to the National Environmental Policy Act of 1969 and its amendments to analyze alternatives for improved station access and parking at Metro-North's North White Plains Station, with the Federal Transit Administration acting as federal lead agency, and begin preliminary design efforts. The commuter parking capacity was 1,200 spaces, which were located in three lots on the west side of the railroad tracks and a fourth lot on the east side of the tracks. Vehicle access to the three lots located to the west of the tracks was limited to the Bronx River Parkway from the west. Significant areas of the parking facilities were located within the County's Bronx River Parkway Reservation, a sensitive environmental area. Project elements evaluated included the construction of a multilevel parking structure, improvements to existing surface parking areas, the development of remote park-and-ride lots, improved station facilities, an intermodal area, pedestrian and bicycle connections, vehicular access to parking, and the reclamation of the Bronx River Parkway Reservation areas currently used for parking.

Niantic River Bridge, Niantic, CT, National Railroad Passenger Corporation (Amtrak). Environmental Task Leader responsible for addressing asbestos and lead-based paint management and associated wetlands issues involved with the replacement of a drawbridge. The drawbridge, located on Amtrak's Northeast Corridor is an electrified, two-rack railroad with high-density rail traffic. Intercity service is operated by Amtrak, and commuter service is provided by Metro-North Railroad. Oversaw the engineering services for the final design of track, signals, communications, catenary, traction power, structural, environmental, and geotechnical analyses. Our firm was retained to perform construction-related services to maintain continuity between the designer and installation contractor.

Grand Avenue Bus Depot, Environmental Services, Queens, NY, MTA New York City Transit. Senior Project Manager responsible for providing environmental services for a $226 million design-build project for a bus and central maintenance facility. Environmental services included developing and implementing an environmental permit strategy; modifying the facility air permit as required to reflect design-build conditions; conducting a Phase I assessment; developing and implementing soils, asbestos, waste management, and dewatering plans; developing and overseeing the implementation of a construction stormwater management plan; and obtaining permits for water and wastewater discharges and storage tanks and unloading systems. Soil and waste management plans were prepared, and ongoing management of contaminated soils encountered during excavation was provided. Our field personnel documented subsurface conditions during soil excavation and handling activities. On-site responsibilities included assistance with field screening of soils, collection of laboratory samples, and documentation and tracking of excavated USTs, asbestos, drums, and other discovered items of environmental concern.

Brownfield Redevelopment, Babylon, NY, Town of Babylon. Senior Project Manager and Principal-in-Charge responsible for conducting Phase I and Phase II assessments and end-use planning and for providing other engineering services related to the brownfield redevelopment of the Straight Path Area in the Hamlet of Wyandanch. This work was funded under a U.S. Environmental Protection Agency Brownfield Grant.

Harlem Line Station Improvements, Bronx and Westchester, NY, MTA Metro-North Railroad. Environmental Task Manager responsible for asbestos and lead-paint management, including abatement, handling, and disposal during the construction of improvements to rail stations, including the design and construction of new canopies, shelter installation with heat and lighting, platform lighting upgrades and uninterruptible power supply emergency lighting systems, installation of canopy drainage and supports, tactile warning strips, platform replacements that are enclosed, new and/or extension of public address system and electric service upgrades as required, pigeon-proofing, replacement of platform edge strips, and fall protection.

Nassau Expressway Rehabilitation, Queens, NY, New York State Department of Transportation. Environmental Task Manager responsible for asbestos and lead-paint surveys and abatement design, stormwater management, and permitting involved with the final highway design (Phases V and VI) for the rehabilitation and

resurfacing of Nassau Expressway/Interim Nassau Expressway - Rockaway Boulevard (from the Van Wyck Expressway to the Nassau County line), including associated ramps and certain bridges, and preliminary design, right-of-way, and final design services for the proposed multiuse (bike/pedestrian) path.

Wall Revetment, Asharoken, NY, William Gallo. Senior Project Manager responsible for providing design, permitting, and construction management for a rock revetment wall along a property on Long Island Sound. The wall was constructed on the seaward side of a sheet pile retaining wall, which was in need of rehabilitation due to severe beachfront erosion and age.

Property Purchase, Site Development, and Litigation Support and Testimony, NJ, Confidential Client. Senior Project Manager responsible for providing litigation support and testimony in a cost allocation and recovery matter regarding two adjacent properties on which environmental concerns were noted and reported. The larger, 26-acre property was a former chemical plant that had gone through an administrative consent order cleanup under the direction of the New Jersey Department of Environmental Protection, which allowed waste residuals to be capped in place and groundwater contamination to remain unremediated. The smaller, 6-acre property was a trucking terminal with a fueling island and USTs. In addition, an extensive Phase II investigation was performed to establish a pre-existing environmental baseline for both properties. The client subsequently purchased the properties and developed a rail-to-truck intermodal facility. The sites border a river, and the federal and state governments took actions against the adjacent property owners to pay for the assessment and cleanup of the river. The former property owner sued our client to have them included in the cost recovery action. We provided litigation support to our client and their attorneys and testified during the trial.

Elevated Rail, NY, Confidential Client. Senior Project Manager responsible for reviewing demolition and material management plans provided by a prospective purchaser and for providing field oversight, including split sampling. The elevated railroad structure was built around 1900 and consists of trackage and ballast in a concrete containment supported by steel columns and extends approximately 1.7 miles. Assisted in addressing liabilities associated with handling ballast, which may be affected by chemical residuals, lead-based paint on the steel work, asbestos-containing materials, and areas of potential concern throughout the abandoned line. Split samples were collected during the purchaser's waste characterization efforts to verify the analytical results and to evaluate the proposed disposal and reuse methods.

Property Purchase and Site Redevelopment, NJ, Confidential Client. Senior Project Manager responsible for a Phase I environmental site assessment of two adjacent properties. The larger property, totaling 26 acres, was a former chemical plant that had gone through an Administrative Consent Order cleanup under the direction of the New Jersey Department of Environmental Protection (NJDEP), which allowed waste residuals to be capped in place and groundwater contamination to remain unremediated. The smaller property, totaling 6 acres, was a trucking terminal with a fueling island and USTs on the property. To establish a pre-existing environmental baseline for both properties, an extensive Phase II investigation was performed. The client subsequently purchased the properties and developed a rail-to-truck intermodal facility. An asbestos survey was conducted in support of the demolition of an on-site administration building. To support redevelopment work on the 6-acre property, an 8,000-gallon gasoline and diesel fuel UST on the property was removed. When removed, the gasoline tank was found to have several holes, and a sheen of phase-separated hydrocarbons was noted on groundwater that infiltrated the excavation. The observed release was reported to NJDEP. Organics detected in the gasoline tank excavation are not organics present in gasoline and were believed to be attributable to an off-site source detected in the baseline groundwater samples. This information was submitted to NJDEP. To support the site improvement of both properties, Occupational Safety and Health Administration (OSHA) surveillance of utility line trenching on the properties was provided, due to the groundwater contamination beneath the site. This required the preparation of a comprehensive health and safety plan, and personnel were provided to monitor trenching activities.

Croton-Harmon Maintenance Facility Replacement, Phase I, Croton-on-Hudson, NY, MTA Metro-North Railroad. Environmental Task Leader responsible for providing leadership for the environmental design

tasks involved with the facility design and the master planning for the yard. Our firm was the overall environmental technical lead responsible for overseeing the efforts of four environmental design subconsultants. Tasks performed included assisting Metro-North's legal counsel in determining that the project was categorically exempt from New York's State Environmental Quality Review Act and the National Environmental Policy Act, which resulted in overall design cost savings; developing guidelines to address the management of soils generated during investigation or excavation operations, which allowed the reuse of petroleum-contaminated soils on site; developing and implementing a geographic information system (GIS)/key database to store the chemical and geological data generated at the site; obtaining approval for dewatering fluids to be accepted by the local publicly owned treatment works, which resulted in cost and time savings for the management of contaminated groundwater; and designing new environmental systems for the site, such as a spill control system for a new 400,000-gallon fuel oil storage tank and a fuel pad oil-water separator, and coordinating requirements with the regulatory agencies.

Brownfields Conversion of Rail Yard, NY, Confidential Client. Senior Project Manager responsible for a site that has been redeveloped as a sports park, which includes restaurants and retail activities. This former rail yard consists of 53 acres of property, including 25 upland areas and 28 acres under water. The site was used as a locomotive and railcar servicing and maintenance facility and switchyard from 1883 to 1994. A presale environmental assessment performed by our firm showed evidence of residuals common to rail yards. Several environmental issues were addressed by removing a UST and aboveground storage tank, removing asbestos from a fire-damaged pier, closing a weigh-scale pit, and removing debris and a railcar in poor condition. The site had been leased to a car parking concession that had filled the leased area and other parts of the property with shredded asphalt shingles. Some of this material was removed from wetland-related areas in accordance with a consent order with the State.

Town Improvements, Northport, NY, Village of Northport. Senior Project Manager and Principal-in-Charge responsible for providing various architectural and engineering services. Served as a Village Engineer in providing design and construction management during the upgrade of the municipal wastewater treatment plant, design and construction management of an interim roadway retaining structure along a major village thoroughfare, engineering assistance during a hillside collapse and response from the U.S. Army Corps of Engineers, design and construction management of a domed roadway salt and sand storage facility, engineering services for the Village Planning Board and Zoning Board of Appeals for various site development projects, architectural design of a new concession and restroom facility in Steers Park, design and construction management of various roadway improvement projects throughout the Village, engineering services involved with New York State Department of Environmental Conservation stormwater discharge regulation requirements, and design and construction management for the installation of new street lamps along Main Street.

Natural Gas Pipe Line Metering Stations, Various Locations, Southeastern U.S., Confidential Client. Project Director for remedial investigations and feasibility studies at more than 200 metering stations along a major natural gas pipeline located in the southeastern United States. In the past, mercury manometers were used in the metering process. Breakage, spillage, and operations and maintenance disposal practices resulted in mercury contamination inside the buildings and in the surrounding soils and groundwater. Due to the large number of sites, our firm used a rapid assessment process that relied primarily on field-testing techniques. Our firm pioneered the use of mercury vapor industrial hygiene equipment to quickly determine the presence/absence and the relative amount of mercury contamination in soil samples. This technique allowed the measurement of mercury vapor levels at various depths in boreholes, as well as in individual soil samples. An immunoassay field test was used on a representative number of samples to more specifically describe the mercury concentrations in samples of concern. Finally, a limited number of samples were sent to the laboratory for mercury measurements in accordance with accepted laboratory protocols. A combination of this data was used to describe the extent of contamination at each of the metering stations and determine the need for and the extent of remedial actions required.

Expert Witness Services, Manhattan, NY. Expert Witness representing the owner of a property in midtown Manhattan whose tenant, an automobile service and fueling station, was decommissioning and closing the site. Fuel oil contamination was found on site, and the tenant claimed that it was not due to its operations. Provided technical and litigation support to the property owner and its attorney. Served as the plaintiff's Expert Witness in the case against Getty Oil to recover damages arising from environmental contamination allegedly caused by Getty Oil to the plaintiff's property. The court ruled in favor of the plaintiff and found Getty liable to the plaintiffs for more than $1 million.

Health and Safety Management, Oyster Bay, NY, Town of Oyster Bay. Senior Project Manager in charge of an on-call brownfield services contract, which included environmental Phase I and II investigations, end-use planning, and remedial design. Also provided health and safety consulting services and groundwater monitoring services to the Town.

LaGuardia, John F. Kennedy (JFK), and Newark Airports, New York City Metropolitan Area, NY, Various Clients. Principal-in-Charge responsible for fueling facility upgrades, site assessments, and remediation projects at three airports. Investigated the nature and extent of petroleum residuals at the LaGuardia Airport fuel farm and designed an upgrade to the tank farm and fuel truck loading area, which provided improved control of releases from the fueling operations. Rehabilitated several deep petroleum product recovery wells at the JFK Airport satellite fuel farm and investigated and remediated releases at the ramp fueling station at Newark Airport.

Illegal Landfill at a Religious Cemetery, Long Island, NY, Kaye Scholer, LLP. Senior Project Manager responsible for developing a restoration and closure plan for a cemetery. The cemetery contracted to fill 8.5 acres with about 180,000 cubic yards (CY) of soil and demolition debris to increase the area for burials. The state, however, cited the operation as a nonpermitted solid waste management facility after the contractor delivered 460,000 CY of material. The cemetery owners signed a consent order that required characterizing the fill materials and preparing a restoration plan. Local civic organizations and politicians demanded that the fill material be removed from the site. The estimated cost of removal and off-site disposal was about $20 million. It was argued that characterizing the fill was not warranted, and a site investigation/closure was proposed to verify that no environmental impacts occurred and closure of the site was in accordance with the cemetery's expansion plan. As part of the landfill closure, quarterly landfill gas monitoring is performed. The monitoring database is summarized in quarterly reports to the New York State Department of Environmental Conservation. The site is characterized by very steep slopes. Slope stability analyses were performed under various closure scenarios to evaluate alternative closure scenarios.

Environmental Site Assessment and On-Call Environmental Engineering Services, Long Island, NY, Northrop-Grumman Corporation. Senior Project Manager responsible for coordinating environmental site assessment and environmental engineering services on an on-call basis. The work included UST investigations and closure work, site investigations for soil excavation projects, asbestos investigations and abatement design and management, and environmental construction management for the closure of manufacturing facilities.

Manufacturing Research and Development Facility, NY, Confidential Client. Project Manager for the presale assessment of a former manufacturing research and development facility, consisting of a 25,000-square-foot main building and two smaller buildings on a 10-acre site. Identified cadmium and mercury residues from prior laboratory activities on building interior surfaces, equipment, and other areas. Determined acceptable metals concentrations on building surfaces and in soil through a risk assessment.

Abandoned Industrial Property, NY, Confidential Client. Environmental Task Leader in charge of a Phase I/Phase II environmental assessment of an inactive railroad property adjacent to mainline track to establish baseline conditions prior to the railroad leasing the site for industrial use. To prepare the site for future use, the owner decided to remove approximately 30,000 cubic yards of concrete and demolition debris that had been stockpiled on the site by others. Our firm was retained to characterize and manage the removal and disposal of

the debris pile. The project was coordinated with the New York State Department of Environmental Conservation's Division of Solid and Hazardous Materials to obtain the Department's concurrence on the scope of the proposed project and the Division of Environmental Permits to obtain a Tidal Wetlands Permit, due to the site location adjacent to a surface water body.

Illegal Landfill on Railroad Property, NY, Confidential Client. Principal-in-Charge for a project involving an illegal landfill site on inactive railroad property. A preliminary environmental assessment of the site was conducted in 1987. In 1988, illegal dumping occurred at the site, which resulted in approximately 500,000 cubic yards of waste being landfilled at the site. A site investigation was conducted in 1994, and ongoing monitoring has been performed at the site since that time. Groundwater and surface water sampling has been conducted, and volatile organic compounds, semivolatile organic compounds, metals, pesticides, ammonia, and various other landfill leachate constituents have been found in groundwater and surface water. A phytoremediation system has been designed and installed that consists of approximately 1,000 trees planted to withdraw groundwater from two water-bearing zones beneath the site. A landfill closure plan was designed and constructed, which included dewatering and closing on-site ponds, performing site grading and development, installing a multilayer cap on the 500,000-cubic-yard waste piles with gas controls, installing stormwater control systems, and installing a groundwater recovery and recirculation system. Also served as a fact witness for the property owner in his cost recovery action against waste generators whose waste was disposed at the site.

The landfilling has been conducted on 26 acres of the overall 39 acres of the inactive railroad. During the course of the site investigation, the railroad negotiated the sale of the rail yard outside of the landfill area. The sale included the track and right-of-way. Environmental issues of concern were addressed with minimal remediation. The sale was to support a revitalization project. The adjacent property is being developed into a sports complex, including restaurants and shops.

Railroad Pre-purchase Property Assessments, Westchester County, NY, MTA Metro-North Railroad. Senior Project Manager responsible for performing prepurchase property assessments to assist this railroad client in acquiring property to expand two rail facilities.

Site Investigation for Inactive Railroad Yard, NY, Confidential Client. Senior Project Manager for a presale site investigation to identify environmental issues that could be of concern to future users of the site. The development of the site was intended to be for sports, recreational, and commercial uses. Actions were taken to address the environmental issues of concern to both the state's and the buyer's satisfaction.

Railroad UST Closures, Various Locations, U.S., Confidential Client. Senior Project Manager responsible for a UST closure program. The program was originally limited to USTs in two states but was so successful that 12 more states were included. The closure program addressed specific state compliance requirements and included the following: initial UST registration, cost recovery for eligible tanks, paperwork and schedule tracking, tank removal, sampling and analysis operations, the establishment of the extent of soil and/or groundwater contamination, the design of remedial alternatives, remedial implementation, and site closure. Provided oversight and supervision services during the various phases of the work. More than 200 USTs were closed. The tanks ranged in capacity from 100 to 20,000 gallons and included buried railcars. Soil remediation efforts included on-site bioremediation cells, off-site bioremediation, and landfilling. Implemented groundwater remediation programs at some of the sites.

Railroad Consent Order Compliance, Various Locations, U.S., Confidential Client. Senior Project Manager for several sites that were placed under a U.S. Environmental Protection Agency consent order. Assisted the client in responding to the items required by the consent order, including demolition, site cleaning, the closure of oil-water separators, the removal of drums, asbestos abatement, the removal of underground tanks, upgrades for aboveground tanks, the closure of septic systems, and the backfilling of open pits.

Remediation Services for Abandoned Railroad Yard, PA, Confidential Client. Senior Project Manager responsible for overseeing the excavation of 11 USTs and the stockpiling of 1,500 cubic yards of diesel-contaminated soils at an abandoned railroad yard. Solicited competitive bids from remedial contractors for on-site soil roasting or cold-batch asphalt recycling. Soil roasting was more cost-effective because it eliminated the need to landfill the waste. Provided oversight during the remedial work and coordinated state air and water permits. Following soil sampling to verify the treatment, the roasted soil was spread on site, graded, and seeded to close out the project.

Chemical Railcar Derailment, MI, Confidential Client. Senior Project Manager for a project involving a railcar derailment site in a residential area where more than 50,000 gallons of volatile organics and acids were released, some of which ignited. Conducted a remedial investigation that determined the nature and extent of chemical residues and their impacts on air, soil, surface water, and groundwater. Built a surface water diversion system as an interim measure to control overland flow from the area. The state initially demanded soil remediation to background levels, but a risk assessment indicated only a low exposure risk, which resulted in a significant reduction in the extent of required soil remediation. The state also initially listed the excavated soil as hazardous, but the soil was delisted on our petition. This was the first instance in the state where hazardous soil was delisted to a nonhazardous waste based on a private-party petition.

Locomotive Petroleum Spill, FL, Confidential Client. Senior Project Manager responsible for developing a cost-effective remedial action plan (RAP) to clean up soil and groundwater contaminated by approximately 4,000 gallons of diesel fuel. The RAP was based on data from soil borings and monitoring wells and called for limited soil excavation. Employed an organic vapor analyzer to delineate specific areas for excavation. Used an interceptor trench to contain and recover free product and dissolved petroleum constituents. The work was done in close coordination with the railroad to avoid disrupting normal operations. Negotiated soil cleanup levels with the state and demonstrated that it was not necessary to excavate the contaminated soil beneath the tracks. The soil and groundwater cleanup objectives were satisfied, and the state closed its file after receiving the site rehabilitation report.

Railcar Manufacturing Facility RCRA Management Plan, WV, Confidential Client. Senior Project Manager responsible for auditing waste management practices and developing a sitewide RCRA management plan at a facility that manufactures, renovates, and rebuilds approximately 40 railcars a day. The management plan integrated many diverse waste streams, including RCRA wastes, other chemical wastes, and waste oil from more than a dozen trade shops. The audit included reviewing operations in each shop and interviewing supervisors and foremen to identify chemical use, waste streams, and waste handling/disposal practices. Recommended product substitution and waste stream segregation to minimize the volume of RCRA wastes. Developed a sitewide RCRA contingency plan.

Site Investigation and Remedial Services for Inactive Railroad Yard, MD, Confidential Client. Senior Project Manager responsible for developing and managing a site investigation and subsequent remedial actions at a closed railroad yard. Facility operations had included painting, metal working, fueling, car building, and engine repair. Closure activities included site characterization, negotiations with state agencies, remedial design, bid specifications, and remedial implementation. Issues of concern included the characterization and disposal of unlabeled drummed waste; the removal of storage tanks; the remediation of soils contaminated with polychlorinated biphenyls (PCBs), chromium, and lead; the closing of two large lagoons containing petroleum-contaminated sludge and free liquids; and the removal of petroleum product floating on the water table. Closing the lagoons involved pumping off and treating approximately 200,000 gallons of water and stabilizing the lagoon sludge using lime kiln material. The remedial action was complicated by karst geology.

Railroad Service Yard Closure, IN, Confidential Client. Senior Project Manager for a preclosure investigation at a 250-acre locomotive and car service yard that found polychlorinated biphenyls (PCBs) and asbestos in buildings, hazardous residuals in underground tanks, and contaminated soil. A biological treatability study demonstrated that in situ biological treatment could remediate petroleum-impacted soil in two fueling areas.

This yard contained more than 200,000 cubic yards of cinder, and elevated concentrations of polynuclear aromatic hydrocarbons were found in many of the cinder samples. A site-specific risk assessment demonstrated that no additional remedial actions were necessary.

Regulatory Compliance Assistance, NY, Confidential Client. Senior Project Manager responsible for determining the regulatory compliance of aboveground storage tanks, USTs, and drum storage areas at an aircraft manufacturing facility. Supervised the preparation of a health and safety plan to protect workers during tank closures, site assessments, and new tank system construction. Assisted in the preparation of plans and specifications for new USTs to replace underground tanks that did not meet UST requirements or would soon be out of compliance. The new specifications for gasoline, diesel fuel, and JP-4 jet fuel tanks included secondary containment and leak detection in accordance with municipal, state, and federal regulations. Developed closure plans for waste storage areas and underground and aboveground tanks. New tanks were constructed and old tanks were removed in a sequence that avoided disrupting the plant's activities. Managed the decommissioning of 30 manufacturing buildings with 1.2 million square feet of floor space. The demolition addressed lead paint, polychlorinated biphenyls (PCBs), reinforced-concrete slabs, and utility and testing tunnels. Provided asbestos abatement design and bid-phase management services to remove asbestos-containing roofs, thermal insulation, floor tiles, and other materials from the buildings.

Bridge Rehabilitations, New York, NY, New York City Department of Transportation. Principal-in-Charge of a project team that oversaw environmental issues of concern associated with the rehabilitation of the Williamsburg, Throgs Neck, Whitestone, and Verrazano-Narrows Bridges. The principal issue of concern was the lead paint being removed during the work. The primary project activities involved worker protection to meet Occupational Safety and Health Administration (OSHA) requirements, the containment and management of lead-based paint dislodged/removed during the work, and the assessment of surrounding areas (soil, pavements, tops of buildings) where the lead may have fallen prior to and during the work. Several buildings required asbestos abatement and demolition and UST inspections and removals.

Remediation Services for U.S. Environmental Protection Agency Superfund Site, WI, Confidential Client. Senior Project Manager responsible for a remedial investigation, a feasibility study, and a remediation project. The site was a former munitions manufacturing facility that contained several landfills, waste lagoons, and areas affected by chemicals associated with the manufacturing processes. Conducted an investigation of the on- and off-site groundwater, soil, and waste. The chemicals of concern at the site included chlorinated hydrocarbons, a forge compound consisting of graphite and long-chain hydrocarbons mixed with kerosene and chlorinated solvents, polynuclear aromatic hydrocarbons, arsenic, and metals. Performed a risk assessment to define the need for remedial action at the site. Conducted a pilot study to evaluate the use of forge compound and forge compound mixed with soil as a secondary fuel in cement kilns. An 11-acre lagoon filled with up to 12 feet of forge compound was excavated, and the material was used as fuel at the kilns. Several on-site landfills were consolidated and closed in place with a soil vapor extraction system serving as the "bottom liner" for the landfill wastes.

Investigative and Remedial Services for Abandoned Industrial Property, WV, Confidential Client. Senior Project Manager responsible for investigating and remediating an abandoned property under the West Virginia Department of Environmental Protection's Voluntary Remediation Program. Historic uses of the 8.5-acre site included a railroad switching yard, a scrap metal yard, a steel mill, a tool and die operation, a wall plaster manufacturer, and a lumber warehousing operation. The involved city has been identified as a U.S. Environmental Protection Agency brownfields pilot community, and the city is interested in facilitating the development of several properties in the vicinity of the subject property. Obtained historical site information from the city and conducted a fast-track Phase I environmental assessment of the site to identify areas of potential concern. Based on the findings of the Phase I assessment, developed and implemented a site investigation work plan to assess the potential presence of residual contamination associated with former site uses. Reviewed the site investigation results in consideration of the proposed redevelopment of the site for commercial use and evaluated potential risks posed by chemical residuals in surficial and shallow soils.

Determined that the chemical residuals in the soils did not pose a risk since they will be capped under the proposed site development. Concluded that no remedial action was warranted, and the agency concurred.

Class I Railroad Freight Yard, IL, Confidential Client. Senior Project Manager responsible for obtaining a no further remediation (NFR) letter for a former railroad yard under the Illinois Environmental Protection Agency's (IEPA's) Site Remediation Program (SRP). The 24.73-acre site was used as a railroad freight yard and contained several freight houses, platforms, and many switching tracks. The freight yard was closed and dismantled in the early 1970s and has been vacant since its decommissioning. Based on the site's location, the redevelopment potential of this brownfield for multiuse, multifamily housing made it extremely attractive to potential developers. As such, the site's remediation objectives were designed to allow for unrestricted residential use. Performed an assessment that found elevated concentrations of arsenic in surficial and near-surface soils and concluded that these elevated concentrations were from historical and routine applications of arsenic-containing herbicides to the main tracks. After a sales agreement was completed with a local developer, the site was enrolled in the IEPA's SRP. Based on past site operations and the results of the initial assessment, arsenic was identified as the only chemical of concern. Performed a feasibility assessment concerning the achievement of both risk-based criteria and generic metropolitan statistical area median background values and concluded that soil excavation was the preferred remedial action to achieve a residential land use endpoint. However, reaching the risk-based criteria and/or generic background values required the excavation and disposal of a large quantity of soil. Conducted further research to assess actual arsenic soil concentrations within the city. The study addressed arsenic levels within various types of fill material that had been imported to the site and the subsequent construction of the freight yard. Based on this study, a site-specific arsenic level was calculated for the area surrounding the impacted zone. Used this information to show the IEPA that achieving default risk-based criteria and/or generic background levels was impractical. Presented an alternative remediation objective (RO) based on the statistical evaluation of data collected outside the Federal Insecticide, Fungicide, and Rodenticide Act application area and the practicality of achieving the alternative RO. The alternative RO was reviewed and accepted by the IEPA. Submitted a remedial action completion report to the IEPA that resulted in the issuance of a NFR letter for unrestricted residential use of the site. The site was sold to a local developer for redevelopment as a multifamily housing complex.

Railroad Yard and Track Redevelopment and Site Remediation, NY, Confidential Client. Senior Project Manager for a site where a land developer had illegally operated a nonpermitted landfill on property owned by a major railroad company. It was alleged that hazardous wastes, medical wastes, asbestos, construction and demolition debris, and municipal wastes had been disposed of in the landfill. Landfill leachate constituents, including hazardous substances, were found in the groundwater downgradient of the site, which is elevated relative to undeveloped wetlands to the south. Prepared a site investigation plan and a closure alternatives study to further define the site hydrogeology; increase the database on possible contaminant migration from the landfill; and identify the extent of contamination and potential impacts to human health and the environment, particularly the adjacent wetlands. Work included installing groundwater monitoring wells and sampling surface water and sediments in the wetlands. The objective of the closure alternatives study was to develop alternative closure and postclosure plans to mitigate unacceptable environmental impacts, evaluate these alternatives, and recommend a cost-effective remediation program. Successfully negotiated the acceptance of the plan and study with the state. The landfilling had been conducted on 26 acres of the 39-acre inactive railroad yard. During the course of the site investigation, the railroad negotiated the sale of the railroad yard outside of the landfill area. The sale included the track and right-of-way, a railroad bridge, and tracks connecting to existing freight lines. Environmental issues of concern were addressed with minimal remediation. This purchase was made to support revitalization. The adjacent property is being developed into a sports complex, including restaurants and shops.

Former Scrap Metal Yard, WV, Confidential Client. Senior Project Manager for a project involving a property that has been used as a railroad yard since the early 1900s. A small parcel on the property, approximately 6 acres, was leased to another party in the early 1970s and used for scrap metal salvaging and sorting. The scrap metal operations were terminated sometime in the 1980s. A subsequent inspection of the parcel by the U.S. Environmental Protection Agency identified polychlorinated biphenyls (PCBs) in the soil at

two locations. In response to this finding, the property owner implemented two site investigations that focused on defining the horizontal and vertical extent of the PCBs in the soil, which indicated that approximately 4,400 cubic yards of soil were affected by the PCB residuals. A real estate developer subsequently expressed interest in purchasing and developing the parcel. Based on the environmental conditions identified at the property and the site development interest, the site was accepted into the West Virginia Department of Environmental Protection's (WVDEP's) Voluntary Remediation and Redevelopment Program. A site assessment work plan was developed and approved by WVDEP to guide the characterization of soil and groundwater at the property with respect to PCBs and other chemicals typically found at railroad yards and scrap yards. The resulting environmental monitoring database was used to assess public health and environmental risks posed by the chemical residuals under the proposed site development scenario. It was concluded that the site development plan, including building slabs, parking lots, roadways, and gardens, would provide an engineering barrier above the chemical residuals and mitigate risks to human health and the environment. As a result no active remediation was needed, saving the property owner the multimillion-dollar cleanup that would have been needed to remediate the site. The owner will thus profit by selling the property, the developer will be able to obtain property that will fit into its development plans, and both will benefit from the development and the rehabilitation of the downtown area.

Railroad Mechanical Facility, MD, Confidential Client. Senior Project Manager responsible for providing environmental and engineering management services during the investigation, decommissioning, and remediation of a railroad mechanical facility. The site consists of 45 acres occupied by 38 structures. The project included a site investigation, remedial actions, lagoon closure, storage tank decommissioning, asbestos abatement, building demolition, and floating product recovery. Performed a preliminary assessment to characterize the site and identify areas of potential environmental concern. Based on the findings of the preliminary assessment, prepared and submitted a lagoon closure plan to the Maryland Department of the Environment (MDE) for approval. Prepared contract and bidding documents, provided project and field management of the closure activities, characterized the underlying soils, and prepared a summary report for submittal to MDE. Provided construction management services during the pumping, cleaning, and dismantling of abandoned aboveground storage tanks and UST's. Prepared an assessment of the potential environmental impacts associated with each tank. Prepared specifications and contract documents for the demolition of the 38 structures at the former locomotive manufacturing, maintenance, and repair facility. The larger structures included a 25-stall roundhouse, two erecting shops, a powerhouse equipped with several boilers, an 80-foot stack, and a wastewater treatment plant. The facility had been inactive for 10 years, and most structures were in poor condition. Performed a structural survey to identify those structures that posed safety concerns due to their potential for collapse and conducted a confirmatory asbestos inspection to verify the asbestos materials and quantities identified by a previous survey. Evaluated the feasibility of a partial demolition approach to remove safety hazards, as well as the full demolition. The full demolition option was selected, and the demolition and abatement specifications were finalized. Performed oversight inspections and air monitoring throughout the duration of the asbestos abatement to make certain of compliance with project specifications and applicable regulations. Provided construction management and inspection services during construction and demolition activities. The facility demolition included the characterization of residual liquids and sludges in the on-site wastewater treatment plant and various subgrade pits, as well as disposal coordination. With the completion of demolition activities, the facility is being entered into Maryland's Voluntary Cleanup Program. Product recovery will continue, and risks posed by residual constituents will be evaluated in consideration of a commercial/retail end use. There is an interest in extending a boulevard through the site, which would create a significant amount of useful and valuable real estate and return this former railroad yard to a beneficial use.

Environmental Assessment, Remediation, and Regulatory Compliance for the Railroad Industry, Various Locations, U.S., Various Clients. Principal-in-Charge responsible for managing a firmwide team providing environmental consulting services to the railroad industry since 1987. Railroad clients have included Norfolk Southern; Conrail; Amtrak; CP Rail; the Metro-North Railroad; and the New York, Susquehanna, and Western Railway. Hundreds of tasks have been performed for these clients throughout the United States. Services provided have involved investigating and remediating railroad sites affected by a variety of chemicals,

including solvents, diesel fuel, lubricating oils, gasoline, arsenic, polynuclear aromatic hydrocarbons, and metals; conducting human health and environmental risk assessments; inspecting and removing numerous UST systems and assessing and remediating spills; providing assistance during train derailments involving spilled hazardous chemicals and diesel fuel; assessing the nature and extent of chemical residues in inactive facilities and designing and overseeing the cleanup and demolition of these structures; obtaining approvals of RBCA at rail sites and for barge lines; performing Phase I and Phase II assessments of properties being sold and/or purchased; assessing hazardous material management practices across the system and assisting with the steps needed to comply with the Clean Air Act 112-R Risk Management Plan requirements; and providing wastewater, air, and hazardous/solid waste engineering services.

UST Program for a Municipality, Hempstead, NY, Town of Hempstead. Project Manager responsible for managing a detailed survey of 90 USTs owned by a town in Nassau County, New York. Developed and coordinated a tank compliance program designed to register, test, remove, and close old tanks and design and oversee the construction of new tank facilities. Negotiated tank closure criteria with the state based on risk. Coordinated a compliance program that included registration, leak testing, bidding, and oversight services during UST removal operations. Designed new tank facilities and provided construction oversight.

Site Investigations for a Class I Railroad, Various Sites, U.S., Confidential Client. Project Manager responsible for site investigations at railroad yards characterized by failed USTs and aboveground storage tanks. Primary contaminants of concern were industrial solvents and diesel fuel. Negotiated site closures with state regulators and designed remediation systems, including soil roasting, bioremediation, barriers, and product recovery and pump-and-treat systems.

Environmental Assessment LaGuardia Airport, New York, NY, Ogden Aviation Services. Principal-in-Charge of the reconstruction of a bulkhead seawall surrounding a bulk fuel storage terminal. Prepared health and safety and confined space entry plans to cover the excavation and removal of fuel-contaminated soils. Collected and analyzed soil samples to determine the concentrations of gasoline and aviation fuel to assess potential entry hazards. The entry plan allowed the confined spaces to be classified as nonpermit-required spaces, which allowed workers to enter the excavation in Level C protection. This classification was justified by pre-entry continuous air monitoring, the design of a confined space entry program, and the cleaning of the confined workspace so that the workers could avoid contact with contaminated soils.

Remedial Action Plan, FL, Confidential Client. Project Manager responsible for the cleanup of 4,000 gallons of diesel fuel released during a tank car derailment. The technology assessment identified air sparging, interceptor trenches, and a groundwater pump-and-treat system as the most feasible and cost-effective remedies. Developed and implemented a remedial action plan. Provided construction oversight during the abatement, investigation, and remedial construction to make certain that the work plan and designs were followed in a cost-effective manner.

Environmental Compliance for the Rehabilitation of the Williamsburg Bridge, New York, NY, New York City Department of Transportation. Project Manager responsible for the environmental oversight and hazardous waste and materials compliance program and a site-specific health and safety plan related to the containment, collection, and disposal of lead paint waste. Other significant issues included asbestos abatement, RCRA compliance, demolition, UST decommissioning, and soil remediation.

Pipe Line Rupture, IN, Buckeye Pipeline Company. Project Manager responsible for overseeing the installation of a groundwater pump-and-treat system after a major pipeline ruptured and released several hundred gallons of petroleum product. Evaluated the impact of the release and designed a cost-effective treatment system that met the operating parameters and the state's discharge criteria.

Site Assessment at Willow Run Airport, Detroit, MI. Project Manager responsible for directing a site assessment to document and evaluate environmental concerns at this property to prepare for long-range

redevelopment. Estimated the extent of environmental problems and the risks associated with site development and identified potential funding sources to address environmental risks and liabilities. Provided a preliminary evaluation of the environmental constraints implied by redeveloping the airport and nearby properties.

Environmental Compliance for the Rehabilitation of the Whitestone and Verrazano-Narrows Bridges, New York, NY, New York City Department of Transportation. Project Manager responsible for managing air monitoring and environmental compliance assistance during the rehabilitation of two major bridges. The principal issues of concern were to protect workers, the public, and the environment from lead hazards and to manage lead paint waste in accordance with hazardous waste requirements.

Assessment of an Electronics Manufacturing Facility, NY, Confidential Client. Project Manager responsible for managing an investigation of an electronics manufacturing facility to evaluate ways to decommission and demolish the building and dispose of the debris. Supervised the oversight of the building cleaning program, which included removing asbestos-containing material and polychlorinated biphenyl (PCB) equipment prior to demolition and remediating mercury residues found on building surfaces and in on- and off-site soils. Developed building demolition and soil excavation protocols to minimize fugitive dust. Supervised the air monitoring program used to document compliance with ambient air quality standards during the work. USTs and waste disposal pits were decommissioned using negative ventilation enclosures with exhaust air treatment. Residential soil on properties adjacent to the site and residential interiors near the site were contaminated with mercury dust. Developed a sampling plan and cleanup protocol and provided oversight during the cleanup.

Wire and Cable Manufacturing Facility Decommissioning, NY, Confidential Client. Project Manager responsible for managing the decommissioning of a closed, 300,000-square-foot industrial facility located on 40 acres, which was a listed Superfund site. A site investigation and risk assessment showed that demolition workers and the public could be exposed to unacceptable levels of organics and heavy metals. The risk assessment also found that the state-approved remedy to solidify on-site soils contaminated with heavy metals was not justified because the metal concentrations were below levels of concern. The state accepted the risk assessment and rescinded its request to remediate the soil. Developed a plan to minimize the exposure risk posed by the building residues by increasing the level of worker protection and developing dust control programs during demolition in lieu of more costly building decommissioning. Asbestos insulation in the closed facility was in very poor condition, and asbestos fibers were spread throughout the building. Developed and carried out an interior cleanup plan to remove the asbestos, as well as other residuals from prior manufacturing operations. Several aboveground wastewater tanks containing cyanide residuals were cleaned and closed in place. An on-site electrical substation was vandalized, and transformers and circuit breakers containing polychlorinated biphenyls (PCBs) were damaged. Decommissioned the substation, removed the PCB fluid, and cleaned up PCB-contaminated soil.

Tool Manufacturing Facility Closure, NY, Confidential Client. Senior Project Manager responsible for directing the decommissioning of a turn-of-the-century tool manufacturing facility that consisted of forging, cutting, machining, parts washing, steel hardening, and painting operations. Fuel oil for the forges and an on-site power plant was stored in USTs. Developed a facility decommissioning plan that involved the cleanup of machinery pits and contaminated building surfaces and the demolition and disposal of the facility buildings. Asbestos was found in certain areas of the facility. Designed and carried out an asbestos abatement program. The roof of the main building was covered with corrugated asbestos roofing material. Obtained waivers from the state's full-enclosure requirements that would have increased the cost of work. Provided oversight and air monitoring services during building demolition and UST removal operations.

Aircraft Manufacturing Facility Closure and Site Redevelopment, NY, Confidential Client. Project Manager responsible for the decommissioning of 30 manufacturing buildings with 1.2 million square feet of floor space. The demolition addressed lead paint, polychlorinated biphenyls (PCBs), reinforced-concrete slabs, and utility and testing tunnels. Provided asbestos abatement design and bid-phase management services to remove asbestos-containing roofs, thermal insulation, floor tiles, and other materials from the buildings. The main plant site was redeveloped into a large-scale recreational, retail, and commercial development. Construction and

demolition debris was used to fill in an existing recharge basin. This fill served as a cap for the contaminants in the basin sediments.

Superfund Assessment of a Metal Finishing Facility, WI, Confidential Client. Senior Project Manager responsible for conducting a Superfund remedial investigation/feasibility study and a risk assessment and developing arguments to support the continued discharge of groundwater contaminated by metal finishing waste into a nearby river prior to the RCRA alternate concentration limit regulations.

Site Investigation and Corrective Action Plan for a Recycling Facility, OH, Confidential Client. Project Manager responsible for developing and supervising a site investigation and multiphase RCRA corrective action program at a solvent recovery facility. Negotiated a phased soil cleanup based on continuing discharges to surface waters with limits established through a risk assessment.

Response Strategy Development for a Waste Recovery and Treatment Facility, WI, Confidential Client. Project Manager responsible for supervising and developing a CERCLA response strategy for a potentially responsible party committee at a site where groundwater contaminated by metal-working waste and solvent discharged to a river.

Remedial Program Following a Transportation Accident, MI, Confidential Client. Project Manager responsible for supervising a remedial program after a transportation accident released extremely toxic materials. Established cleanup requirements for uncommon chemicals based on a risk assessment where no cleanup protocols existed.

Site Investigation of a Textile Finishing Facility, NJ, Confidential Client. Project Manager responsible for supervising an Industrial Site Recovery Act site investigation, including soil and groundwater sampling and UST removal. Designed a petroleum recovery and in situ soil remediation system.

PROFESSIONAL ASSOCIATIONS

American Society of Civil Engineers, Member

American Railway Development Association, Board of Directors and former Environmental Committee Co-chair

New York City Brownfield Partnership, Board of Directors and Former First President

Railroad Environmental Conference at University of Illinois at Urbana - Champaign (annual), Conference Moderator and Planning Committee

National Brownfield Association, Former Member of NYS Executive team and National Advisory Board

Northeast Sustainable Communities Workshop, Conference Moderator and Planner

Brownfield Renewal Magazine, Brownfield Award Judge

EPA National Brownfield Conference, Speaker and Conference Planning Committee

Sustainable Long Island Conference, Speaker and Conference Planning Committee

Kevin P. McCarty, P.G.
Senior Practice Leader

resume

Mr. Kevin McCarty is a principal geologist with more than 30 years of experience providing investigative and remediation technical advice to project managers, coordinating and supervising all section staff, preparing and commenting on work plans and progress, providing guidance on protocols/equipment/specialty contractors, and organizing/coordinating schedules of staff and equipment in the performance of investigations and remediation on a wide variety of projects. Mr. McCarty worked on a wide variety of project sites that have been involved with regulatory programs and oversight of the New York State Department of Environmental Conservation (NYSDEC). These sites have included each division within NYSDEC and have covered nearly every region within New York State. Mr. McCarty has a long and trusted relationship with all levels of NYSDEC management and works with the department regularly on interpreting and implementing program enhancements. He is highly regarded for his knowledge of solid waste management in construction projects, which encompasses material generated from both upland locations and excavations, demolition of existing structures, and material removed from underwater excavation or dredging. He has worked and continues to work with all three regions of NYSDEC in the application of environmental conservation law and the New York's Solid Waste Management Policy in creating sustainable solutions on large construction efforts.

Mr. McCarty also has extensive environmental construction management experience on above and belowground projects. He has historically managed the environmental construction management aspects for the New York City Department of Environmental Protection (NYCDEP) Bureau of Engineering Design and Construction Combined Sewer Overflow Program. He continues to work with NYCDEP and has recently rewritten the NYCDEP environmental and material management specifications for the Departments $2.1 billion dollar annual capital construction program.

PREVIOUS PROJECT EXPERIENCE

Springfield Gardens/Linden Place Beneficial Reuse, New York, NY. Served as representative of the City of New York in providing a solution to a large waterfront drainage project being managed under NYCEDC for multiple agencies. Issues included large volumes of material generated from the large basin expansion and storm buffering project in Jamaica Queens. Mr. McCarty offered a solution to the team prior to being contracted by the City and was able to present the plan to City as well as State Agency Engineers and regulators providing for multiple reuse sites all under City management. The reuse approval required State review and approval and he worked with Albany NY in a rapid manner gaining approval and managing all of the material movement, reuse and documentation for the City. The project was

EDUCATION
B.A., Geology/Earth Science, Western Connecticut State University

EXPERIENCE IN THE INDUSTRY
33

EXPERIENCE WITH GEI
1

REGISTRATIONS/CERTIFICATIONS
Professional Geologist, Pennsylvania (License No. PG0024455G), Delaware (License No. S4-0001302)

GEI Consultants

completed in under two months and moved over 45,000 cubic yards preventing landfilling of any material. This saved multiple projects over $6 million in contract fees for disposal.

Voluntary Cleanup Agreements at a Former Manufactured Gas Plant, New York, NY. Coordinated with city and state agencies for review and approval of documents related to 13 voluntary cleanup agreements for a former manufactured gas plant site between New York City, the former utility and the State of New York under Voluntary and Brownfield Cleanup programs. Negotiated two cost recovery agreements between the City and the utility for redevelopment of individual sites by third party entity that allowed control for developer and approval status for utility with respect to planning and cost control.

Multiple New York State Landfill Cap Investigations.Managed soil and groundwater investigations at over 60 New York State Superfund dump and landfill sites throughout the State of New York to assess levels of contamination, cap appropriateness and final remedy.

Beneficial Reuse Program Development, NYCDEP, New York, NY. Designed and developing a major soil and fill reuse program for NYCDEP to utilize material generated within the area of NYC for construction capping and reuse efforts. The Program involves regulatory negotiation, presentation of capital construction information and adaptation to specifications and additional project constraints.

Development of Fulton Fish Market, New York, NY. Managed the investigation, design and implementation of the remediation combined with the full development of the Fulton Fish Market. The remedy included full design, specifications and construction management throughout the entire project. The design evaluated most efficient method of beneficial reuse for excavated material taken from an area historically used to dispose over 36,000 tons of coal tar and purifier waste. Final selection was incineration in a NYSDEC-permitted waste-to-energy facility where the material would be used for fuel. In the end, a total of 7.6 megawatts of electricity was generated and placed into the local electrical grid as well as a significant amount of steam energy that was supplied via underground piping to local industrial facilities. Project received an ACEC Diamond Award, an EPA Region 2 Phoenix Award, and 2011 New York City Sustainable Remediation Award.

Permitting, Assessment, Closure and Redevelopment of Multiple Major Oil Storage Facilities, New York, NY. Managed multiple investigations, permit conditions, spill closure remediation efforts as well as prepared demolition plans and specifications for complete removal and redevelopment of older facilities. Also handled full assessment for both sale and purchase of multiple MOSF for both operation and closure. Managed multiple aspects of one of NYC largest MOSF for over 25 years through transition and sale and continue to permit and evaluate transition of storage, leak detection systems and operational permit modifications. Managed the complete purchase evaluation, investigation, remediation and operations of an MOSF and for over 12 years functioned as environmental compliance and consultant. Following the sale of the terminal managed the demolition and closure with NYSDEC and subsequent residential redevelopment.

The Anheuser Busch/Greenway Remediation and Redevelopment, Bronx, NY. Involved the classification and reuse of over 43,000 cubic yards of material generated on adjacent construction projects to raise the development site out of the 100 year floodplain. The approval required a significant coordination effort with NYSDEC Divisions of Environmental Remediation and Solid Waste. The project created a document used by NYSDEC for other similar reuse efforts in New York. The project was completed saving NYC over $6 million in disposal of material and the developer over $.5 Million in purchasing new fill. The project was awarded the 2010 Diamond Award for environmental projects in New York State and was a National Finalist.

PROFESSIONAL AFFILIATIONS

Board of Directors and founding member for the New York City Brownfield Partnership
Board of Directors and founding member for New Partners for Community Revitalization
Member of the Downstate Soil Reuse Committee, New York City Department of Environmental Protection
Member of the New York City Brownfields Task Force
Charter Member of the Hudson Valley Brownfields Partnership Steering Committee

Jaimie L. Wargo
Senior Data Coordinator

resume

Jaimie Wargo is part of an in-house service team managing analytical and survey data flowing through the East Region for QC and regulatory comparison.

Prior to joining GEI, Ms. Wargo worked 5 ½ years as a Database Technician for a company providing food distribution software maintaining inventory; customer; vendor; accounts receivable; accounts payable and purchasing data. Her responsibilities included providing technical support to over 150 clients' via phone, fax, email and remote access; installing new software and maintaining program updates on clients' server and troubleshooting and reporting program bugs. She also conducted in house and onsite training sessions for her clients.

EDUCATION
A.A., General Studies, Manchester Community College

EXPERIENCE IN THE INDUSTRY
11 years

EXPERIENCE WITH GEI
9 year(s)

EXPERIENCE

As Coordinator of the Data Management team Ms. Wargo schedules and coordinates daily deliverables; provides day to day technical support to project staff; and works closely with Project Managers and staff to create and provide custom deliverables. She works as a laboratory liaison setting up lab deliverables and formats of electronic data and facilitating supply chains to ensure timely project delivery. This includes database setup and tracking, sample verification, troubleshooting data errors, database input, creating custom reports and invoice review. Ms. Wargo uses established database software such as EarthSoft EQuIS, MS Access, SQL, and other software programs and maintains procedures based on project needs which include generating chemical data tables with regulatory comparison and screening. She works with multiple state agencies to provide analytical data in a required specified format.

Data Management projects include:

- Erie Street Former Manufactured Gas Plant, AGL Resources, Inc., Elizabeth, NJ.
- Columbia Gas of Virginia/nisource Ap - Craford Bay Dredging-former Portsmouth Virginia Mgp, Columbia Gas of VA, Inc. /NiSource AP, Portsmouth, VA.
- Brownfield Citizen Participation Plan Site #C224162, Dca 1, Lp, Brooklyn, NY.
- Henderson Remediation, Titanium Metals Corporation, Henderson, NV.
- Former MGP Site, National Grid, Metropolitan, NY.
- Expert Consulting and Litigation Services (Confidential Client), PSEG Services Corporation, Confidential, .

GEI Consultants

- Elmira Water Street Former MGP Remedial Investigation, New York State Electric & Gas Corp, Elmira, NY.
- Former Greenpoint MGP Site, National Grid, Brooklyn, NY.
- Halesite Former Manufactured Gas Plant, National Grid, Halesite, NY.
- Former Manufactured Gas Plant, National Grid, Sag Harbor, NY.
- Clifton Former MGP Site, National Grid, Clifton, NY.
- National Grid - Williamsburg, National Grid, Williamsburg, NY.
- Gowanus Canal Superfund Site, National Grid, Brooklyn, NY.
- Alternative Gas Sites 2009, National Grid, Long Island, NY.
- Sanford Air Monitoring Program, Sanford Gasification Plant Site Grp, Sanford, FL.
- Feasibility Study at an Urban MGP Site, Orange and Rockland Utilities, Inc., Haverstraw, NY.
- Ithaca First Street Former MGP Remedial Investigation and Workplan, New York State Electric & Gas Corp, Ithaca, NY.
- Clean Water Project - Geotechnical Services, Metropolitan District Commission, Multiple, CT.
- Stewardship Permit, MacDermid, Inc., Waterbury, CT.
- Multiple Site Characterizations, National Grid, Multiple, NY.
- Con Edison Hastings-on-Hudson, Consolidated Edison Company of NY, Hastings on Hudson, NY
- KeySpan MGP Services Program, National Grid, Various, NY.
- Sea Isle City RASR & RAW Remedial Design, FirstEnergy Corporation, Sea Isle City, NJ.

COMPUTER SKILLS

- EarthSoft EQuIS Chemistry
- Microsoft Access
- Microsoft Excel
- Microsoft PowerPoint
- Microsoft SQL Server 2012
- Microsoft Word
- Microsoft Outlook
- Adobe Acrobat
- PC Anywhere, Terminal Services, gotomeeting, VPN
- Internet and 'DOT' a dos based command prompt

Appendix C

Field Sampling Plan

GEI Consultants

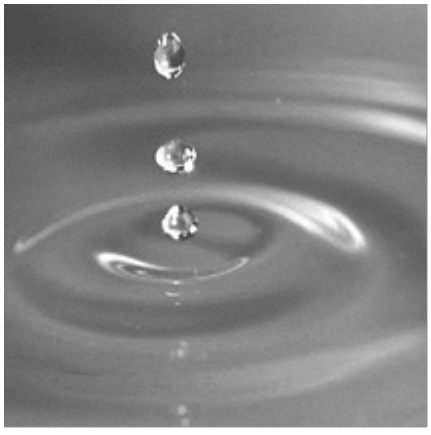
Consulting
Engineers and
Scientists

FIELD SAMPLING PLAN

Hunts Point Parcel D
Property Located at Food Center Drive (NE Corner)
Bronx, NY 10474

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 11th Floor
Albany, NY 12233-7020

Submitted by:
GEI Consultants, Inc., P. C.
1385 Broadway
20th Floor
New York, NY 10018



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Section 7 – Groundwater (GW)

GW-001 Water Level Measurement
GW-002 Non-Aqueous Phase Liquid (NAPL) Measurement
GW-003 Low Flow (Low Stress) Groundwater Sampling
GW-004 pH and Temperature Measurement
GW-005 Turbidity Measurement
GW-006 Specific Conductance Measurement
GW-007 Dissolved Oxygen Measurement
GW-008 Temporary Groundwater Sampling Points

Acronyms and Abbreviations

AOC	Area of Concern
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethyl Benzene, Xylenes
CAMP	Community Air Monitoring Plan
CD	Corrected Depth
COC	Chain of Custody
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DOT	Department of Transpsortation
EM	Electro-Magnetic
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FSP	Field Sampling Plan
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information Systems
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HASP	Health and Safety Plan
HSAs	Hollow-Stem Augers
ID	Inner Diameter
IDW	Investigation Derived Waste

IHC	In-House Consultants
JHS	Jar Head Space
LNAPL	Light Non-Aqueous Phase Liquid
MC	Macrocore®
MTBE	Methyl Tert-Butyl Ether
NAPL	Non-aqueous Phase Liquids
NAVD	North American Vertical Datum
NYSDEC	New York State Department of Environmental Conservation
OD	Outer Diameter
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation Recovery Act
SC	Specific Conductance
SMP	Site Management Plan
SOP	Standard Operating Procedure

SPLP	Synthetic Precipitate Leaching Procedure
SPT	Standard Penetration Test
SVOC	Semi-Volatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compounds

Measurements

bgs	Below Ground Surface
ft	Feet or Foot
g	Grams
lpm	Liters per minute
mg/L	Milligram per liter
ml	Milliliter
mL/min	Milliliters per minute
MSL	Mean Sea Level
mV	Millivolt
ng	Nanogram
NTUs	Nephelometric Turbity Units
ppm	Parts per million
µg/Kg	Microgram per kilogram

1. INTRODUCTION

1.1. Introduction

This document serves as a Field Sampling Plan (FSP) for various types of environmental sampling activities that may be utilized during implementation of Site Characterizations, Remedial Investigations, Interim Remedial Measures, Feasibility Studies, Remedial Designs, and/or Remedial Actions. The primary intent of this document is to promote accuracy and consistency for field and office support operations.

This FSP encompasses a broad range of activities to improve the planning, implementation, and documentation of field and pertinent office operations. All methodologies presented in this document may not be applicable to site-specific situations. In the event of differences between the FSP and any site-specific work plan, including a work plan or a quality assurance project plan, the provisions of the site-specific plan will prevail.

This document is organized according to the chronological sequence of typical work flow proceeding from project setup to field activities and then to data collection.

The document contains two types of guidance:

General Guidance Procedures – Documents intended to be informative and not prescriptive. The documents are designed to provide necessary background information to adequately understand associated field processes.

Standard Operating Procedures (SOPs) – Documents intended to provide the necessary procedures and notes to successfully implement the operation.

This FSP incorporates requirements including but not limited to New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation dated May 3, 2010, any applicable local, state, or federal requirements, and client requirements. Each SOP is current as of the effective date indicated in the header and will be updated as necessary.

This document has been provided to all staff performing field tasks for the client.

1.2. Site Location

The Site is located in a commercial and industrial area on the northeastern portion of the Hunts Point former MGP in the Borough of Bronx, New York City, Bronx County, New York (Figure 1). The property is approximately 7.23-acres, set along the waterfront at the confluence of the Bronx and East Rivers, a single small structure exists on the Site which is a Con Ed gas metering station that sits on an easement that traverses the northern portion of the Site from the water's edge to the western boundary. The remainder of the parcel is an unimproved vacant lot over grown with vegetation. The Site is bounded by a rail line immediately along the western edge and Food Center Drive just beyond the rail corridor, Chef's Warehouse to the north, Krasdale Foods to the south, and the Bronx River to the east and is currently zoned M3-1.

1.3. Sampling Objective

To fully evaluate the location, depths and limit of the purifier bed material as well as to provide additional delineation for limits of coal tar identified during the initial investigation. Samples will be collected from groundwater, purifier waste, clay and other native units and will be submitted for geotechnical and/or laboratory analysis. The evaluation will provide preliminary information that will be used in the initial evaluation for remedial alternatives. Current options for material include thermal treatment, incineration, landfilling and In-Situ Stabilization (ISS).

1.4. Field Activities

1.4.1. Soil

Soil samples will be collected using the direct push method (Geoprobe®) with a 3-inch macro core sampler. Probes will be advanced through waste material and into the lower lying soil units to provide full depth information on the surface of the underlying clay and other native units with respect to fill and groundwater. Soil boring locations are presented in **Figure 3**.

Native Perimeter Soils

- Identify native soil layers in perimeter delineation borings.
- Target soils from the 5-20 ft. bgs interval.
- Collect a minimum of 100 lbs. per each dominant soil type identified and submit for geotechnical analysis.

Native Clay Beneath Purifier Waste

- Minimally disturbed clay cores preserved in the macro core sleeve and collected from a minimum of four locations from beneath the purifier beds.
- Cores to be submitted for geotechnical analysis.

Three (3) additional borings will be installed offsite to observe potential offsite impacts originating from Site and will be advanced using the Geoprobe® direct push method to depths ranging from approximately 15-20 ft. bgs depending on observed soil conditions in the field as determined by GEI Field Personnel. These locations will also be converted into temporary monitoring wells. Continuous sampling will be conducted until the desired depth is reached. If impacts to soil are observed at depth, the boring may be advanced further to identify vertical extent of contamination until un-impacted soils are observed, or a confining layer or bedrock refusal is reached. Prior to the advancement of soil borings, all locations will be cleared for utilities and subsurface infrastructure to a depth of 5 ftbg using minivac, air knife, or by hand. Continuous sampling will be conducted until the desired depth is reached.

Soil samples collected from the temporary monitoring well locations will be analyzed for Target Compound List Volatile Organic Compounds (TCL VOCs) by 8260C, Target Compound List Semi-Volatile Organic Compounds (TCL SVOCs) by 8270D, for Target Analyte List Metals (TAL Metals) by 6010B and 7471A, for Polychlorinated Biphenyls (PCBs) by 8082A, for Pesticides by 8081B, and Total Cyanide analysis by 9012B.

Soil will be inspected for visual and olfactory impacts and screened with a Photo Ionization Detector for VOCs. Only one (1) soil sample will be collected either from an interval where impacts are noted or one-foot above the water table if no obvious signs of impacts are observed.

Quality Assurance/Quality Control (QA/QC) samples will only be collected for soil borings advanced as part of the offsite investigation and submitted for chemical analysis. A summary of analyses and methods for soil can be found in **Table 1** and **Table 4** in the Quality Assurance Project Plan (QAPP). Additional analyses may be included based on field observations. Groundwater samples will be properly transported to a NYSDOH ELAP-certified laboratory under chain of custody procedures.

All sampling will be conducted consistent with the FSP, QAPP, and Health and Safety Plan (HASP).

1.4.2. Groundwater

Groundwater samples will be collected from seven (7) on-site wells. Using the Low-flow groundwater sampling method, samples will be collected from three (3) shallow overburden monitoring wells (MW-107S, MW-109S and MW-110S), and four (4) deep overburden monitoring wells (MW-107D, MW-108D, MW-109D and MW-110D). Monitoring well

locations are shown on **Figure 2**. All groundwater samples will be analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8260C, for the 16-priority pollutant polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270D, for total cyanide by EPA Method 9014, and for free cyanide by EPA Method 9016. Four (4) of the wells will also be analyzed for an expanded analyte list to include total dissolved solids, total organic carbon, alkalinity, priority pollutant metals, and major ions. The four wells sampled for these additional analytes will include the well pair between the waste footprint and the river (MW-107S and MW-107D), and the well pair closest to the center of the Site D waste footprint (MW-109S and MW-109D).

1,4-dioxane and Per- and Polyfluoroalkyl Substances (PFAS) sampling will be incorporated into the field sampling effort for groundwater as part of the overall onsite sampling. This sampling for emerging contaminants will be confined to groundwater and not soil. The data package will include a full ASP Category B deliverable. An estimated total of four (4) groundwater samples will be collected and analyzed from onsite monitoring wells for emerging contaminants.

PFAS sample analysis will be performed by an ELAP certified lab for EPA method 537 or ISO 25101. The preferred method for analysis is a modified EPA Method 537. The reporting limit of 2 ng/l (parts per trillion) should be targeted. If this level cannot be achieved, the NYSDEC PM will be notified. PFAS sample reporting will include the list of compounds provided by NYSDEC.

1,4-dioxane analysis and reporting will use a method detection limit (MDL) of 0.28 micrograms per liter (ppb) using EPA method 8270. Sampling protocols will follow the NYSDEC "Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and other Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol".

Additionally, three (3) temporary wells will be installed as part of an offsite investigation to assess potential offsite impacts from onsite contaminants. Groundwater samples collected from the temporary monitoring wells will be analyzed for Target Compound List Volatile Organic Compounds (TCL VOCs) by 8260C, Target Compound List Semi-Volatile Organic Compounds (TCL SVOCs) by 8270D, for Target Analyte List Metals (TAL Metals) by 6010B and 7471A, for Polychlorinated Biphenyls (PCBs) by 8082A, for Pesticides by 8081B, and Total Cyanide analysis by 9012B. Proposed offsite temporary well locations are shown on **Figure 2**.

QA/QC samples will be collected according to the QAPP. Additional analyses may be included based on field observations. Groundwater samples will be properly transported to a NYSDOH ELAP-certified laboratory under chain of custody procedures. A summary of analyses and methods can be found in **Table 2** and **Table 4** in the QAPP.

All sampling will be conducted consistent with the FSP, QAPP, and HASP.

1.4.3. Soil Vapor

The scope of work proposed for the characterization of soil vapor onsite and offsite focuses on the potential for offsite migration as well as the potential for onsite migration of contaminants from offsite sources. The results of soil vapor and air sampling will assist in evaluating future onsite engineering controls.

The following scope of work is proposed to characterize the soil vapor at the Site:

- Install six (6) soil vapor points in the immediate vicinity (approximately 5ft) from monitoring well or groundwater sampling locations. If existing wells or offsite soil vapor points are found to exist, they may be used;

- Purge and collect soil vapor samples from six (6) points; and

- Analyze soil vapor samples for contaminants of concern including: benzene, toluene, ethylbenzene, xylene, and naphthalene.

The locations of the proposed samples and rationale for placement will be evaluated based upon data available from investigation reports for adjacent sites. When locations have been determined a figure will be prepared and submitted to NYSDEC.

Each soil vapor probe will be installed approximately 2 ft below the ground surface using dedicated 1/8" Teflon tubing. The tubing will be implanted into the hole and the annular space sealed with bentonite to prevent ambient air from entering the area around the probe. Once the seal is secure, a "T" fitting and valve will be connected on the above-surface end of the tubing. A syringe will be used to purge the vapors in the probe and tubing of three volumes. As required by the NYSDOH, a helium (He) tracer will be used as part of the sampling process and all testing will follow the NYSDOH Soil Vapor Guidance. If greater than 10% He is detected during the screening process, this will indicate excessive leakage and will require the point to be resealed or reinstalled after which tracer gas testing will be performed. Prior to sample collection, the He vapor will be screened using a field meter and the measurement recorded at each soil vapor sampling location. A multi-gas meter will also be used to measure the concentration of O_2, CO_2, and CH_4 in each probe, to assess the subsurface chemistry (e.g. redox state). Following this procedure, the soil vapor samples will be collected in clean, batch certified, two (2) liter Summa^{TM} canisters at flow rates no greater than 200 ml/min. A slight vacuum should remain in the Summa canister prior to shipment to the lab in order to show no leakage has occurred.

QA/QC samples will be collected according to the QAPP. A summary of analyses and methods for soil can be found in **Table 3** and **Table 4** in the QAPP.

All sampling will be conducted consistent with the FSP, QAPP, and HASP.

1.4.4. Purifier Waste

Purifier waste samples will be collected using the direct push method (Geoprobe®) with a 3-inch macro core sampler.

Unsaturated Purifier Waste

- Bulk samples of purifier waste to be collected from the unsaturated zone above the water table (0-5 ft. bgs) and submitted for ISS treatability analysis.

Saturated Purifier Waste

- Bulk samples of purifier waste to be collected from zone beneath the water table (5-15 ft. bgs) and submitted for ISS treatability analysis.

A summary of analyses and methods can be found in **Table 1** in the QAPP.

All sampling will be conducted consistent with the FSP, QAPP, and HASP.

2. PROJECT PLANNING ACTIVITIES (PP)

SUMMARY GUIDANCE

PP-001 General Guidance on Project Planning Activities

Objective

The purpose of this summary guidance section is to present a summary of the project planning activities that must be completed prior to the start of field activities. The following text outlines the steps which should be followed.

To begin, the task-specific work plan should be reviewed to identify the specifics of the task to be completed. This includes the type of work, sampling requirements, and schedule, among others. A site visit (if possible) should be made to verify that sample locations are accessible. Once the review of the work plan is completed, it can then be determined which steps need to be taken to start the project. A project planning checklist (see attached) should be completed and includes the items detailed below

Execution

- **Subcontractor Selection** – If the subcontractor is to be contracted through GEI, the subcontractor should be selected based on a combination of their qualifications and their proposed costs, if not identified in the Master Services Agreement. A minimum of two subcontractor cost proposals should be obtained for each task.
- **Subcontractor Agreement** – Once a subcontractor is selected, a subcontractor agreement between GEI and the subcontractor must be established. This agreement is task specific and should reference an approved proposal from the subcontractor.
- **Markouts** – If the project includes intrusive work, a utility markout request must be called in to Dig Net (811). Markouts must be called in at least 72 hours prior to the start of intrusive activities; however, five business days is recommended. If the work conducted is on private property, markouts by a private markout company should be obtained as public utility locating services will generally only identify line point- of-entry to a private property from a right-of-way. Markout verifications from Dig Net must be received at least one day prior to the start of field activities. Following the receipt of the markout verifications, a GEI utility clearance form must be completed, and the markouts must be visually verified. The markout verifications, verification spreadsheet and the GEI utility clearance forms must be compiled and remain onsite during the duration of intrusive activity. In addition, markouts must be checked

every 10 days throughout the duration of intrusive work. For more information on markouts, please see SOPs PP-002 and PP-003.

- **Health and Safety** – A site-specific Health and Safety Plan (HASP) must be developed prior to any field work. The site-specific HASP must be reviewed by the staff involved in the project and signed prior to the start of work (by field staff). Subcontractors are required to provide their own HASPs (which are at a minimum, as strict as the GEI HASP), or must sign and comply with the GEI site-specific HASP. The subcontractor must also provide the proper certifications for the field crew, which should include, but is not limited to, OSHA certifications (8-hour and 40-hour HAZWOPER) and medical clearance documentation. In addition, tailgate safety meetings must be held daily, which discuss hazards related to the task being performed. For more information, please refer to the site-specific HASP. For the SOPs presented in this FSP, health and safety items must be adhered to during the conduct of all field activities.
- **Notifications** – prior to the scheduling of field activities, all team members should be identified. The appropriate project manager should be notified as soon as possible of the upcoming work and the proposed schedule. As a general rule, at least one week notice should be provided. The client will coordinate access to any private property where sampling is planned to be conducted.
- **Data Group Notification** – GEI's Data Group should be notified if laboratory analysis is to be performed. The Data Group should be made aware of the types of analysis being performed, the approximate number of samples to be collected, the validation requirements and turnaround times.
- **Lab Notification** – If laboratory analysis is needed, the selected laboratory should be notified as soon as possible to order the necessary sample bottles and supplies. They also should be informed of the anticipated amount of samples, type of analysis and required turnaround times.
- **Equipment** – Any specialized equipment or supplies, including Community Air Monitoring Program (CAMP) equipment, needed for the job should be ordered, to allow for sufficient lead time. CAMP equipment is required for any intrusive work. For more information on CAMP requirements, please see the site-specific HASP or Work Plan and SOPs AR-001 through AR-005.
- **Investigation Derived Waste (IDW) Management** – Consideration should be given to the management of IDW. Based on the work to be performed at the specific site, a determination needs to be made on how the IDW is to be handled. Possibilities include drums for soil and groundwater, frac tanks for groundwater or roll-offs for soil. Reducing the amount of IDW generated through selection of the appropriate

sampling and investigation methods, as well as cost and efficiency of disposal, should always be considered.

- **Background Information** – Prior to field activities, pertinent background information should be discussed with the field staff and GEI task and project managers. Such information may include: historical perspective, property owner/community member interests, potential litigation matters, access and logistical issues, safety concerns, requirements and concerns, among others.
- **Kick-off Meeting** – A kick-off meeting should be conducted prior to the start of field activities. At a minimum, the meeting should be attended by the project manager and field staff. This meeting should review the tasks to be completed, equipment needed, laboratory analysis, and a review of any necessary background information (including potential sensitivities associated with the site or work area of the site). Other items that should be discussed include the process of and the need to keep the client informed of the work progress (including any relevant observations) and the steps to be taken if a member of the field crew is approached/questioned by a regulator or a member of the public or media.

SUMMARY GUIDANCE

PP-002 General Guidance on Private Utility Markout

Overview

Prior to installing any wells, performing excavations or penetrating the subsurface for any investigation; all service lines, including water, electrical power, natural gas, sewers, cable and product distribution piping, and others, must be mapped out on the ground surface. This requirement is independent of the need for borehole clearing to 5 feet. Both exercises together minimize the safety risk as well as the time and cost penalty associated with severing an underground line.

This guidance describes and recommends technologies that should be (and normally are) employed from the companies performing the mapping, which are private utility locators. Public utility locating services will identify line point-of-entry from a right-of-way, but in many cases are unwilling to mark locations within the footprint of a site. Even if the public companies provide onsite service, it is good insurance to have a private company verify buried utility locations because of the potential consequences of hitting an unknown buried utility.

Because subsurface lines may be metal, plastic, clay, or concrete, multiple technologies are generally needed for their identification. For most applications the following technologies are fit-for-purpose.

Electro-Magnetic (EM) Device: This technology uses an electro-magnetic field in the subsurface to accurately locate metallic lines or non-metallic lines incorporating a metallic trace wire along their surface. The field is created either by direct contact to the pipe or trace wire, or by an induced current via radio waves.

Sewer Sonde: For non-metallic lines where internal access is possible (such as cleanout ports in a sewer), a beacon or 'sonde' that emits a signal to a surface receiver as it is snaked through the pipe provides the same accuracy as the EM detector. If the internal condition of the pipe is desired, a camera can be deployed instead of only a sonde.

Ground Penetrating Radar (GPR): This technology involves radar waves reflecting to a surface receiver which provides a visual real-time map of the subsurface by which anomalies (such as pipes or tanks) may be detected. It has limitations in clay or wet soils and requires a skilled operator for interpretation. For high risk utilities (e.g. PVC natural gas lines without trace

wire) where line-of-sight projection from site entry point to a kiosk or other building is uncertain, GPR should be considered.

For most sites, utility markouts using the above technologies can be conducted in about two hours, assuming work covers a limited area where subsurface activities will be conducted. Consideration should be given to mapping an entire site if as-built drawings are suspect and work is planned over an extended period of time.

SUMMARY GUIDANCE

PP-003 General Guidance on Maintaining Markouts

Overview

Maintain the marks set down by utility operators/ locators at your site. Several steps should be taken to ensure site markouts are maintained/refreshed throughout the project.

Walk-through the site to become familiar with the markings and the locations of buried utilities. Pay special attention to any changes in direction that the underground facilities take. Consider photographing the markouts.

If the excavation will cause the removal or disturbance of markings, establish offset marks in order to maintain a reference point for those underground facilities.

Make sure that everyone involved in your excavation is aware of any offsets that have been established, any marks that have been compromised, or any other information regarding facility locations.

Don't put spoil piles over markings.

If the markouts are located over grassy areas or if snow is expected, flags or stakes should be employed to avoid having the markouts washed away by rain or covered by snow.

Avoid driving machinery over stakes and flags. Paved areas should be swept periodically so that painted marks remain visible.

If marks have faded or have been compromised to the point where proper and safe excavation is no longer possible, call the public or private utility markout service and make a request for a new markout ticket. If the markings at your site are refreshed, make sure that you use the uniform color code.

Attachment A

Project Planning Checklist

SITE: _____

PROJECT MANAGER: _____

Activity	Completed (Yes, No or NA)	Date Completed	Comments
Subcontractor Identified (if needed)			
Subcontractor agreement			
Markouts			
HASP			
Subcontractor certs obtained			
National Grid Notifications			
Data Group Notified			
Laboratory notified			
Equipment Ordered			
IDW Management			
Background info reviewed			
Kick-off meeting or call			

3. FIELD DOCUMENTATION (FD)

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

Objective

Proper documentation of all site activities is a crucial part of the field investigation process. Documentation, relative to sampling procedures, includes sample labels, sample seals, field logbooks, chain of custody (COC) records, sample analysis request forms, and laboratory sample logs. The field notebook serves as a record of significant field activities performed or observed during the project. The field notebook provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Appendix A.

Execution

- Use a separate all-weather bound notebook for each site/location/ project number, as appropriate.
- Write neatly using black or blue waterproof indelible pen (or note if field conditions [i.e., cold or wet weather] require use of pencil).
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and “Return Book To:” the office address of the project manager.
- Number all of the pages of the field book starting with the first entry if notebook is not numbered already.
- Record activities as they occur.
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted. If an error is made on an accountable document assigned to one individual, that individual will make all corrections. The person who made the entry will correct any subsequent error discovered on an accountable document. All subsequent corrections will be initialed and dated.
- Sign or initial and date the bottom of the last daily page of an entry. Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    1. Date/time/weather/project number.
    2. GEI personnel.
    3. Purpose of visit/daily objectives.
    4. Record conversations with:
        a. Contractors.

b. Client.
c. Visitors (include complete names, titles, and affiliations whenever possible).
d. GEI office staff.
e. Landowners (site or abutters).

5. If possible, record telephone numbers of individual contacts for the site in the field notebook.
6. Note time of arrival and departure of individuals visiting the site.

- Potential additional observations to record (as needed):
  1. Type and quantity of monitoring well construction materials used.
  2. Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.).
  3. Ambient air monitoring data.
  4. Locations and descriptions of sampling points.
  5. Sample media (soil, sediment, groundwater, etc.).
  6. Sample collection method.
  7. Sample identification number(s) and date and time of sample collection.
  8. Approximate volume of groundwater removed before sampling.
  9. Field observations.
  10. Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
  11. References for all maps and photographs of the sampling site(s).
  12. Information pertaining to sample documentation: bottle lot numbers/dates, method of sample shipments, COC record numbers, and overnight shipping numbers.
  13. Surveying data (including sketches with north arrows).
  14. Changes in weather.
  15. Rationale for critical field decisions.
  16. Recommendations made to the client representative and GEI Project Manager.
  17. Include a site sketch or representative site photograph of conditions at the end of the day, if required.
  18. Time.
  19. Summarize work completed/work remaining.

Notes

- Only record facts.
- Record all observations regardless of relevancy.
- Identify conditions or events that could affect/impede your ability to observe conditions.

- Do not use spiral notebooks because pages can be easily removed.

References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

Yerington Mine Site SOP-03 Standard Operating Procedure Field Notes and Documentation, Revision 0 Revision Date: June 6, 2006.

ASFE Model Daily Field Report (1991), ASFE, Inc.

Attachments

Attachment A – Example Field Notes

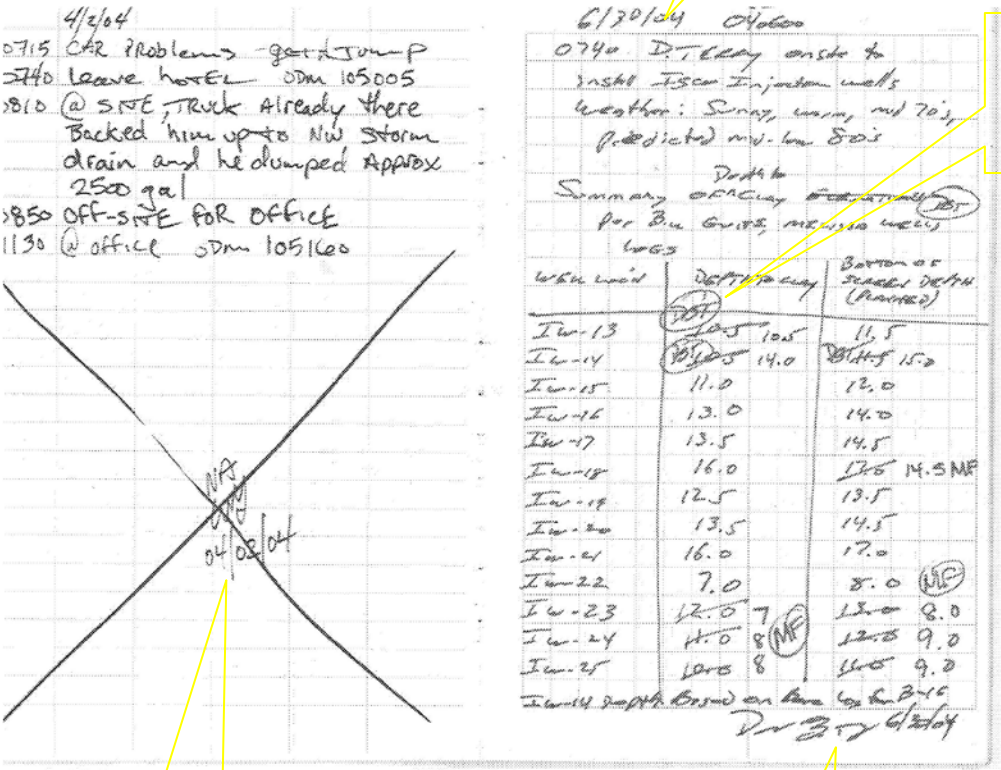
Attachment A

SOP FD-001

Attachment A – Example Field Notes

Start of each day includes:
- **Date**
- **Project Number**
- **People on site**
- **Purpose of Work**
- **Weather Conditions**

Errors are single line crossed out and initialed



Blank Space crossed out and initialed

Bottom of each page signed and dated

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

Objective

A Daily Report may be required to accurately summarize the activities, observations, and decisions made during the day's field work. The daily field observation report may serve as a permanent record of the day's activity for the Project Manager (PM) and In-House Consultant (IHC).

Execution

- If required, at the close of the day's field work, a Daily Report must be prepared by the individual responsible for the field notebook. This report must be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information.
    1. A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
    2. A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
    3. A summary of deviation(s) from the field plan or objectives.
    4. A summary of field decision(s) made, who made it/them, and the basis for such decision(s).
    5. A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
    6. Any recommendations that may result from field observations and any actions that resulted from those recommendations.
    7. A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review and editing related to the clarity and conciseness of the report. Complete any editorial changes, sign, date, and submit the report to PM/IHC for approval/signature. Field Observation Reports should be written neatly. They are not required to be typed unless specifically requested by the PM.

Notes

- Not all projects require daily field observation reports.
- The Field Observation Report should be based solely upon factual information, not opinions. Any speculation should be clearly noted in the report as such.

- The Field Observation Report should never be released to anyone other than the PM/IHC prior to review and signoff unless explicitly authorized by the PM/IHC.

References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

Yerington Mine Site SOP-03 Standard Operating Procedure Field Notes and Documentation, Revision 0 Revision Date: June 6, 2006.

ASFE Model Daily Field Report (1991), ASFE, Inc.

Attachments

Attachment A – Example Daily Report Form

Attachment A

Attachment A: FIELD OBSERVATION REPORT

Project : **Date:**
Client : **Report No.**
Contractor: **Page:**
GEI Proj. No.

Time of Arrival: **Departure:** **Weather:**

Persons Contacted, Company **GEI Representatives**

Purpose of Site Visit:

Observations

1.

By:	**Reviewed By:**

STANDARD OPERATING PROCEDURE

FD-003 Sample Handling and Chain of Custody

Objective

To properly collect, label, document, preserve, package, and transport environmental samples; provide a record of the custody of any environmental field sample from time of collection to delivery to the laboratory. The chain of custody (COC) can be used as a legal document to demonstrate that samples were not mishandled and that they were delivered to the laboratory within the timeframe necessary to start analysis. A sample is under custody if it is in:

a) GEI's possession;
b) GEI's sight after being in GEI's possession;
c) it was in GEI's possession and then it was locked up to prevent tampering; or
d) a designated secure area. GEI facilities are designated secure areas.

Execution

- Review the work plan and Quality Assurance Project Plan (QAPP) prior to sampling to determine the following:
  i. The analysis required by the work plan and sample volumes required by the laboratory to perform those analysis. (Be explicit when requesting analysis on the COC (e.g. rather than "VOCs" [Volatile Organic Compounds], write "VOCs 8260".)
  ii. The turnaround time required by the project.
  iii. If the data will be sent directly from the laboratory to the data validator or Data Group.
  iv. Holding time restrictions for sampling media and analytical methods.
- Label the jar or bottle
- Following sample collection, the sample container is labeled using a waterproof marker with the sample ID, the date and time (military time) of sample collection, project number, sample preservatives, and the sampler's initials. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material. Place samples in a chilled (4°C) cooler immediately after collection.
- Complete a COC for the samples as described below, and sign off on the COC each time a new person takes possession of the samples. A COC form must accompany each shipment/delivery of samples to the laboratory. GEI or laboratory COC forms may be used as long as the laboratory form contains the same required information as described

below.

- An example COC is provided in Attachment A.
- Place a custody seal on the cooler if shipping.
- Transport samples to the laboratory as soon as possible. It is preferable the samples are sent from the field rather than brought back to the office for submission at a later date.

Chain of Custody (COC) Completion

- Record the project name and number, the sampler's name(s) and the site, town, and state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, whether the sample is a grab or composite sample and the number of sample containers. Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- When samples are ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., FedEx, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.
- Include turnaround time and project contact on the COC.
- The forms are in triplicate (white, yellow, and pink copies). The pink copy should be retained by the sampling personnel and provided to the Data Group for proper filing. The white and yellow copies should accompany the samples to the laboratory.
- Prior to sample shipment, the COC must be placed inside the cooler (in a ziplock bag or other watertight package taped inside the lid of the cooler), and the cooler must be sealed with a signed COC seal.
- If a common carrier such as FedEx is used to transport the samples to the laboratory, include the carrier tracking number and identify the carrier in the "Received by" box on the COC.
- Any unused sampling containers/media that is sent back to the lab should be included on the COC. Return samples to the laboratory in a timely manner.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field copy of the COC and also the field book.

- Prior to samples being sent to the laboratory, the project or task manager will check the COCs for accuracy against the sample tracking summary, if appropriate, or the work plan.
- After the samples are sent to the laboratory, the field copy must be sent to the Data Group. You can send the field copy with duplicate information in the mail to the Data Group.

Notes

- The field notebook must document all GEI personnel who had custody of any samples prior to shipping the samples to the laboratory, the samples must be relinquished to the shipper and the COC signed and dated by the sampler and the shipper, even if both people are GEI personnel.
- Keep the number of people involved in collecting and handling samples and data to a minimum.
- Only allow people associated with the project to handle samples and data.
- Always document the transfer of samples and data from one person to another on chain of custody forms.
- Always accompany samples and data with their chain of custody forms.
- Give sample identification at all times that is legible and written with permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Do not send samples from more than one site with separate COCs in a single package.

References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

Attachments

Attachment A – Example Chain of Custody

Attachment A (See QAPP)

STANDARD OPERATING PROCEDURE

FD-004 Photo Documentation

Objective

To properly document and retain photographic records. Keeping a record of photographs taken is crucial to their validity as a representation of an existing situation.

Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- All photographic records should be recorded in the Field Notebook (SOP FD 001) and the following information should be recorded in the field notebook:
    i. Number of photograph in sequence.
    ii. Compass direction describing the direction the photograph was taken (e.g. looking southeast).
    iii. Brief description of what the photograph is intended to show.
- The field notebook should also note who took the photographs, and the date and time each photograph was taken.
- The photographs should be electronically backed up on a computer or other data storage device.
- Photographs should be placed on a photograph record template and the relevant information describing the photograph should be inserted into the caption section for each photograph.

References

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Attachments

Attachment A – Example of Photo Documentation Template

Attachment A

Attachment A – Example of Photographic Record
GEI Consultants, Inc.

Project: Project Name

Location: Project Location

Photographer: K. Barber
Date: 10/25/07
Photo No.: 1
Direction: N

Comments:
Entrance of site with tree mulching operations.

Photographer: K.Barber
Date: 10/25/07
Photo No.: 2
Direction: W

Comments:
On-site building built in 1936.

STANDARD OPERATING PROCEDURE

FD-005 Surveying and Mapping Specifications

Objective

The objective of this Standard Operating Procedure (SOP) is to present the minimum requirements for establishing horizontal and vertical surveying control for field programs. Accurately surveyed locations are a key element in the evaluation of all field data, and are necessary for the preparation of geologic profiles and the interpretation of horizontal and vertical groundwater flow directions, and the locations of facilities. The accuracy of measurements and established elevations is particularly important when groundwater gradients are low, as errors may easily lead to misinterpretation of the direction of groundwater flow. The survey is usually performed after the field activities have been completed. Activities and land features requiring accurate horizontal and vertical control include:

- borings;
- test pits and trenches;
- monitoring wells and piezometers;
- geophysical surveys;
- surface water and drainage features;
- buildings and structures; and
- underground utilities and storage tanks as marked on the surface.

Execution

Mapping shall be based on field measurements and calculated to sufficient accuracy to be in conformance with A-2 standards, regardless of the intended end product of such work.

Standard site plans, as a minimum, shall provide the following elements:

- Location of all surface features, including, but not limited to: buildings, structures, fences, aboveground utilities, drainage equipment, underground features as marked on the surface, limits of pavement, landscaped or graded areas, and a general description of surface material and vegetation. All monitoring wells, soil borings, test pits, and other samples points shall be located.
- Location of all enclosed or abutting water bodies. Flow direction of rivers, streams, or surface drainage shall be noted with arrows.
- Location of boundaries by reference to other plans, when available, and to lines of occupation, where apparent. If this information does not exist, the surveyor shall make reference to Assessor's map and lot numbers.

- Disclaimers of certification to boundary and title should be prominently displayed.
- Location of surface features on abutting properties to a distance of 100 feet beyond property boundaries of study area are desired where practical, but in any case, to a minimum of 20 feet. Names of abutting property owners, as listed by the Town Assessor, shall be included.
- Include a location map of sufficient scale and detail to locate the site from a statewide reference.
- Provide a verbal and graphical scale of distance. All maps shall include a north arrow with reference to direction (magnetic, true, or grid). Unless a site-specific grid system is required, NAD83 (2007) should be identified as the horizontal datum.
- All maps shall be accompanied by copies of all field notes and sketches used in their preparation. The surveyor shall provide a coordinate and elevation list for all control and location points.
- Topography, when requested, shall conform to Class T-2 standards (90 percent of contours true to within 1/2 contour interval). The vertical datum should be identified on the plan. Monitoring well elevations shall be established at the ground surface and at the top of casing or riser.
- Requirements for location by state plane coordinates will include reference to geodetic monuments or global positioning system (GPS) base stations used.
- Plan should comply with GEI's Section 3 "File Specifications for Subcontractors" provided below.

Requests for boundary survey entail the following additional requirements.

- Examination of record descriptions of the property and adjoining parcels, of record surveys and plans, and of record easements appurtenant to the property. Record search will extend long enough to determine the original intended boundary locations. Certification as to ownership should be provided by the client's legal counsel.
- Location and description of all boundary monumentation found.
- Location of record easements and visible evidence of entry.
- Location and description of apparent encroachments by structures, occupation, and improvements on the property.
- Location and description of any conflict between deed description and actual occupation.
- Distance and bearing of property lines are to be shown to the nearest hundredth foot (0.01') and arc second (0°00'01"). Area should be shown in decimal acres and/or square feet.

- Plans should include certification as to conformation to state standards for boundary and topographic survey. No other certifications should be provided, except as specifically negotiated with the client.

Survey Requirements for Exploration Programs

The project manager shall go over the survey program with the survey chief to be sure that all requirements are understood and that the survey crew is alerted to potential site hazards.

The following criteria should be met for all survey programs.

- The survey is to be performed by or under the direction of a registered professional land surveyor.
- The survey shall be accurately performed to a precision of 0.01 foot for vertical control and 0.1 foot for horizontal control.
- Horizontal control is to be related to either a state plane coordinate system or the Universal Transverse Mercator (UTM) coordinate system. North American Vertical Datum (NAVD) 1988 should be used as the vertical datum unless a site-specific datum is required.
- Elevation precision to be obtained at monitoring wells and piezometers shall be:
    i. Top lip of protective casing without cover (0.01 foot); this point should only be used for vertical control and not for water-level measurements.
    ii. Top of monitoring well riser pipe (0.01 foot); a permanent reference point should be marked on the top of the riser to be used as the measuring point for all water-level measurements.
- Establish a permanent site benchmark on the most stable nearby feature and note its location on survey maps.
- The surveyor should submit a report of the survey, including a copy of all original field notes. Survey information needs to be reviewed carefully with respect to horizontal and vertical determinations. Survey errors may often be caught by using relative distances between wells or noting apparent anomalies in water levels or flow directions.

Previous Use of a Datum Other Than Mean Sea Level

Many times a parcel of land contains a previously established vertical benchmark on site to which elevations have been referenced. Such an arbitrary local datum may not provide any specific information about its relationship to Mean Seal Level (MSL), or a standard vertical datum. An arbitrary datum, when used, should be identified as a local or arbitrary datum. In other cases, when a standard city-wide local datum is used, the vertical relationship to the standard datum should be provided.

Otherwise, surveys at all sites subject to agency review shall be referenced to NAVD88.

Weather Conditions

Inclement conditions increase the chance for errors in identification, measurement, and recordings. Surveyors need to take extra time to assure proper identification of all monitoring wells surveyed, to guarantee ice- and snow-free surface elevation shots, and to carefully record survey data despite adverse conditions. Obtaining stable tripod set-ups may be more difficult under these conditions. Sightings should use shorter distances than under more favorable conditions. Warm, sunny days generate heat waves that may present problems for optical instruments.

Work at Hazardous Waste Sites

Surveyors need to be made aware of hazardous site conditions and potential exposures. Surveyors should have been enrolled in a health monitoring program for any sites which require personal protection above Level D. Note that anticipated risks to surveyors would be expected to be less than for those engaged in collecting samples or in subsurface explorations. However, potential exposure to hazardous materials should be pointed out and appropriate protective equipment worn and used. Surveyors shall also be made aware of other site activities and procedures for evacuation in case of emergency.

File Specifications For Subcontractors

3.1. General File Standards

- The method of naming files shall incorporate the name of the site and/or the GEI project number and the content. For example, SITE NAME-001110-Site Layout.
- All files provided to GEI will be electronically transmitted or recorded on CD, DVD, or other permanent recording medium. All referenced files and other supporting files such as special line types, color tables, images, etc., shall be included.
- All files are to be provided in .DWG or .DXF format and shall be compatible with AutoCAD Release 2007.
- It will be standard procedure to have purged all unused entities from a CAD file prior to delivery.
- Each file will be clearly labeled as follows:
    i. Project No.:
    ii. Project Name:
    iii. Drawing Title:
    iv. File Size:
    v. Date:

vi. Revised Date:

- Files which contain non-standard ACAD fonts, line types or custom menus are not acceptable.

General Drafting Standards

- All entity line types, colors, etc. are to be defined “BYLAYER.”
- It shall be standard to use “object snap” for the creation or insertion of all entities (as compared to “eyeballing”).
- All symbols will be originally drawn on layer “0.” This will allow the symbol to acquire the color and line type properties it is inserted on. All symbols used to define sample locations are to contain attributes describing the sample identifier and any elevation data required by contract.
- All line entities are to be continuous polylines (PLINES).
- All text shall be rotated such that it is readable from the bottom of the sheet and from the right of the sheet. It will be standard to use the AutoCAD style “STANDARD” and Arial font whenever possible. All text shall be of a size such that it is legible when plotted at the file's intended scale.
- North up or to the right.

General Layering Standards

- The following are some of the acceptable layer names. Others may be added as needed. Descriptions of new layers are to be provided to GEI.
  i. PROPERTY (property lines)
  ii. TRAVERSE
  iii. BASELINE
  iv. BUILDING (buildings, other on-site/off-site structures)
  v. STREET
  vi. ELEC (all electrical lines, manholes, power poles, transformers)
  vii. WATER (all water lines, manholes, hand holes, gates, valves)
  viii. SAN (all sanitary sewer lines, manholes, catch basins, if combined sanitary/storm sewer)
  ix. STM (all storm sewer lines, manholes, roof drains, catch basins)
  x. CONTOUR (all contour lines & labels)
  xi. TEL (telephone)
  xii. GAS (all gas lines, valves, etc.)
  xiii. TEXT
  xiv. TANKRIVER
  xv. STREAM
  xvi. SEDIMENT (sediment sample location)
  xvii. SURFACE SOIL (surface soil sample location)
  xviii. MW (monitoring well location)

xix. BORING (soil boring location)
xx. SURFACE WATER (surface water sample location)
xxi. PAD, SLAB, STRUCTURE, FND (foundations or miscellaneous structures)
xxii. EASEMENT
xxiii. SAMPLING LAYERS (begin with "E" existing or "P" proposed)

Additional Data Required

- All files shall be accompanied by a "check plot" of each file. The "check plot" shall be checked for accuracy and corrected as necessary.
- Whenever surveyed files are supplied to GEI, they shall be considered incomplete until GEI is provided with copies of all field notes and sketches, data printouts, and a point reference file (if applicable).

4. DRILLING METHODS (DM)

SUMMARY GUIDANCE

DM-001 General Guidance on Determination of Appropriate Drilling Methods

Objective

There are multiple drilling methods which can be employed based on the type of stratum (e.g. overburden or bedrock) and the end use of borehole. End uses include geotechnical investigation, subsurface soil sampling, and monitoring well installation or a combination thereof.

The following text describes different methods of drilling with considerations for their use to collect groundwater and/or subsurface soil samples. Profiles of subsurface conditions encountered and well installation details must be recorded on logs. Procedures for field documentation are provided in Section 3 – Field Documentation.

Hollow-Stem Augers (HSAs)

Borings can be installed in unconsolidated formations using hollow-stem augers (HSAs). The augers are advanced by rotation and the drill cuttings are brought to the surface by travelling up the outside of the auger flights in a screw-like manner. HSAs have the advantage of allowing the well to be installed inside the hollow stem of the auger, which prevents the borehole from collapsing. Upon reaching the planned well depth, the casing and screen are placed inside the HSAs and the flights are individually removed while the annular space around the well is filled with the filter pack and grout, as appropriate. Conversely, solid-stem augers must be completely removed from the borehole before well installation, which can lead to collapse of the borehole. For this reason, solid stem augers are seldom used for installation of monitor wells.

HSAs come in a variety of sizes and allow collection of soil samples utilizing split spoons or Shelby tubes. Samples are collected ahead of the augers for determining soil/sediment type, stratigraphy, depth to the water table, and for collecting soil samples for chemical analysis. During this process, the standard penetration test (SPT, American Society for Testing and Materials [ASTM] Method D 1586) can also be performed. The HSA method also has an advantage over mud-rotary drilling techniques in that drilling mud is not used that can contaminate the soil samples and potentially reduce the yield of the wells.

A disadvantage of the method is that HSAs cannot be used to drill into competent bedrock or through large boulders. Also, heaving or running sands can be forced up inside the augers as a result of strong vertical groundwater gradients, which

can hamper efforts to collect soil samples or complete well installation. Furthermore, the maximum depth achievable using HSAs, which is generally shallower than other methods, is dependent not only on the ability of the rig (e.g., horsepower, rig-torque, weight of augers, etc.), but also the lithology of the material drilled.

Rotary Drilling

Rotary drilling methods include both direct rotary and reverse-circulation rotary. Direct rotary is more commonly used in environmental investigations, whereas reverse-circulation rotary is used in drilling large-diameter water supply wells. In direct rotary drilling the borehole is advanced by rotating the drill pipe (rods) and bit to produce a cutting action. The cuttings are removed from the borehole by continuous circulation of a drilling fluid. The fluid or mud is pumped down the inside of the drill pipe and is circulated back to the surface on the outside of the pipe. The fluid removes the drill cuttings from the borehole and cools and lubricates the bit. Mud used during direct rotary consists of additives (e.g., bentonite), water, or air.

Reverse-circulation rotary drilling is similar to direct rotary except the drill rigs are larger and the flow of the drilling fluid is reversed. The drilling fluid moves upward inside the drill pipes and circulates back to the borehole via settling pits. The drilling fluid returns to the borehole via gravity and moves downward in the annular space between the drill pipe and borehole wall. Drilling fluids for reverse-circulation rotary are generally water and any suspended particles picked up from the surrounding formations.

Mud-rotary methods can be used to drill in both unconsolidated and consolidated (bedrock) formations. In addition, drilling mud stabilizes the borehole and limits the potential for borehole collapse. Disadvantages of using the mud-rotary method include the difficulty in determining the depth to the water table, the potential for drilling mud to impact soil samples and dragging of contamination into deeper zones since the drill cuttings are re-circulated in the borehole. Wells installed using this method typically take longer to develop than wells installed using the HSA or air-rotary methods due to the invasion of mud filtrate into the formation.

In air-rotary drilling, compressed air is directed down the inside of the drill pipe to a percussion “hammer” that breaks up soil and shatters rock. As in mud-rotary drilling, air removes the cuttings and lubricates the bit. However, since air has no viscosity, it cannot be used to stabilize a borehole therefore, casing must be advanced in unconsolidated formations to keep the borehole open. This is why air rotary methods are best suited for drilling in bedrock formations. The percussion-type air-rotary hammer bit provides the best penetration rate when drilling bedrock consisting of crystalline rock. However, when drilling above the water table, an air-rotary bit can grind the soil and bedrock to a fine powder which is blown out of the hole with air and which has the potential to be inhaled. Therefore, drilling above the water table using air-rotary methods requires the addition of potable water to the borehole for dust control. In addition, the air

compressor should be of the oil-less variety, or have a filter to prevent any oil from entering the borehole.

A disadvantage of using rotary methods while drilling in unconsolidated formations is the requirement of pulling the drill pipe out of the hole each time a split-spoon soil sample is collected (and the SPT is performed). This adds up to considerable amounts of time when deep wells are being installed or when continuous split-spoon sampling is being performed. As stated above, split- spoons used to collect soil samples can become contaminated when they are advanced down a mud-filled borehole.

A special type of rotary drilling is bedrock coring, wherein a special core bit and barrel are used to retrieve relatively undisturbed core samples of the bedrock. Coring allows better characterization of bedrock lithology and other features including orientation of fractures and bedding planes, which can control contaminant migration. Core barrels can either be unoriented or oriented. An oriented core is scribed with respect to magnetic north. Although more expensive than collecting an unoriented core, this method gives the true orientation of the features encountered in the core.

Drilling fluids are generally air (air-rotary) or bentonite and/or water (mud-rotary). Water added to a borehole must be of potable quality. The source of the potable water used during the installation (and development) of monitor wells should be documented (e.g., in the Remedial Investigation Report).

Bentonite is high swelling clay with sodium montmorillonite as its primary clay mineral. Bentonite is added to water to increase the viscosity of the drilling fluid so that drill cuttings can be removed from the borehole more effectively. At the same time, the viscosity must be low enough to allow cuttings and coarse- grained particles to settle out once they are circulated out of the hole. Bentonite also adds weight to the drilling fluid, which helps to maintain borehole stability.

Sonic Drilling

The method involves driving a core barrel using vibration, rotation, and a downward force to collect soil samples. A sonic drill rig looks and operates very much like a conventional top-drive rotary or auger rig. The main difference is that a sonic drill rig has a specially designed, hydraulically powered drill head or oscillator, which generates adjustable high-frequency vibrational forces. The oscillator uses two eccentric, counter-rotating balance weights or rollers that are timed to direct 100 percent of the vibrational energy at 0 and 180 degrees. There is an air spring system in the drill head that insulates or separates the vibration from the drill rig itself. The sonic head is attached directly to the drill pipe or outer casing, sending the high-frequency vibrations down through the drill pipe to the bit.

A core barrel is advanced using vibration, rotation, and downward force to collect continuous soil cores up to 20 feet in length. The bit at the end of the core barrel contains carbide teeth allowing the core barrel to be advanced through most overburden, soft bedrock, and minor obstructions such as bricks and boulders. Once the core barrel has been advanced, a secondary or over-ride casing is advanced down to the same depth as the inner core barrel. The over-ride casing keeps the borehole from collapsing while the inner core barrel is removed. Once the core barrel is removed, the soil core is pushed out of the core barrel through the use of vibration and either air or water pressure. Soil core diameters are dependent on the size of core barrel used and range from 3 to 12 inches. The use of multiple over-ride casings of increasing diameter allows the borehole to be telescoped down through multiple confining units. The setup used in sonic drilling makes this drilling method amendable to collecting soil cores and installing wells in angled boreholes. With only the bottom of the inner and outer core barrel exposed to the aquifer at any given time, determining the location of the water table can be difficult.

While this drilling method has the capability of drilling through and providing samples of coarse gravels, boulders, and tight clays, these situations will result in slow drilling or advancement of the core barrel. The result is a hotter core barrel and a longer contact time between the core barrel and the encased soil core. The aforementioned conditions will increase the probability that the sonic method will raise the temperature of the soil core and facilitate volatile organic compound (VOC) and semi-volatile organic compound (SVOC) loss.

The ability to quickly install deep borings and wells, while generating a large-diameter continuous soil core, makes this drilling technique invaluable when continuous soil sampling is needed to assess deep or complex geological situations. However, sonic drilling's high cost, relative to other drilling methods, may be prohibitive for small projects or shallow boreholes. The higher cost of the drilling method should be weighed against the cost savings incurred due to its faster drilling rate and high quality of the soil core produced.

GeoProbe®-Direct Push

The method involves hydraulically pushing a sampling device attached to a string of hollow rods into the subsurface for the purpose of collecting soil and/or groundwater samples (e.g., Geoprobe®). The method can be used to collect discrete soil samples or groundwater samples, as well as install small-diameter groundwater monitoring wells.

Advantages of the direct-push method include the relatively quick collection of groundwater samples and, when used along with a mobile laboratory, collection of data in “real” time. The method allows for collection of multiple samples in a day with the potential for achieving contaminant delineation in one mobilization of

the field equipment. The data can also be used to select locations of permanent monitor wells.

Disadvantages of using a mobile lab include the fact that the data quality achieved are often suitable only for screening purposes. Direct-push methods typically result in very turbid groundwater samples since an oversize borehole is not produced and a filter pack is not used. Turbid samples can produce higher metal concentrations in groundwater samples since metals are typically adsorbed onto soil particles. Use of direct-push methods can also cause cross- contamination since contamination from shallow zones may be driven down to deeper zones.

Another disadvantage of using direct-push technology for collecting groundwater samples is the potential to breech confining units. To prevent this, soil sampling using direct-push technology or conventional split-spoon sampling techniques should first be performed to identify the presence, depth and lateral extent of confining units. Pushing through confining units should be avoided if the presence of dense non-aqueous phase liquid (DNAPL) or very soluble compounds, such as methyl tert-butyl ether (MTBE), are suspected or the contaminant plume appears to be diving in the aquifer.

STANDARD OPERATING PROCEDURE

DM-002 Hollow-Stem Auger

Objective

To standardize the drilling of overburden soil borings for environmental investigations. This standard operating procedure (SOP) addresses the use of hollow-stem augers to drill the soil boring.

Execution

- If work is to be conducted on private property, verify that the client has been notified (see SOP PP-001) and that access has been granted.
- Ensure that markout procedures outlined in PP-001, PP-002, and PP-003 have been completed.
- Ensure that a safety check has been conducted.
- Inspect the drilling rig to make sure it has been appropriately decontaminated and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Record all observations and measurements in the field notebook.
- Plastic sheet, plywood sheet, or other suitable cover will be placed around the auger area during drilling, if needed, to contain soil cuttings.
- Soil cuttings will be placed in a 55-gallon steel drum or a roll-off container for subsequent sampling and disposal. Decontamination water and drilling water will be placed in tanks and/or 55-gallon steel drums for proper disposal.
- Prior to the start of drilling, the borehole location should be hand- cleared to a minimum of 5 feet below ground surface.
- For all split-spoon soil samples, use a 140-pound hammer to drive the sampler, unless conditions necessitate using a 300-pound hammer (see SOPs SM-001, *Split-Spoon Sampling* and SM-0003, *Soil Classification,* for details). Count and record the number of blow counts per 6-inch increments, confirming, blow counts with driller if necessary.
- Remove the sample with a clean laboratory spoon and transfer it directly to a suitable sample container.
- Label, preserve, and store the sample in accordance with SOP SC-002 *Sample Handling*.
- Decontaminate the split-spoon sampler after each use (see *Equipment Decontamination,* SOP QA-001) or use another decontaminated split-spoon sampler.
- Direct the drillers to drill the borehole to the top of the next sampling interval. Remove the auger cutting bit/plug and insert the split-spoon

sampler into the interior of the augers (the drillers are responsible for this activity). Measure the stick-up of the rods attached to the sampler to ensure that the nose of the spoon is in virgin soil below the augers.

- Watch for signs of a soil strata change at depth during drilling (i.e., change in blow counts, change in soil color, soil wetness, soil contamination, bouncing of the drill rig, etc.). If important to the investigation, stop drilling and collect a soil sample.
- Repeat until the borehole has been drilled to the desired depth.
- If a monitoring well is not installed in the soil boring, the boring should be abandoned with cement/bentonite grout. Do not backfill the boring with drill cuttings unless explicitly allowed under state-specific regulations and approved by the client.
- Complete boring log and, if necessary, well installation logs (SOP SM-003, *Soil Classification*).
- Record boring locations on a site map and in a field notebook sketch. Measure each location from onsite reference points in the field notebook so that enough information can be obtained to recreate the location.
- All boring locations or monitoring well locations should be surveyed and a boring/well location figure generated.

Notes

- In areas of significant soil contamination, hollow-stem augers may cross-contaminate upper soil layers as contaminated cuttings move up the auger flights. The potential also exists for contaminated augers to carry contamination to deeper soil strata.
- If *in situ* borehole permeability tests are to be performed prior to installation of the monitoring well, the hollow-stem auger method is not appropriate due to water loss at the auger junctions.
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions. If the borehole is to be advanced below the contaminated strata, use telescoping techniques, if appropriate, (see SOP DM-008 *Monitoring Well Telescoping*) to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of “running sands” or “blow in” to occur. Frequent measurements inside the hollow-stem augers after the drill bit/plug is removed will indicate if running sands are present.
- If necessary, arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site. Containers should be labeled.
- Plan the drilling program to drill borings from the least- to most-contaminated areas. Be prepared in advance and know where

alternative drilling locations are in the event that problems are encountered at each planned soil boring location. Alternative locations will need to have utility clearance.

References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

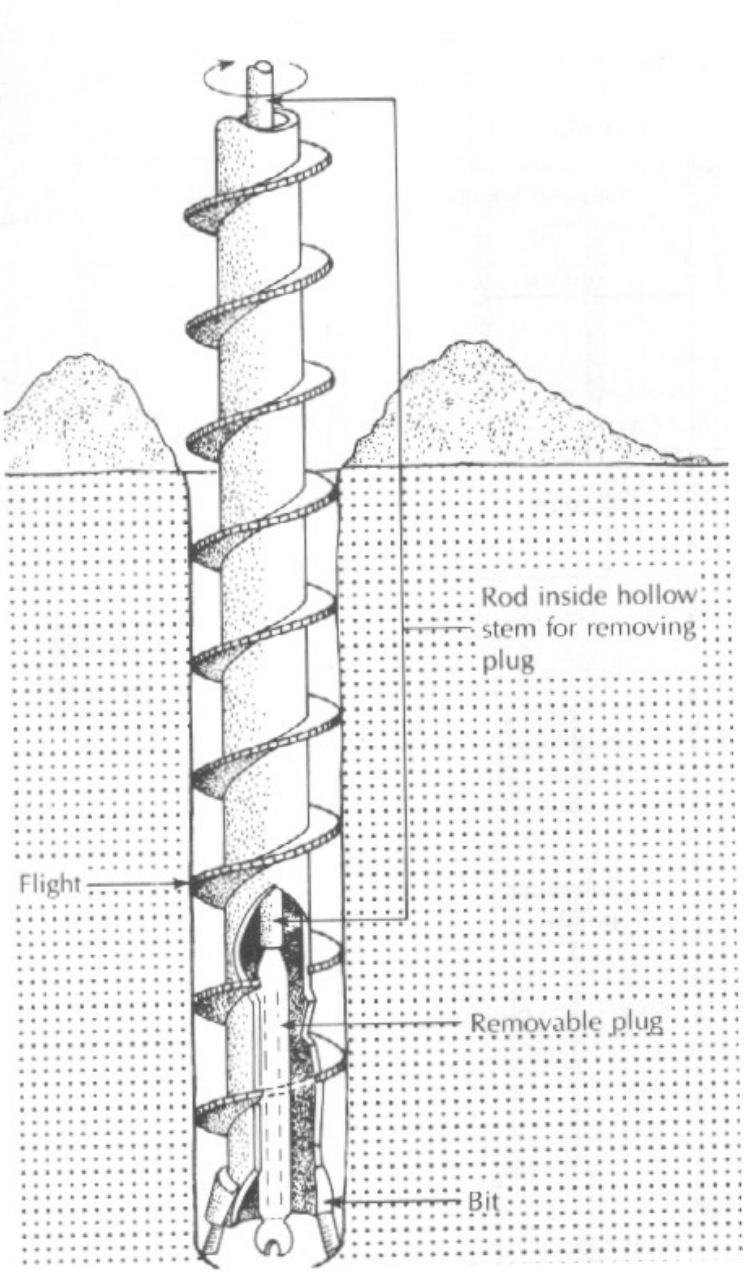
Attachments

Attachment A – Hollow-Stem Auger

Attachment A

SOP DM-002

Attachment A – Hollow Stem Auger



STANDARD OPERATING PROCEDURE

DM-003 Sonic Drilling

Objective

The objective of this standard operating procedure (SOP) is to standardize the drilling of overburden soil borings for environmental investigations. This SOP addresses the use of sonic drilling to drill the soil boring.

Execution

- If work is to be conducted on private property, verify that the client has been notified (see SOP PP-001) and that access has been granted.
- Ensure that markout procedures outlined in PP-001, PP-002, and PP-003 have been completed.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Record all observations and measurements in the field notebook.
- Prior to the start of drilling, the borehole location should be hand- cleared to a minimum of 5 feet below ground surface (bgs).
- Collect soil cores in shorter runs. While some sonic rigs have the capability of collecting 20 feet of soil core at a time, the process of collecting the longer core results in the core being in contact with the core barrel for a longer period of time and consequently absorbing more heat from the core barrel itself.
- The core barrel should be cleaned with tap water following each use.
- The field geologist will classify and sample the soil located within the liner.
- Upon completion, the excess soil will be placed into a 55-gallon drum for disposal and the inner liner properly disposed.
- The core barrel will then be advanced, within the isolation casing on the same borehole, to collect the next soil core interval.
- Add water between the inner core barrel and the outer override casing. This water would reduce friction and adsorb heat between the inner core barrel and the outer over-ride casing.
- Maximize drilling advance rate. The faster the core barrel is advanced, the less likely the core barrel will heat up, and the less contact time the soil core has with the core barrel. Drilling with a 3-inch diameter core barrel and a 5-inch diameter override casing, instead of the standard 4-inch core barrel and 6-inch over-ride casing, may increase advance rates and reduce the potential for soil core heating.
- If a significant decrease in drilling advance rate is observed, stop drilling and remove what soil core has accumulated in the core barrel.

Resume drilling through the resistant material (gravel, boulder, hard clay, etc.). When the resistant material has been penetrated and the drilling advance rate increases, stop drilling and remove what material has accumulated in the core barrel.

- Wash down the core barrel with cool water to cool the core barrel and associated casing, and resume drilling.
- If a well is to be installed in the borehole, the sandpack and grout are placed as the core-barrel and over-ride casing(s) are selectively vibrated out of the ground. The vibratory action reportedly facilitates the settlement of the sandpack and grout. Upon completion, no casing is left in the ground other than the well casing and screen.

Notes

- Disturbance of the soil core is most likely to occur during removal of the soil core from the core barrel. The soil cores are usually vibrated out of the core barrel into plastic bags approximately 5 feet in length. As the plastic bags are a little larger than the soil core itself, fragmentation of the soil core may occur as the core is extruded into the bag or while the bagged core is being moved in an unsupported manner. Soil conditions that are prone to disturbance include wet or dry zones that contain little or no fines, and well graded sands that contain significant volumes of water.
- If integrity of the soil core is of concern, the following procedures should be implemented:
    i. Measures should be taken to ensure that the core, from the time it is extruded from the core barrel, is rigidly supported through the use of some type of cradle or carrying device.
    ii. The core should not be removed from its cradle until all sampling of the core has been completed. Acrylic liners are available for some core sizes and can be used to hold the core together upon removal from the core barrel.
    iii. If the soil is to be sampled for volatile organic compounds (VOCs), acrylic liners must be used.
    iv. Sampling of the soil core for VOCs or semi-volatile organic compounds (SVOCs) must be approved on a case by case basis. Proposals for VOC or SVOC soil core sampling must include provisions to minimize core fragmentation and heat generation, such as:
        1. Acetate liners in the core barrel so that the soil core does not have to be extruded out of the core barrel.
        2. Limit the length of soil core generated during a given downhole run.
        3. Implement practices to reduce the residency time of the soil core in the core barrel.

- For the analysis of SVOCs, the use of the acetate liners is not required.
- The large diameter of the core barrel enables ground water sampling equipment to be placed inside the core barrel so that discrete depth groundwater samples can be collected during borehole advancement.

References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

STANDARD OPERATING PROCEDURE

DM-004 Drive and Wash

Objective

The objective of this standard operating procedure (SOP) is to standardize the drilling of overburden soil borings for environmental investigations. This SOP addresses the use of casing with either the drive-and-wash or spin method to drill the soil boring.

Execution

- If work is to be conducted on private property, verify that the client has been notified (see SOP PP-001) and that access has been granted.
- Ensure that markout procedures outlined in PP-001, PP-002, and PP-003 have been completed.
- Steam cleaning may be performed by drillers either on site or prior to site mobilization. If performed prior to site mobilization, observe the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Record all observations and measurements in the field notebook (See SOP FD-001).
- If a surface-soil sample is desired, this sample should be collected prior to hand-clearing the borehole and in accordance with SOP SM- 001 and American Society of Testing and Materials (ASTM) Specification D-1586-84.
- Prior to the start of drilling, the borehole location should be hand- cleared to a minimum of 5 feet below ground surface.
- For all split-spoon soil samples, use a 140-pound hammer to drive the sampler, unless conditions necessitate using a 300-pound hammer (see SOPs SM-001, *Soil Sampling Techniques Including Split-Spoon* and SM-0003, *Soil Classification,* for details). Count and record the number of blow counts per 6-inch increments, confirming, blow counts with driller if necessary.
- Decontaminate the split-spoon sampler after each use (see SOP QA-001 *Equipment Decontamination).*
- Instruct drillers to drill the borehole, either by pounding or spinning the casing, to the top of the next sampling interval.
- The wash water should be carefully observed for indications of a soil strata change with depth (i.e., change in soil color and particle size). Record the changes and depth of changes on the boring log. Make sure that the soils in the borehole have been fully removed by the rotary bit before sampling by measuring the depth of the borehole, or by measuring the length of stick-up of drill rods to verify that the driller has

sufficiently cleaned out the boring.

- Monitor the return wash water and record water losses from around the borehole onto the ground surface.
- Follow steps until the borehole has been drilled to the desired depth. If refusal is encountered, a 5-foot core of the rock (at a minimum) may be required to confirm the bedrock surface (see site-specific field sampling plan).
- If a monitoring well is not installed in the soil boring, the boring should be abandoned with cement/bentonite grout. Do not backfill the boring with drill cuttings unless explicitly allowed under state-specific regulations and approved by the client.
- Complete boring log and, if necessary, well installation logs (see SOP SM-006 *Rock Coring Log*).
- Record boring locations on a site map. Measure each location from on-site reference points and record the information in the field book.

Notes

- At all times, follow safety procedures as defined in the site-specific Health and & Safety Plan.
- When the first 5-foot section of casing is pounded into the ground, make sure that the casing (i.e., the borehole) is vertical.
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions.
- If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see DM-008 *Monitoring Well Telescoping)* to avoid cross-contaminating underlying geologic strata.
- While drilling through contaminated strata, do not recirculate the drilling water. Be prepared to containerize the drilling water in these situations.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of “running sands” to occur. To minimize the problem, remove the drill rods with the rotary bit very slowly while adding potable water to the casing. A head should be kept on the borehole at all times.
- Arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site (see SOP SC-003, *Investigation Derived Waste*).
- Plan the drilling program to drill borings from the least to most contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. These locations must also have been cleared by the state utility service prior to drilling.

References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

Standard References for Monitoring Wells (April 1991), Commonwealth of Massachusetts Department of Environmental Protection, WSC-310-91.

ASTM Standard D1586, Standard Method for Penetration Test and Split Barrel Sampling of Soils.

STANDARD OPERATING PROCEDURE

DM-005 GeoProbe® Direct Push Boring

Objective

The purpose of this standard operating procedure (SOP) is to standardize soil sample collection using GeoProbe® and MacroCore® technologies. A Geoprobe® relies on a relatively small amount of static (vehicle) weight combined with percussion as the energy for advancement of a tool string. Using a Geoprobe®, you can drive a MacroCore® to obtain continuous soil cores or discrete soil samples.

Execution

- Complete utility markout procedures in accordance with PP-001, PP-002, and PP-003.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Record all observations and measurements in the field notebook.
- Prior to the start of drilling, the borehole location should be hand- cleared to a minimum of 5 feet below ground surface.
- Insert a Macrocore® (MC) liner, (i.e., polyvinyl chloride [PVC]) into the sample tube, and connect a MC drive head to the top of the sample tube. A diagram of the MC assembly is provided as Attachment A.
- The drive head is then tightened into the sample tube, and a drive cap is attached to the drive head.
- Place the sampler in the driving position, and drive the sampler until the drive head reaches the ground surface.
- Remove the drive cap, attach a pull cap to the sampler drive head, and pull the sampler out of the ground.
- Remove the cutting shoe and filled liner.
- When the sampler is brought to the ground surface, it should be opened immediately, and the length of recovery should be measured and recorded.
- Decontaminate the sampler if necessary (SOP QA-001 *Equipment Decontamination*) and reassemble the parts with a new liner, and insert the sampler down the same hole to take the next soil core.
- In non-cohesive soils, slough material may enter the sampler as the next core is collected (see notes below).
- Careful logging of soil stratigraphy is necessary to document whether soil sloughing has occurred within the borehole (see limitations).
- Remove the sample with a clean laboratory spoon and transfer it directly to a suitable sample container.

- Label, preserve, and store the sample in accordance with SOP SC-002 *Sample Handling*.
- If a monitoring well is not installed in the soil boring, the boring should be abandoned with either cement/bentonite grout. Do not backfill the boring with drill cuttings unless explicitly allowed under state-specific regulations and approved by the client.
- Upon completion, all soil boring locations will be surveyed. This will include the location and ground surface elevation.

Notes

- The GEI oversight person shall ensure that the borehole created by the MC sampling tube does not collapse between collection of each sample. If the borehole collapses and representative samples cannot be obtained using the standard macro-core sampler, then one of two options may be used.
    i. The MC sampler can be fitted with a piston rod assembly, or a 1.5-inch outer diameter (OD), large bore sampler equipped with a piston rod assembly may be used to collect the samples. The sample tube (MC) is advanced through the caved-in borehole material to the top of the desired sampling interval. The sample tube remains closed by a piston tip as it is advanced. Upon reaching the target sample depth, the piston tip will be released and the discrete sampler device is then advanced to collect the representative sample.
    ii. The piston rod assembly is driven up to the top of the sample tube as the sample enters the tube.
- Because the MC sampling tube uses a dedicated, disposable liner made of clear plastic, the only part of the sampler that contacts the soil sample is the cutting shoe. Each sample liner will be disposed of after use and a new liner will be placed in the macro-core tube prior to collection of subsequent samples. Cutting shoes and sample collection spoons used to transfer samples to the laboratory jars will be decontaminated between use.

References

ASTM D6001-05 Guide for Direct Push Water Sampling for Geoenvironmental Investigations, April 2005.

GeoProbe Systems, "GeoProbe MacroCore MC-5 1.25-inch Light Weight Center Rod Soil Sample System SOP", Technical Bulletin No. MK 3139, November 2006.

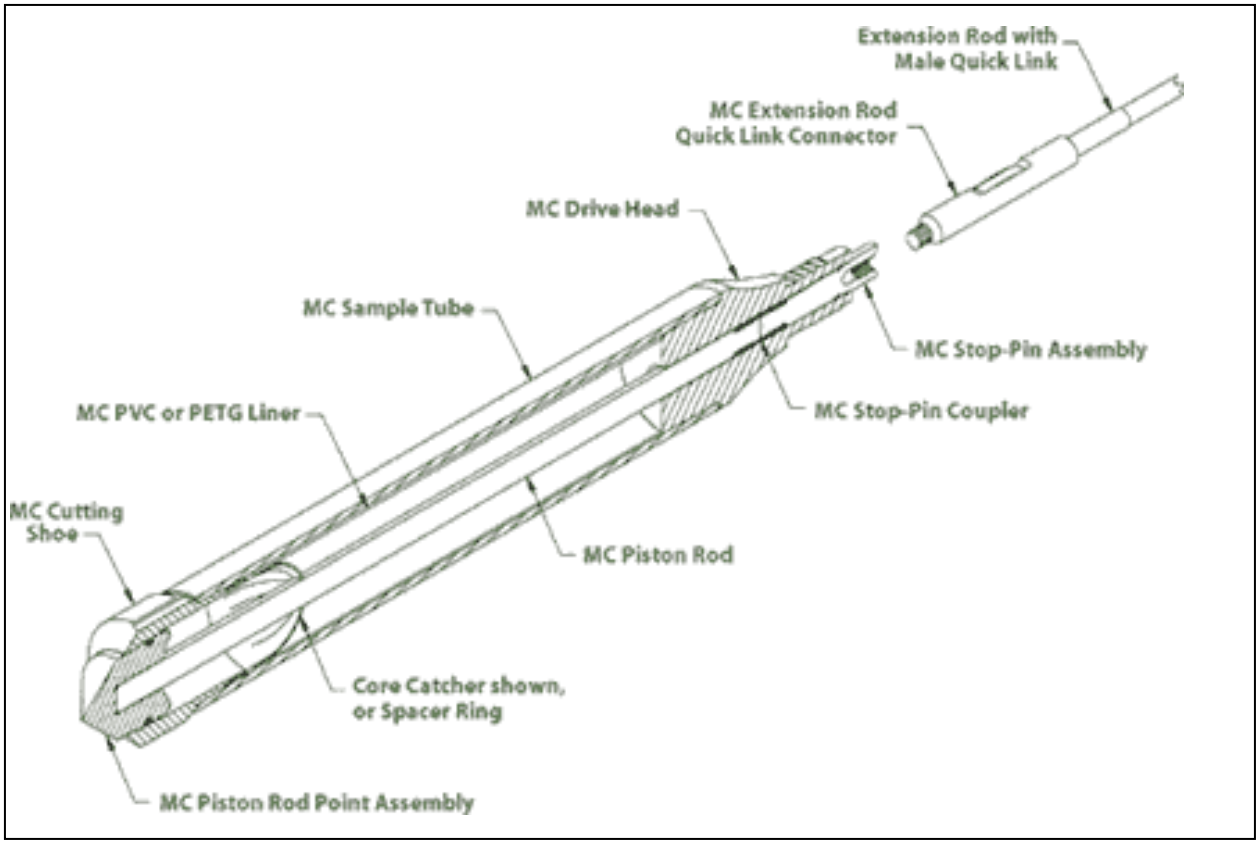
Attachments

Attachment A – GeoProbe® with Macrocore® Sampler Assembly

Attachment A

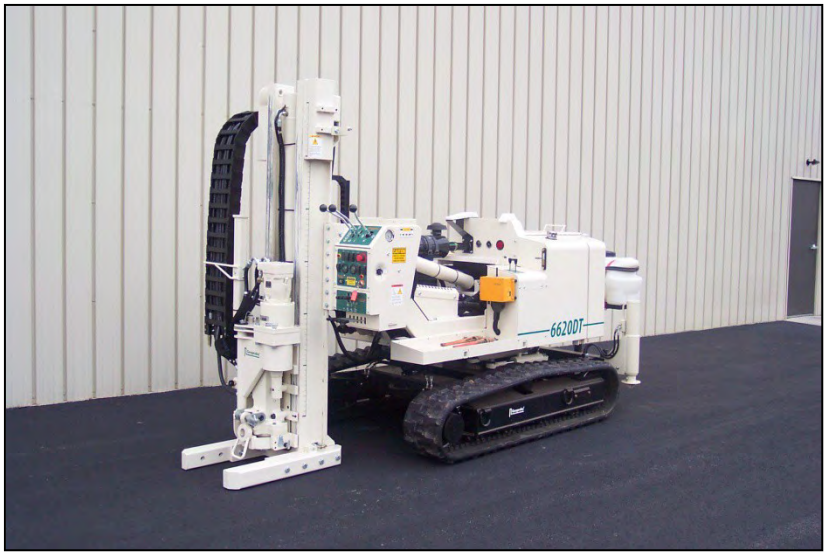
SOP DM-005

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a Macrocore® sampler

Right: A track-mounted GeoProbe ® Rig



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STANDARD OPERATING PROCEDURE

DM-006 Monitoring Well Construction and Installation

Objective

The objective of this standard operating procedure (SOP) is to standardize the installation of overburden monitoring wells for environmental investigations. This SOP assumes the monitoring wells will be constructed of flush-joint polyvinyl chloride (PVC) pipe; the screened section will have factory-slotted openings. Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan and recorded in field notes, along with rationale for any changes from the work plan.

Execution

- Attachment A provides a diagram of typical shallow, intermediate, and deep groundwater monitoring well construction detail.
- During the monitoring well installation, record all pertinent information on Attachment B, Well Construction Form.
- Using a weighted tape, measure and record the depth of the completed soil boring (within the augers), if applicable, before beginning the well installation.
- Measure the depth to groundwater in the borehole over a 10 to 15 minute period to ensure that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from the soil samples, if collected prior to well installation, to the measured water level in the borehole. If drilling water has been used during boring advancement, pump the water out of the borehole to the static water depth, based on examination of the soil samples, and monitor the recovery of groundwater until the level has stabilized.
- Choose the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table, for shallow wells. If the borehole is deeper than the desired well depth, then fill the base of the borehole with sand.
- A minimum of a one-foot sump should extend to the bottom of the well if dense non-aqueous phase liquid (DNAPL) is suspected.
- Monitoring well screens should be constructed of either 2 or 4 inch inner diameter (ID) 0.01-inch or 0.02-inch slotted Schedule 40 PVC well screen.
- If DNAPL is suspected, the monitoring well should be constructed of either 2 or 4 inch ID 0.02-inch slotted Schedule 40 PVC well screen.
- Monitoring wells should be constructed of either 2 or 4 inch ID Schedule 40 threaded flush-jointed PVC. One-inch wells may be installed with prior approval of the client and the New York State Department of

Environmental Conservation.

- Install and secure a bottom well cap. The bottom cap should be secured with either a threaded coupling and/or stainless steel screws. Do not use any kind glue to secure well sections together.
- Place at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole. Measure and record the depth of the boring. Temporarily cover the top of the riser pipe and lower the complete well plus riser into the borehole, with the base resting on the sand pack.
- Add adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.
- Remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals. As the drillers pour or use tamping rods to place the filter sand in the borehole, take frequent measurements of the depth-to-sand. Do not let the sand bridge in the annular space. Continue to observe the water level in the borehole.
- Place at least 1 foot of bentonite seal above the filter pack. If the seal is above the water table, use at least 5 gallons of potable water to hydrate the bentonite.
- If necessary, pump bentonite-cement grout using a tremie pipe into the bottom of the annular space to the ground surface. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-pound bag of cement to 2-4 pounds of pulverized bentonite. The grout must be mixed using the pump on the rig to ensure proper mixing. The protective casing should be set in the grout before it sets.
- The protective surface casing will be either a flush-mounted roadbox or a steel “stick up” pipe. The base of either type of casing should extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- Cut the monitoring well riser flat and place a mark or V -notch or an arrow on the casing with an indelible marker at one point for surveying and groundwater measurements. Cut the well riser so that the top of the well is 3 to 6 inches below the top of the protective casing.
- Set bentonite-cement grout in the annular space between the protective casing and the borehole up to the ground surface. Slope the concrete radially away from the protective casing at the ground surface to promote surface water runoff. In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox FLUSH with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area with a guardpipe, additional protection such as steel pole bumpers around the guardpipe may be necessary.
- Place a locking, vented cap on the well pipe.

- All well locations should be photodocumented in accordance with SOP FD-004, *Photo Documentation*.
- Label the protective well casing with a paint pen and tape out the location to nearby landmarks so that the well may be located in the future. Make sure to enter this information in the field notebook. If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).
- Upon completion, all newly installed monitoring wells will be surveyed. This will include the well location, ground surface elevation and measuring point elevation.

Notes

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Site-specific conditions must be evaluated to determine appropriate materials.
- The water table will fluctuate seasonally and from year-to-year. Try and estimate the maximum high and low elevations of the water table from the current water table elevation and the season. Place the 10- foot screen so that at least 2 feet of the screen will extend above the top of the screen when water is at its highest. If very substantial fluctuations in the groundwater table are expected, a 15-foot screen is acceptable.
- Do not screen across different hydrostratigraphic units if possible (for example, outwash sands and till) unless specified in the Work Plan or approved by the Project Manager.
- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand must be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.
- Do not use borehole/auger cuttings for backfill during monitoring well installation. If the cuttings are suspected to contain contamination which was identified during drilling, cuttings are to be containerized for later characterization and not used for filter pack materials.
- Do not screen across a confining layer (e.g., silt or clay). Backfill all confining layers with hydrated bentonite or grout.

References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), "Correct Well Design Improves Monitoring," Environmental Protection, July, pp. 38-49.

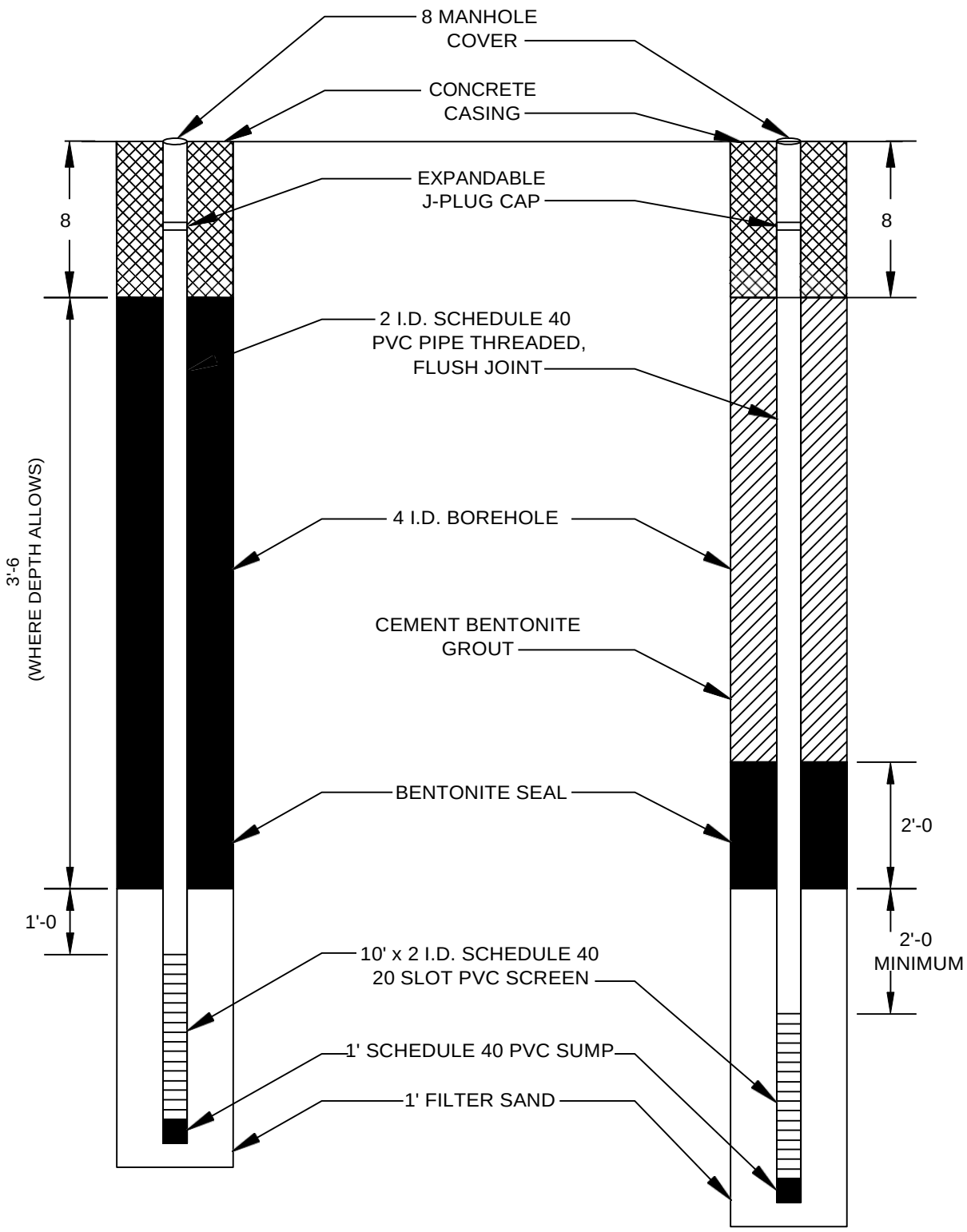
Attachments

Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Well Construction Form

Attachment A

SHALLOW ***INTERMEDIATE AND DEEP***



NOT TO SCALE

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TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

November 2010

Attachment B

WELL CONSTRUCTION FORM

Project _____ ID No.

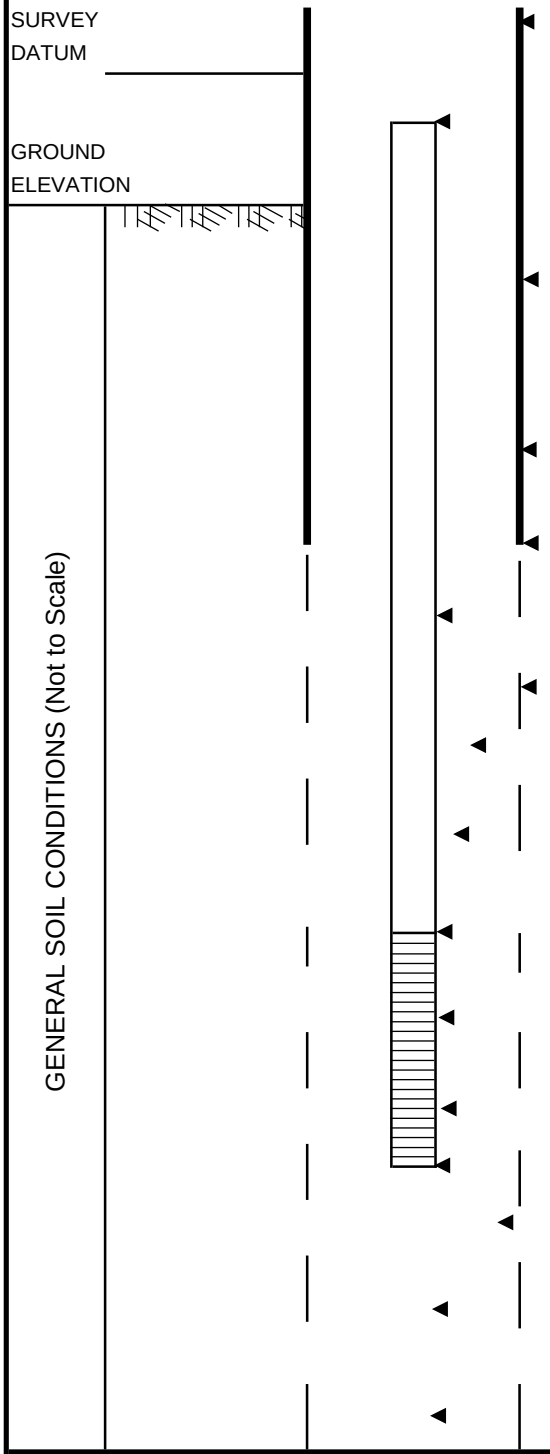
Location _____ **PG. 1 OF 1**

Client _____ Boring No. _____

Contractor _____ Driller _____ Location _____

Inspected by _____ Date Started _____

Checked by _____ Date Completed _____ Project No. _____



LENGTH OF SURFACE CASING ABOVE GROUND SURFACE (FT) _____

LENGTH OF RISER PIPE ABOVE GROUND SURFACE (FT) _____

THICKNESS OF SURFACE SEAL BELOW GROUND SURFACE, IF ANY (FT) _____

TYPE OF SURFACE SEAL (indicate any additional seals) _____

ID OF SURFACE CASING (IN) _____

TYPE OF SURFACE CASING _____

DEPTH BOTTOM OF CASING (FT) _____

ID and OD OF RISER PIPE (IN) _____

TYPE OF RISER PIPE _____

DIAMETER OF BOREHOLE (IN) _____

TYPE OF BACKFILL AROUND RISER PIPE _____

DEPTH TOP OF SEAL, IF ANY (FT) _____

TYPE OF SEAL _____

DEPTH BOTTOM OF SEAL (FT) _____

DEPTH TOP OF PERVIOUS SECTION _____

TYPE OF PERVIOUS SECTION _____

DESCRIBE OPENINGS _____

ID and OD OF PERVIOUS SECTION (IN) _____

TYPE OF BACKFILL AROUND PERVIOUS SECTION _____

DEPTH BOTTOM OF PERVIOUS SECTION (FT) _____

DEPTH BOTTOM OF SAND COLUMN (FT) _____

ELEV./DEPTH TOP OF SEAL, IF ANY (FT) _____

TYPE OF SEAL _____

ELEV./DEPTH BOTTOM OF SEAL (FT) _____

TYPE OF BACKFILL BELOW PERVIOUS SECTION, IF ANY _____

NOTES:

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STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Telescoping

Description

The method of monitoring well telescoping prevents the connection of two stratigraphic layers during monitoring well installation. Typically, these two stratigraphic layers are overburden and bedrock strata, or overburden deposits with a semiconfining layer.

Execution

- If work is to be conducted on private property, verify that the client has been notified (see SOP PP-001) and that access has been granted.
- Ensure that markout procedures outlined in PP-001, PP-002, and PP-003 have been completed.
  Prior to the start of drilling, the borehole location should be hand-cleared to a minimum of 5 feet below ground surface.
- Install large diameter casing (e.g., 6-inch outer diameter) to the top of the bedrock or semiconfining layer.
- Drill or core at least 10 feet into bedrock, or an appropriate thickness into the semiconfining layer, to confirm the presence of bedrock and adequately separate stratigraphic units (see precautions below).
- Freshly mixed grout is required. Depending on application, a mixture of Portland cement and bentonite meets most grouting requirements. For proper consistency, use no more than 6 gallons of water per 94- pound sack of cement. Add a few pounds of bentonite or hydrated lime per sack of cement for a better flow.
- Use a tremie pipe to deliver grout outside the casing. This method is not recommended for depths greater than 100 feet. You can use this method if the space between the casing and the borehole wall is large enough to contain a 1-inch tremie pipe. Use the following procedures to complete grouting using this method:
  i. Lower the tremie-pipe to the bottom of the borehole outside of the well casing. Make sure that the lower end of the casing is tightly seated at the bottom of the borehole.
  ii. Mix a sufficient quantity of grout and pump it through the tremie pipe or let it descend naturally. As the grout is placed, lift the tremie pipe slowly, but keep the lower end submerged in the grout.
  iii. Fill the casing with water as the grout is placed to balance the fluid pressure inside and outside the casing. Doing so prevents grout from leaking under the bottom of the casing.

iv. Allow the grout to set for a minimum of 24 hours.

v. Drill through the existing casing into bedrock to complete monitoring well. Install additional casing, polyvinyl chloride (PVC), or open borehole into bedrock.

Notes

- These operating procedures include drilling the borehole used to case off the overburden a minimum of 10 feet into a semiconfining layer. However, if dense non-aqueous phase liquid (DNAPL) and/or dissolved contamination is suspected or likely to be present in the weathered bedrock, the 10-foot casing requirement will hide the DNAPL from detection. In this case, an overburden well (with casing and screen) should be installed in the weathered bedrock and an outer steel casing installed 10 feet into bedrock would not be required.

References

Environmental Protection Agency, Region 4, "Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, Chapter 6 – Design and Installation of Monitoring Wells," November 2001.

STANDARD OPERATING PROCEDURE

DM-008 Monitoring Well Development

Objective

To remove drilling fluids and fine soil particles that may be trapped in the monitoring well's sand pack and screen, and to set the sand pack so that it will function properly, and create good hydraulic communication between the well and the formation.

Execution

- Wait at least 24 hours following monitoring well installation before beginning development activities.
- Decontaminate all development equipment prior to use with, Alconox, and deionized-water rinses. See SOP QA-001, *Equipment Decontamination*.
- Calculate the volume of water in the monitoring well (one well volume).
- Record volume on Monitoring Well Development Record (Attachment A).
- Collect a sample of water from the monitoring well with a submersible pump, a bailer, or a water pump. Record the color and turbidity of the sample.
- Utilize one of the following methods for purging:
  - Surging;
  - Bailing;
  - Using a centrifugal pump and dedicated polyethylene tubing;
  - Positive displacement pumps and dedicated polyethylene tubing; and/or
  - Other methods recommended by the field geologist and approved by the client Project Manager.
- Purge groundwater until it runs clear (<50 nephelometric turbity units [NTUs]) or until pH, temperature and specific conductivity stabilize as judged suitable by the field geologist.
- Well development should not exceed two hours for a single well.
- Measure the purge rate (gallons per minute) and total volume purged.
- Monitor the groundwater level in the well during development to determine if the pumping rate is sufficient to create a drawdown in the well.
- Collect groundwater samples every few well volumes during the pumping and record the physical properties (color and turbidity).
- Stop pumping when the purge water is relatively clear. Place a surge block in the monitoring well (if the method of development doesn't include a down-hole pump which serves as a surge block). Slowly

move the surge block up and down in the well. Periodically remove the surge block and purge the groundwater until it is relatively clear again. Start at a slow pace and progress to a faster surging action through time.

- Monitor the turbidity and color of the water during this procedure. The well is considered fully developed when all of the following criteria have been met:
    i. The volume of fluid added during drilling has been removed.
    ii. The water removed from the well is relatively free of fine-grained particles.
    iii. Record the volume of water pumped from the well and the physical properties (color, turbidity) of the water.

Notes

- Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action.
- Pump contaminated groundwater into an approved container (properly labeled drum or portable tank for transfer into frac tank).
- Use a bailer to develop monitoring wells that are installed in soils that are composed of fine-grained silts and clays. Pumping and mechanical surging is not recommended because these more vigorous techniques can cause fine particles to clog the filter pack.
- Sampling of groundwater should not occur prior to stabilization of the water table following development.

Calculations

To calculate the volume of water in the well, the following equation is used:
Well Volume (V) = Br^2 h (cf) **[Equation 1]**
where:

B = pi (3.14)
r = radius of monitoring well in feet (ft)
h = height of the water column in ft. [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
cf = conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft ^{3}. [In this equation, 7.48 gal/ft^3 is the necessary conversion factor.]

Monitor well diameters are typically 2-, 3-, 4-, or 6-inches. A number of standard conversion factors can be used to simplify the above equation using the diameter of the monitor well. The volume, in gallons per linear foot, for various standard monitor well diameters can be calculated as follows:
Where:

V (gal/ft) = Br^2 (cf) **[Equation 1]**

B = pi (3.14)
r = radius of monitoring well (ft)
cf = conversion factor (7.48 gal/ft^3)

For example, a 2 inch diameter well, the volume per linear foot can be calculated as follows:

V (gal/ft) = Br^2 (cf) **[Equation 2]**
= 3.14 (1/12 ft)^2 7.48 gal/ft^3
= 0.1631 gal/ft

NOTE: The diameter must be converted to the radius in feet as follows:

Well Diameter (inches) x 0.5 = Well Radius (ft) **[Equation 3]**

The volume in gallons/feet for the common size monitor wells are as follows:

Well diameter (inches)	Volume (gal/ft)
2	0.1631
3	0.3670
4	0.6524
6	1.4680

If you utilize the volumes for the common size wells above, Equation 1 is modified as follows:
Where:

Well volume = (h) (f) **[Equation 4]**

h = height of water column (ft)

f = the volume in gal/ft calculated from Equation 2

References

Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (October 1990), American Society for Testing and Materials [ASTM] D5092-90.

Nielsen, D.M. (1993), Correct Well Design Improves Monitoring, Environmental Protection, July, pp. 38-49.

The Methods & Mechanics of Well Development, Part 2 of 5, National Drillers Buyers Guide, March 1993, p. 17.

Standard References for Monitoring Wells (April 1991), Commonwealth of

Massachusetts Department of Environmental Protection, WSC-310-9U. S. EPA Environmental Response Team Standard Operating Procedure SOP: 2044 ," Monitor Well Development" REV: 0.1, 10/23/01.

Attachments

Attachment A - Monitoring Well Development Record

Attachment A

Monitoring Well Development Record

Project: _____ **Well ID:** _____ **Date:** _____

Total Well Depth (from top of casing): _____

Depth to Water (from top of casing): _____

Well Diameter: _____

Pump Intake Depth: _____

Sampling Crew: _____

Purge Time: *Start:* _____ *Finish:* _____

Purging Method: _____

Sample Time: *Start:* _____ *Finish:* _____

Sampling Method: _____

Sample Analysis: _____

Purge Data										
Sample Time	**Flow Rate** *(lpm/gpm)*	**Volume Purged** *(liters/gals.)*	**pH** *(std. Units)*	**Conductivity** *(mS/cm)*	**Turbidity** *(NTU)*	**Dissolved Oxygen** *(mg/l)*	**Temperature** *(Cel.)*	**Salinity** *(%)*	**ORP** *(mV)*	**Comments/Observations**
										Well Headspace PID =

Final Stabilization Data										
Sample Time	**Flow Rate** *(lpm/gpm)*	**Volume Purged** *(liters/gals.)*	**pH** *(std. Units)*	**Conductivity** *(mS/cm)*	**Turbidity** *(NTU)*	**Dissolved Oxygen** *(mg/l)*	**Temperature** *(Cel.)*	**Salinity** *(%)*	**ORP** *(mV)*	**Comments/Observations**

SUMMARY GUIDANCE

DM-009 General Guidance on Monitoring Well Abandonment

Objective

To properly abandon a monitoring well, preventing direct connections from surface conditions to the well screen zone.

When a decision is made to abandon a monitoring well, the borehole should be sealed in such a manner that the well can not act as a conduit for migration of contaminants from the ground surface to the water table or between aquifers. Guidelines for well abandonment are provided below but do not supersede state or local regulations. Make sure all well abandonment procedures adhere to appropriate regulations.

To properly abandon a well, the preferred method is to completely remove the well casing and screen from the borehole, clean out the borehole, and backfill with a cement or bentonite grout, neat cement, or concrete. In order to comply with New York State well abandonment requirements, the New York State Department of Environmental Conservation (NYSDEC) should be notified (if applicable) of monitoring well abandonment. However, some state requirements are not explicit, so a technically sound well abandonment method should be designed based on the site geology, well casing materials, and general condition of the well(s). In New York, the NYSDEC policy document titled, CP-43: Groundwater Monitoring Well Decommissioning Policy, should be followed. The document includes a flow chart to be used in selecting the appropriate decommissioning methods based upon the geologic and hydrogeologic conditions at the well site, the presence or absence of contamination in the groundwater and the original well construction details.

Execution

In accordance with NYSDEC's policy document referenced above, the four primary well decommissioning methods are:

- Grouting in-place.
- Perforating the casing followed by grouting in-place.
- Grouting in-place followed by casing pulling.
- Overdrilling and grouting with or without a temporary casing.

The methods and rationale for each of these methods is detailed in NYSDEC's policy document.

Borehole Abandonment

All soil borings not finished as monitoring wells or piezometers will be abandoned by adding neat cement grout or cement/bentonite grout via tremie pipe from the bottom of the borehole up to the ground surface. If the boring was completed via the hollow stem auger method, the borehole will be grouted as the augers are withdrawn, in the case of a direct-push soil boring, the borehole will be redrilled and pressure-grouted from the bottom depth of the borehole up. The neat cement grout will be mixed in accordance with the manufacturer's recommendations. The bentonite/cement grout will be mixed in the following relative proportions: 30 gallons of water to three 94-pound bags of cement to 25 pounds granular bentonite.

References

New York State Department of Environmental Conservation, *"CP-43: Groundwater Monitoring Well Decommissioning Policy"*, November 2009.

Environmental Protection Agency, Region 4*, "Environmental Investigation Standard Operating Procedures and Quality Assurance Manual, Chapter 6 – Design and Installation of Monitoring Wells,"* November 2001.

Attachment

Attachment A – CP-43: Groundwater Monitoring Well Decommissioning Policy

Attachment A

CP-43:Groundwater Monitoring Well Decommissioning Policy

New York State Department of Environmental Conservation

DEC POLICY

Issuing Authority: Commissioner Alexander B. Grannis	
Date Issued: November 3, 2009	**Latest Date Revised:**

I. Summary:

Groundwater monitoring wells provide essential access to the subsurface for scientific and engineering investigations (including monitoring wells installed for leak detection purposes). To a degree, every monitoring well is an environmental liability because of the potential to act as a conduit for pollution to reach the groundwater. To limit the environmental risk, a groundwater monitoring well must be properly decommissioned when its effective life has been reached. This document provides procedures to satisfactorily decommission groundwater monitoring wells in New York State. This policy also pertains to other temporary wells such as observation wells, test wells, de-watering wells and other small diameter, non-potable water wells. It does not pertain to water supply wells.

II. Policy:

Environmental monitoring wells should be decommissioned when:

1. they are no longer needed and re-use by another program is not an option; or
2. the well's integrity is suspect or compromised.

The method for decommissioning will be determined based upon well construction and environmental parameters. The method selected must be designed to protect groundwater and implemented according to current best engineering practices while following all applicable federal, state and local regulations. *Groundwater Monitoring Well Decommissioning Procedures* shall be maintained as an addendum to this policy.

This policy is applicable to all New York State Department of Environmental Conservation (DEC) programs that install, utilize and maintain monitoring wells for the study of groundwater, except monitoring wells for landfills regulated under 6 NYCRR Part 360 decommissioned in accordance with those regulations [*see* 6 NYCRR 360-2.11(a)(8)(vi)] and wells installed under the Oil, Gas and Solution Mining Law, Environmental Conservation Law Article 23. There is no specific time frame to dictate when to decommission a well; timing is dependent upon the use and condition of the well

and shall be determined on an individual basis. Best professional judgment must be exercised when using the decommissioning procedures. Outside of DEC use, this policy is mandatory when incorporated into the specifications of a state contract, an Order on Consent or a permit. In all other situations, it shall serve as guidance.

Purpose and Background:

This document establishes a monitoring well decommissioning policy and provides technical guidance. Synonyms for well decommissioning include “plugging,” “capping” and “abandoning. For consistency, only the term “decommissioning” is used within this document.

Unprotected, neglected and improperly abandoned monitoring wells are a serious environmental liability. They can function as a pollution conduit for surface contaminants to reach the subsurface and pollute our groundwater. They also can cause unwanted mixing of groundwater, which degrades the overall water quality within an aquifer. Improperly constructed, poorly maintained or damaged monitoring wells can yield anomalous poor data that can compromise the findings of an environmental investigation or remediation project. Unneeded or compromised monitoring wells should be properly decommissioned in order to prevent harm to our groundwater.

Since 1980, the DEC has installed, directed or overseen the installation of thousands of monitoring wells throughout New York for various state and federal programs, such as Superfund, solid waste, Resource Conservation and Recovery Act (RCRA), spill response, petroleum bulk storage and chemical bulk storage. This guidance addresses the environmental liability associated with this aging network of wells.

Within its boring zone, a successfully decommissioned well prevents the following:

1. Migration of existing or future contaminants into an aquifer or between aquifers;
2. Migration of existing or future contaminants within the vadose zone;
3. Potential for vertical or horizontal migration of fluids in the well or adjacent to the well; and
4. Any change in the aquifer yield and hydrostatic head, unless due to natural conditions.

Monitoring well construction in New York varies considerably with factors such as age of the well, local geology and either the presence or absence of contamination. The predominant type of monitoring well in New York is the shallow, watertable monitoring well constructed of polyvinyl chloride plastic (PVC). The best method for decommissioning should be selected to suit the conditions and circumstances. Each decommissioning situation is to be evaluated separately using this guidance before a method is chosen and implemented.

Responsibility:

The Division of Environmental Remediation (DER) is responsible for updating this policy and the *Groundwater Monitoring Well Decommissioning Procedures* (addendum) in consultation with the Division of Solid and Hazardous Materials (DSHM) and the Division of Water (DOW). Compliance with the guidance does not relieve any party of the obligation to properly decommission a monitoring well. Oversight responsibility will be carried out by the DEC Regional Engineer.

Procedure:

Groundwater Monitoring Well Decommissioning Procedures, the addendum to this policy, provides guidance on proper decommissioning of monitoring wells in New York State.

Related References:

- Groundwater Monitoring Well Decommissioning Procedures, October 1986. Prepared by Malcolm Pirnie, Inc. for the New York State Department of Environmental Conservation, Division of Environmental Remediation.
- Standard Guide for the Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities, ASTM D 5299-99. American Society for Testing and Materials (ASTM). Philadelphia. 2005.
- 6 NYCRR Part 360 Solid Waste Management Facilities, New York State Department of Environmental Conservation, Division of Solid and Hazardous Materials.
- Specifications for Abandoning Wells and Boreholes in Unconsolidated Materials, New York State Department of Environmental Conservation, Region 1 - Water Unit, undated.
- Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA 600/4-89/034, United States Environmental Protection Agency (EPA).

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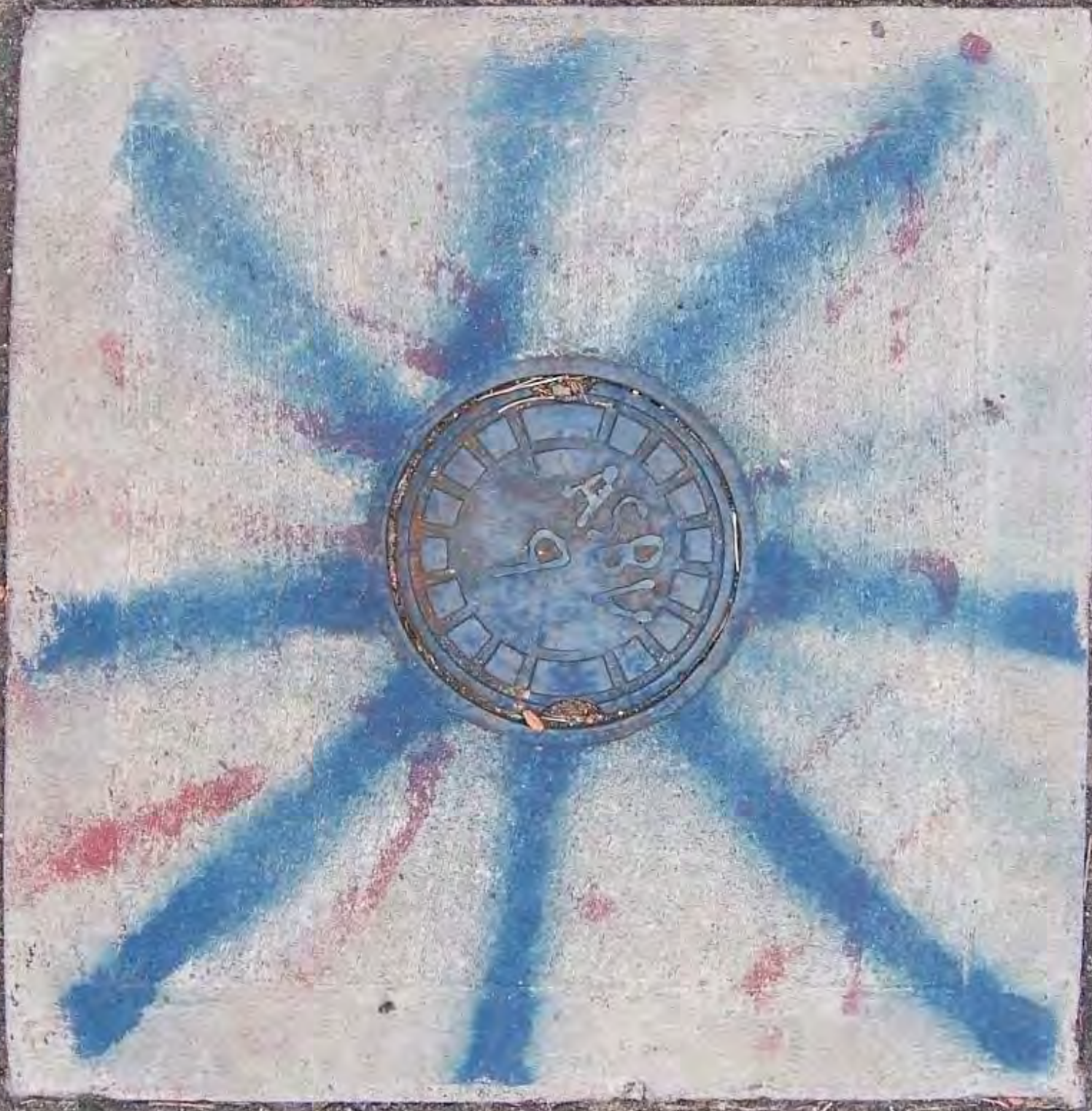
Final - August 2009

GROUNDWATER MONITORING WELL DECOMMISSIONING PROCEDURES



New York State Department of Environmental Conservation
Division of Environmental Remediation

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INTRODUCTION

This document, *Groundwater Monitoring Well Decommissioning Procedures*, is the addendum to CP-43, Groundwater Monitoring Well Decommissioning Policy, which provides acceptable procedures to be used as guidance when decommissioning monitoring wells in New York State. Please note that this document does not address some site-specific special situations that may be encountered in the field. Compliance with the procedures set forth in this document does not relieve any party of the obligation to properly decommission a monitoring well.

Unprotected, neglected and improperly abandoned monitoring wells are a serious environmental liability. They can function as a pollution conduit for surface contaminants to reach the subsurface and pollute our groundwater. They also can cause unwanted mixing of groundwater, which degrades the overall water quality within an aquifer. Improperly constructed, poorly maintained or damaged monitoring wells can yield anomalous poor data that can compromise the findings of an environmental investigation or remediation project. Unneeded or compromised monitoring wells should be properly decommissioned in order to prevent harm to our groundwater.

Previous versions of this guidance have been issued since 1995. Originally developed as a specification for well decommissioning at Love Canal, the procedures were rewritten to make them applicable across the state. From an engineering standpoint, the guidance has changed very little. Most situations do not require a complex procedure.

If you have any questions, please contact Will Welling at (518) 402-9814.

Sincerely,

Gerald J. Rider, Jr., P.E.
Chief, Remedial Section D
Remedial Bureau E
Division of Environmental Remediation

1.0 PREPARATION

If an unneeded monitoring well remains in good usable condition, an alternative to decommissioning might be the reuse by another agency program. DEC encourages reuse in situations where a well will continue to be used and cared for responsibly.

When reuse is not an option, the first step in the well decommissioning process is to review all pertinent well construction information. One must know the well depth and construction details. GPS coordinates and permanent labeling (if available) will be useful in confirming the well to be decommissioned. An inspection must be performed prior to decommissioning in order to verify the construction and condition of each well. Specific details and subsurface conditions form the basis for decisions throughout the decommissioning process.

Well Details

1. Is the well a single stem riser (all one diameter)?
2. Is the well a simple overburden well (no penetration into bedrock)?
3. Does the well riser consist of telescoping diameters of pipe which decrease with depth?
4. Is the well seal compromised (leaking, inadequate or damaged)?
5. If the well is PVC, is it 25 feet or shallower and not grouted into rock?
6. Can the riser be pulled and is removal of the well desired?
7. Is the well a bedrock well?
8. If the monitoring well is a bedrock well, does it have an open hole?
9. Is there a well assembly (riser and screen) installed within the bedrock hole?

Subsurface Conditions

10. Is the soil contaminated?
11. Does the well penetrate a confining layer?
12. If the well penetrates a confining layer, might overdrilling or casing pulling cause contamination to travel up or down through a break in the confining layer?
13. Does the screened interval cross multiple water-bearing zones?

For additional collection and verification of information, the "Monitoring Well Field Inspection Log" (Figure 1) can be used during a field inspection. After the well has been located and the information gathered, one is ready to select the decommissioning procedure in accordance with Section 2.

Special conditions, such as access problems, well extensions through capped and covered non-Part 360 landfills and seasonal weather patterns affecting construction, should be assessed in the planning stage. Decommissioning work requiring the use of heavy vehicular equipment on landfill caps should be scheduled during dry weather (if possible) so as to minimize damage to the cover. If work must be performed during the spring, winter or inclement weather, special measures to reduce ruts should be employed to maintain the integrity of a completed landfill cover system. As an example, placement of plywood under vehicular equipment can eliminate deep ruts that would require repair.

2.0 DECOMMISSIONING METHODS

The primary rationale for well decommissioning is to remove any potential groundwater pathway. A secondary rationale, often important to the property owner or owner of the well, is to physically remove the well. Removed well materials may be recycled and will not interfere with future construction excavation. The previous versions of these decommissioning procedures have stressed that physical removal of the well by pulling is preferable to leaving casing in the ground. Due to the added effort, expense and risk involved with pulling, the decision of whether to pull or not should be a separate consideration aside from selecting the sealing procedure.

One should select a decommissioning procedure that takes into account the geologic and hydrogeologic conditions at the well site; the presence or absence of contamination in the groundwater; and original well construction details. The selection process for well decommissioning procedures is provided by the flow chart, Figure 2. Answers to the questions

in the preceding section are the input for this flow chart. The four primary well decommissioning methods are:

1. Grouting in-place;
2. Perforating the casing followed by grouting in-place;
3. Grouting in-place followed by casing pulling;
4. Over-drilling and grouting with or without a temporary casing.

In a complex situation, one or more decommissioning procedures may be used for different intervals of the same well.

The remainder of Section 2 discusses the well decommissioning methods and the selection process. Refer to Figure 2 for a flow chart diagram of the complete procedure selection process. The DEC Project Manager has the discretion to deviate from the flow chart, (Figure 2), based on site conditions and professional judgment.

2.1 Grouting In-Place

Grouting in-place is the simplest and most frequently used well decommissioning method and grouting itself is the essential component of all the decommissioning methods. The grout seals the borehole and any portion of the monitoring well that may be left in the ground. Because dirt and foreign objects can fall into an open well, whenever possible a well should be sealed first with grout before attempting subsequent decommissioning steps.

For the purpose of these decommissioning procedures, the well seal is defined as the bentonite seal above the sand pack. Aside from obvious channeling by in-flowing surface water around the well, an indication of the well seal integrity may be obtained through review of the boring logs and/or a comparison of groundwater elevations if the well is part of a cluster. Any problems noted on the boring logs pertaining to the well seal, such as bridging of bentonite pellets or running sands, or disparities between field notes (if available) and the well log would indicate the potential for a poor (compromised) well seal.

If the well seal is not compromised and there is no confining layer present, a single-stem, 2-inch PVC, monitoring well can be satisfactorily decommissioned by grouting it in-place. If the seal is compromised, casing perforation may be called for as discussed in Section 2.2.

As discussed in Section 2.4 and its sub-sections, this method is specified for the bedrock portion of a well, and is used for decommissioning small diameter cased wells. Grouting in-place involves filling the casing with grout to a level of five feet below the land surface, cutting the well casing at the five-foot depth, and removing the top portion of the casing and associated well materials from the ground. The casing must be grouted according to the procedures in Section 6. In addition, the upper five feet of the borehole is filled to land surface and restored according to the procedures described in Section 7.

For open-hole bedrock wells, the procedure involves filling the opening with grout to the top of rock according to the procedures in Section 5. A thicker grout may be required to fill any bedrock voids. If excessive grout is being lost down-hole, consider grouting in stages to reduce the pressure caused by the height of the grout column.

The standard mix with the maximum amount of allowable water will be required to penetrate the well screen and sand pack when a well assembly has been installed within a bedrock hole. For an assembly such as this, the grout should be mixed thinly enough to penetrate the slots and sand pack. The grout mixes are discussed in Sections 6.1 and 6.2.

2.2 Casing Perforating/Grouting In-Place

Casing perforation followed by grouting in-place is the preferred method to use if there is poor documentation of the grouting of the well annulus, or the annulus was allowed to be back-filled with cuttings. The grout will squeeze through the perforations to seal any porous zones along the outside of the casing. The procedure involves puncturing, cutting or splitting the well casing and screen followed by grouting the well. A variety of commercial equipment is available for perforating casings and screens in wells with four-inch or larger inside diameters. Due to the diversity of applications, experienced contractors must recommend a specific technique based on site-specific conditions. A minimum of four rows of perforations several inches long around the circumference of the pipe and a minimum of five perforations per linear foot of casing or screen is recommended (American Society for Testing and Materials, Standard D 5299-99, 1999). After the perforating is complete, the borehole must be grouted according to the procedures in Section 6 and the upper five feet of borehole restored according to the procedures in Section 7.

2.3 Casing Pulling

Casing pulling should be used in cases where the materials of the well assembly are to be recycled, or the well assembly must be removed to clear the site for future excavation or re-development. Casing pulling is an acceptable method to use when no contamination is present; contamination is present but the well does not penetrate a confining layer; and when both contamination and a confining layer are present but the contamination cannot cross the confining layer. Additionally, the well construction materials and well depth must be such that pulling will not break the riser. When contamination is likely to cross the confining layer during pulling, a temporary casing can be used. See Section 2.4.

Casing pulling involves removing the well casing by lifting. Grout is to be added during pulling; the grout will fill the space once occupied by the material being withdrawn. An acceptable procedure to remove casing involves puncturing the bottom of the well or using a casing cutter to cut away the screen, grouting, using jacks to free casing from the hole, and lifting the casing out by using a drill rig, backhoe, crane, or other suitable equipment. Additional grout must be added to the casing as it is withdrawn. Grout mixing and placement procedures are provided in Section 6. In wells or well points in which the bottom cannot be punctured, the casing or screened interval will be perforated or cut away prior to being filled with grout. This procedure should be followed for wells installed in collapsible formations or for highly contaminated wells.

At sites in which well casings have been grouted into the top of bedrock, the casing pulling procedure should not be attempted unless the casing can be first cut or freed from the rock.

2.4 Over-Drilling

Over-drilling is the technique used to physically remove an entire monitoring well, its sand pack and the old grout column and fill. In situations where PVC screens and risers are expected to sever and removal of all well materials is required, over-drilling will be required. Over-drilling is called for when a riser can't be pulled and it penetrates a confining layer. Compared to the other procedures, over-drilling is the least common method of well decommissioning.

A "temporary casing" may be necessary when extraordinary conditions are present, such as a high concentration of mobile contaminants in the overburden, depth to water is shallow, there is poor construction documentation or shoddy construction practices. The approach involves installing a large diameter steel casing around the outside of the well followed by drilling / pulling /grouting within this casing. The casing is withdrawn at the end of pulling, grouting and (perhaps) drilling. If the confining layer is less than 5 feet thick, the casing should be installed to the top of the confining layer. Otherwise, it is installed to a depth of 2 feet below the top of the confining layer. After the outer casing has been set, the well can be removed and grouted through pulling if possible or removed and grouted by drilling inside the casing.

Over-drilling is used where casing pulling is determined to be unfeasible, or where installation of a temporary casing is necessary to prevent cross-contamination, such as when a confining layer is present and contamination in the deeper aquifer could migrate to the upper aquifer as the well is pulled. The over-drilling method should:

- Follow the original well bore;
- Create a borehole of the same or greater diameter than the original boring; and
- Remove all of the well construction materials.

In over-drilling the difficulty lies in keeping the augers centered on the old well as the bit is lowered; it will tend to wander off. As a precaution, the well column should be filled with grout before over-drilling. Then without allowing the grout to dry, the driller proceeds with over-drilling the well. Grouting first guarantees that if the drill wanders off the old well and the effort is less than 100% successful, the remaining well portion will at least have been grouted. There are many methods for over-drilling. Please note that the following methods are not suitable for all types of casing, and the advice of an experienced driller should be sought.

- Conventional augering (i.e., a hollow stem auger fitted with a pilot bit). The pilot bit will grind the well construction materials, which will be brought to the well surface by the auger.
- A conventional cable tool rig to advance "temporary" casing having a larger diameter than the original boring. The cable tool kit is advanced within the casing to grind the well construction materials and soils, which are periodically removed with large diameter bailer. This method is not applicable to bedrock wells.

- An over-reaming tool with a pilot bit nearly the same size as the inside diameter of the casing and a reaming bit slightly larger than the original borehole diameter. This method can be used for wells with steel casings.

- A hollow-stem auger with outward facing carbide cutting teeth having a diameter two to four inches larger than the casing.

Prior to over-drilling, the bottom of the well should be perforated or cut away, and the casing filled with grout as with casing removal by pulling.

In all cases above, over-drilling should advance beyond the original bore depth by a distance of half a foot to ensure complete removal of the construction materials. Oversight attention should be focused on the drill cuttings, looking for fragments of well materials. Absence of these indicators is a sign that the drill has wandered off the well. If wandering is suspected, having previously filled the well with grout, the remaining portion which cannot be over-drilled can be considered grouted in-place. When the over-drilling is complete, grout should be tremied within the annular space between the augers and well casings. The grout level in the borehole should be maintained as the drilling equipment and well materials are sequentially removed. As with all the other methods, the upper five feet of borehole should be restored according to the procedures in Section 7.

3.0 SELECTION PROCESS AND IMPLEMENTATION

The decommissioning procedure selection flow chart, Figure 2, is to be used to select decommissioning methods. The selection process first identifies the basic monitoring well type. There are only two types of monitoring wells described in this guidance, overburden wells and bedrock wells. Bedrock wells typically have an overburden portion which in the selection process is to be treated as an overburden well. Techniques are specified for wells based upon their type and the other physical conditions present. Decommissioning techniques called for by the selection process have their practical limits; construction details dictate when a well stem can be pulled without breaking and when it cannot be pulled. The DEC project manager has the discretion to deviate from the flow chart, (Figure 2), based on site conditions, budgetary concerns and professional judgment. The remainder of this section will discuss types of monitoring wells in various settings along with recommended decommissioning techniques.

3.1 Bedrock Wells

Referring to Figure 2 and Section 2.1, if the well extends into bedrock, the rock hole portion of the well is to be grouted in-place to the top of the rock. The grout mix, however, may vary according to the conditions. A thicker grout may be required to fill voids and a thinner grout may be necessary to penetrate well screen and sand pack. Refer to the grout mixture specifications given in Section 6.1 and 6.2.

Prior to grouting, the depth of the well will be measured to determine if any silt or debris has plugged the well. If plugging has occurred, all reasonable attempts to clear it should be made before grouting. The borehole will then be tremie grouted according to Section 6.4 from the bottom of the well to the top of bedrock to ensure a continuous grout column.

After the rock hole is grouted, the overburden portion of the well is decommissioned using appropriate techniques described below. If the bedrock extends to the ground surface, grouting can extend to the ground surface or to slightly below so that the site can be restored as appropriate in accordance with Section 7.

3.2 Uncontaminated Overburden Wells

For overburden wells and the overburden portion of bedrock wells, the first factor in determining the decommissioning method is whether the overburden portion of the well exhibits contamination, as determined through historical groundwater and/or soil sampling results. If the overburden is uncontaminated, the next criteria considers whether the well penetrates a confining layer. In the case that the overburden portion of the well does not penetrate a confining layer, the casing can either be tremie-grouted and pulled or tremie grouted and left in place. As a general rule, PVC wells greater than 25-feet deep should not be pulled unless site-specific conditions or other factors indicate that the well can be pulled without breaking. If the well cannot be pulled, the well should be grouted in-place as accordance with Sections 2.1 and 2.2.

If a non-telescoped overburden well penetrates a confining layer, the casing should be removed by pulling (if possible) in accordance with Section 2.3. If the casing cannot be removed by pulling, the well should be grouted in-place or where complete removal is required, removed by over-drilling. Over-drilling will be based upon the site-specific conditions and requirements. If pulling is attempted and fails (i.e., a portion of the riser breaks) the remaining portion of the well should be removed by using the conventional augering procedure identified in Section 2.4. Note that if the riser is broken during pulling, it is highly unlikely that the driller will be able to target it to over-drill it. This is the reason why all wells should be grouted first. In all cases, after the well construction materials have been removed to the extent possible, the borehole will be grouted in accordance with Section 6 and the upper five feet will be restored in accordance with Section 7.

3.3 Contaminated Overburden Monitoring Wells/Piezometers

Contamination in the overburden plays a role in the selection process. Any contamination present in the overburden must not be allowed to spread as a result of the decommissioning construction. For wells and piezometers suspected or known to be contaminated with light non-aqueous phase liquid (LNAPL) and/or dense non-aqueous phase liquid (DNAPL), often referred to as “product,” the decision to decommission the well should be reviewed. Such gross contamination is a special condition and requires design of the decommissioning procedure. If decommissioning is determined to be the proper course of action, measurement of the non-aqueous phase liquid volume will be determined and this liquid will be removed.

If an overburden well (or the overburden portion of a bedrock well) is contaminated with LNAPL, DNAPL and /or dissolved fractions as indicated by historical sampling results, one must evaluate the potential for contamination to cross an overburden confining layer (if one exists) during decommissioning. A rock or soil horizon of very low permeability is known as a confining layer. Contamination in the overburden lying above a confining layer is a significant condition to recognize. To prevent mobile contaminants from crossing a confining layer during pulling or over-drilling, a temporary casing should be installed to isolate the work zone. One should follow the procedure selection flow chart. Some contaminated conditions call for over-

drilling or a specially designed procedure.

A well in contaminated overburden may be grouted in-place as long as the grout fully seals the well and boring zone. If a well in contaminated overburden was constructed allowing formation collapse as annular backfill or if the well has a compromised well seal, one must either physically remove the well or thoroughly perforate the riser and grout it in-place.

If physical removal of the well is required and the overburden contaminants are likely to be dragged upward or downward during decommissioning, a temporary casing should be used to seal off the construction work zone. Casing pulling and overdrilling can be safely accomplished within the temporary casing. Section 2.4 discusses the temporary casing technique.

3.4 Telescoped Riser

If the riser is telescoped in one or more outer casings, the decommissioning approach depends upon the integrity of the well seal. If there is no evidence that the well seal integrity is compromised, the riser should be grouted in-place in accordance with Sections 2.1 or 2.2 and the upper 5 feet of the well surface should be restored in accordance with Section 7. If indications are that the well seal is not competent, it will be necessary to design and implement a special procedure to perforate and grout or remove the well construction materials. The presence and configuration of the outer casing(s) will be specific in the individual wells and will be a key factor in the decommissioning approach. The special procedure must mitigate the potential for cross-contamination during removal of the well construction materials.

4.0 LOCATING AND SETTING-UP ON THE WELL

Prior to mobilizing to decommission a monitoring well, one should notify the property owner and/or other interested parties including the governing regulatory agency. It is advisable that when at the well location, one should review the proposed well decommissioning procedure. Verify well locations and identification by their identifying markers and GPS coordinates. Lastly, verify the depth of each well with respect to depth recorded on the well construction log.

5.0 REMOVING THE PROTECTIVE CASING

Most monitoring wells installed in non-traffic locations are finished with an elevated, protective casing (guard pipe) and a concrete rain pad. Wells at gasoline stations, usually being in high-traffic areas, are typically finished with a flush-mount, curb box and protective 8" dia steel inspection plate rather than a stick-up riser. The curb box is usually easily removed from around the flush-mount well before pulling or over-drilling. In the case of stick-up wells, the riser pipe may be bonded to the guard pipe and rain pad. When the protective casing and concrete pad of a stick-up monitoring well are "yanked out," a PVC riser will typically break off at the bottom of the guard pipe several feet below grade. Once this happens, it may become impossible to center a drill rig upon the well. The riser may become splintered and structurally unstable for pulling. Unless grouted first, the well may fill with dirt. Before pulling a casing or over-drilling a well, a method must be devised for removing these protective surface pieces without jeopardizing the remaining decommissioning effort.

Generally, unless the protective casing is loose and can be safely lifted off by hand, *one*

should fill the monitoring well with grout before removing the outer protective casing. This will ensure that the well is properly sealed regardless of any problems later when removing the protective casing. Remove the protective casing or road box vault initially only if the stick-up or vault will interfere with subsequent down-hole work which must be done before grouting. This down-hole work may include puncturing, perforating or cutting the screen or riser. But as a general procedure don't remove the protective casing or road box until after initial grouting is complete.

The procedure for removing the protective casing of a well depends upon the decommissioning method specified for the monitoring well. The variety of protective casings available preclude developing a specific removal procedure but often one can simply break up the concrete seal surrounding the casing and jack or hoist the protective casing out of the ground. A check should be made during pulling to ensure that the inner well casing is not being hoisted with the protective casing. If this occurs, the well casing should be cut off after the base of the protective casing is lifted above the land surface. At well locations where the riser has been extended, the burial of a previous concrete pad may require the excavation of soil to the top of the concrete pad to remove the well.

Steel well casing should be removed approximately five feet below the land surface so as to be below the frost line and out of the way of any subsequent shallow digging. The upper five feet of casing and the protective casing can be removed in one operation if a casing cutter is used.

Waste handling and disposal must be consistent with the methods used for the other well materials unless an alternate disposal method can be employed (i.e., steam cleaning followed by disposal as non-hazardous waste).

6.0 SELECTING, MIXING, AND PLACING GROUT

This section gives recipes for the “standard grout mixture” and the thicker “special grout mixture.” Mixing and placing grout is also discussed in this section. The goal of well decommissioning is to eliminate the capability of water to travel up or down within the volume of the former well and its boring. Success depends upon the correct grout mixture and placement where it is needed. There are two types of grout mixes that may be used to seal monitoring wells: a standard mix and a special mix. Both mixes use Type 1 Portland cement and four percent bentonite by weight. However, the special mix uses a smaller volume of water and is used in situations where excessive loss of the standard grout mix is possible (e.g., highly-fractured bedrock or coarse gravels).

6.1 Standard Grout Mixture

For most boreholes, the following standard mixture will be used:

- One 94-pound bag Type I Portland cement;
- 3.9 pounds powdered bentonite; and
- 7.8 gallons potable water.

Slightly more water may be used in order to penetrate a sand pack when a well screen transects multiple flow zones. This mixture results in a grout with a bentonite content of four percent by weight and will be used in all cases except in boreholes where excessive use of grout is anticipated. In these cases a special thicker mixture will be used.

6.2 Special Mixture

In cases where excessive use of grout is anticipated, such as high permeability formations and highly fractured or cavernous bedrock formations, the following special mixture will be used:

- one 94-pound bag type I Portland cement;
- 3.9 pounds powdered bentonite;
- 1 pound calcium chloride; and
- 6.0-7.8 gallons potable water (depending on desired thickness).

The special mixture results in a grout with a bentonite content of four percent by dry weight. It is thicker than the standard mixture because it contains less water. This grout is expected to set faster than the Standard Grout Mixture due to the added calcium chloride. The least amount of water that can be added for the mixture to be readily pumpable is 6 gallons per 94-pound bag of cement.

6.3 Grout Mixing Procedure

To begin the grout-mixing procedure, calculate the volume of grout required to fill the borehole. If possible, the mixing basin should be large enough to hold all of the grout necessary for the borehole.

Mix grout until a smooth, homogeneous mixture is achieved. Grout can be mixed manually or with a mechanized mixer. Colloidal mixers should not be used as they tend to excessively decrease the thickness of the grout for the above recipes.

6.4 Grout Placement

This guidance requires that grout be placed in the well from the bottom to the top by means of a "tremie." A tremie is a pipe, a hose or a tube extending from the grout supply to the bottom of the well. The tremie delivers the grout all the way down through the water column without its being diluted and mixed with the water that may be present in the well. The tremie pipe or tube is withdrawn as (or after) the well is filled with grout.

Using the tremie, grout is placed in the borehole filling from the bottom to the top. Two-inch and larger wells should use tremie tubing of not less than 1-inch diameter. Smaller diameter wells will call for a smaller tremie pipe. Grout will then be pumped in until the grout appears at the land surface (when grouting open holes in bedrock, the grout level only needs to reach above the bedrock surface). Any groundwater displaced during grout placement, if known to be contaminated, will be contained for proper disposal.

At this time the rate of settling should be observed. If grouting the well in place, the well

casing remains in the hole. But if the decommissioning method has involved down-hole tools such as hollow-stem augers or temporary casing for overdrilling, these will be removed from the hole. As each section is removed, grout will be added to keep the level between 0 and 5 feet below grade. If the grout level drops below the land surface to an excessive degree, an alternate grouting method must be used. One possibility is to grout in stages; i.e., the first batch of grout is allowed to partially cure before a second batch of grout is added.

As previously described in Section 5.0, the outer protective casing "stick-up" should be removed only after a well has been properly filled with grout. This will ensure that the well is properly sealed regardless of any breakage which may occur when removing the stick-up. It is important to reiterate that when either casing pulling or over-drilling are required, due to the uncertainty of successfully pulling a well or over-boring a well, we insist that the driller tremie grout the well first. Then without allowing the grout to dry, the driller proceeds with pulling the casing or over-drilling the well.

Upon completion of grouting, ensure that the final grout level is approximately five feet below land surface. A ferrous metal marker will be embedded in the top of the grout to indicate the location of the former monitoring well. Lastly, a fabric "utility" marking should be placed one foot above the grout so an excavator can see it clearly.

7.0 BACKFILLING AND SITE RESTORATION

The uppermost five feet of the borehole at the land surface should be filled with material physically similar to the natural soils. The surface of the borehole should be restored to the condition of the area surrounding the borehole. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness, grassed areas will be seeded, and topsoil will be used in other areas. All solid waste materials generated during the decommissioning process must be disposed of properly.

8.0 DOCUMENTATION

A form which may be used in the field to record the decommissioning construction is included as Figure 3. Additional documentation may be required by a DEC project manager and samples are included in Appendix A. Programs within the DEC that maintain geographic data on monitoring wells strive to keep that data up to date. Owners of these data sets must be notified when a well is decommissioned. Historical groundwater quality data is linked to monitoring well locations so when a well is decommissioned, existing GIS data must be updated to reflect that fact but the coordinate location in the GIS database should not be eliminated. A metal detector may not be able to detect a deeply buried marker so if this locator is important for future utility runs or foundations, a map should be submitted to the property owner and the town engineer showing the decommissioned well locations. Global Positioning System (GPS) coordinates should be indicated on this map. Lastly, whatever documentation is produced should be provided to the property owner, the DEC, and all other parties involved.

9.0 FIELD OVERSIGHT

Over-drilling requires careful observation to detect whether the drill has wandered off the well. Grout preparation and tremie work should be carefully observed. The successful implementation of a decommissioning work plan depends upon proper direction, observation and oversight. Methods to be employed must be clearly worked through and all parties must understand what they have to do before going into the field. Flexibility is allowed where necessary but the work effort must be thorough and effective to protect our groundwater.

10.0 RELATED REFERENCES

- *Groundwater Monitoring Well Decommissioning Procedures*, October 1986. Prepared by Malcolm Pirnie, Inc., for the New York State Department of Environmental Conservation, Division of Environmental Remediation.

- American Society for Testing and Materials, A.S.T.M. D 5299-99, Standard Guide for the Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities. A.S.T.M.. Philadelphia. 2005.

- New York State Department of Environmental Conservation, Division of Solid and Hazardous Materials, 6 NYCRR Part 360, Solid Waste Management Facilities.

- New York State Department of Environmental Conservation, Region I - Water Unit, Specifications for Abandoning Wells and Boreholes in Unconsolidated Materials, undated.

- United States Environmental Protection Agency, The Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA 600/4-89/034.

FIGURES

APPENDICES

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FIGURE 1

MONITORING WELL FIELD INSPECTION LOG

FIGURE 1

SITE NAME:

SITE ID.: _____
INSPECTOR: _____
DATE/TIME: _____
WEll ID.: _____

MONITORING WELL FIELD INSPECTION LOG
NYSDEC WELL DECOMMISSIONING PROGRAM

	YES	NO
WELL VISIBLE? (If not, provide directions below)		
WELL I.D. VISIBLE?		
WELL LOCATION MATCH SITE MAP? (if not, sketch actual location on back).....		

WELL I.D. AS IT APPEARS ON PROTECTIVE CASING OR WELL: .....

	YES	NO
SURFACE SEAL PRESENT?		
SURFACE SEAL COMPETENT? (If cracked, heaved etc., describe below)		
PROTECTIVE CASING IN GOOD CONDITION? (If damaged, describe below)		

HEADSPACE READING (ppm) AND INSTRUMENT USED..... _____
TYPE OF PROTECTIVE CASING AND HEIGHT OF STICKUP IN FEET (If applicable) _____
PROTECTIVE CASING MATERIAL TYPE: ..... _____
MEASURE PROTECTIVE CASING INSIDE DIAMETER (Inches): .....

	YES	NO
LOCK PRESENT?		
LOCK FUNCTIONAL?		
DID YOU REPLACE THE LOCK?		
IS THERE EVIDENCE THAT THE WELL IS DOUBLE CASED? (If yes,describe below)		
WELL MEASURING POINT VISIBLE?		

MEASURE WELL DEPTH FROM MEASURING POINT (Feet): ..... _____
MEASURE DEPTH TO WATER FROM MEASURING POINT (Feet): ..... _____
MEASURE WELL DIAMETER (Inches): ..... _____
WELL CASING MATERIAL: ..... _____
PHYSICAL CONDITION OF VISIBLE WELL CASING: ..... _____
ATTACH ID MARKER (if well ID is confirmed) and IDENTIFY MARKER TYPE ..... _____
PROXIMITY TO UNDERGROUND OR OVERHEAD UTILITIES..... _____

DESCRIBE ACCESS TO WELL: (Include accessibility to truck mounted rig, natural obstructions, overhead power lines, proximity to permanent structures, etc.); ADD SKETCH OF LOCATION ON BACK, IF NECESSARY.

DESCRIBE WELL SETTING (For example, located in a field, in a playground, on pavement, in a garden, etc.) AND ASSESS THE TYPE OF RESTORATION REQUIRED.

IDENTIFY ANY NEARBY POTENTIAL SOURCES OF CONTAMINATION, IF PRESENT (e.g. Gas station, salt pile, etc.):

REMARKS:

FIGURE 2

DECOMMISSIONING PROCEDURE SELECTION

NYSDEC Monitoring Well Decommissioning Procedure Selection

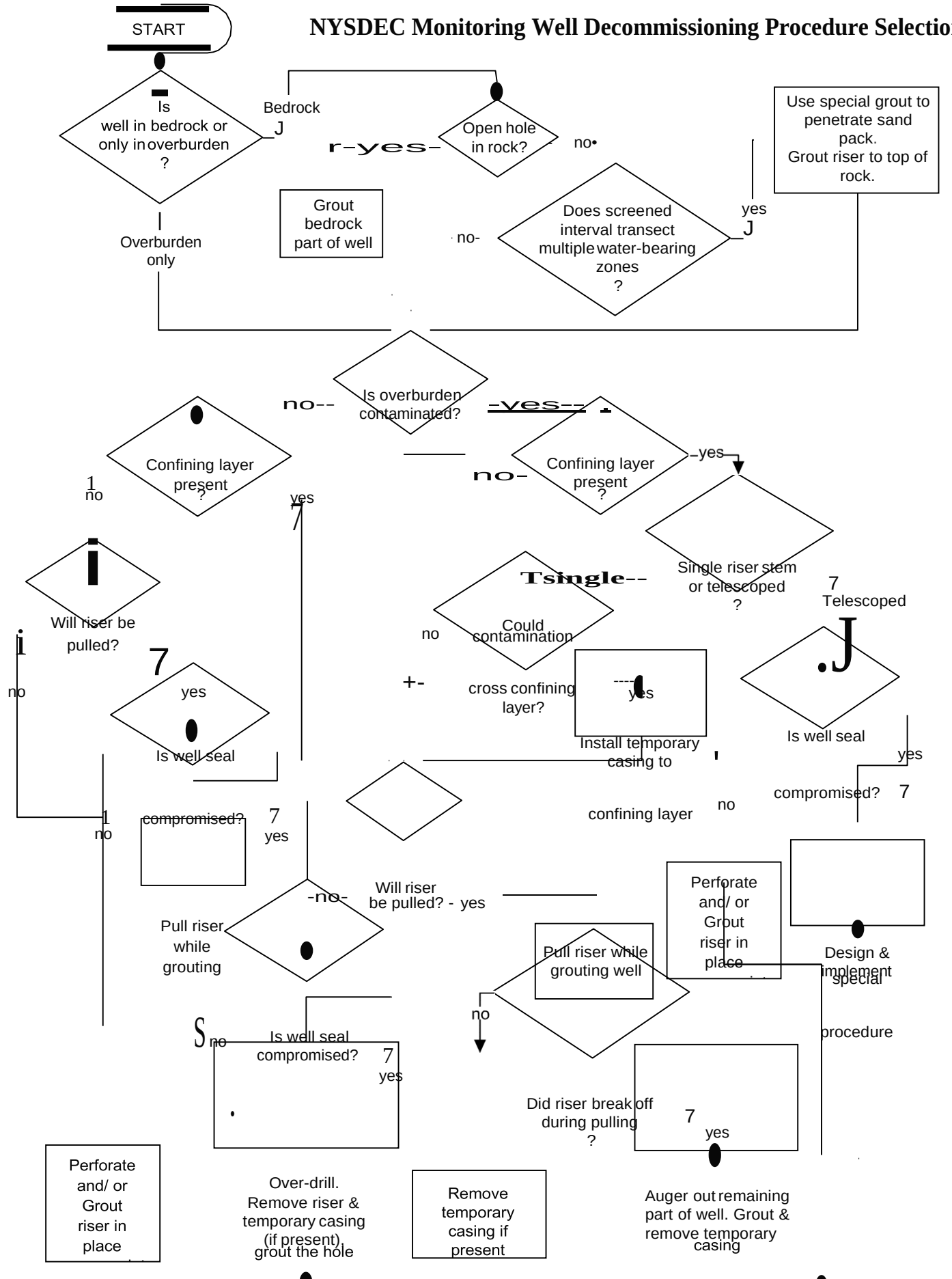


FIGURE 2

FIGURE 3

WELL DECOMMISSIONING RECORD

FIGURE 3

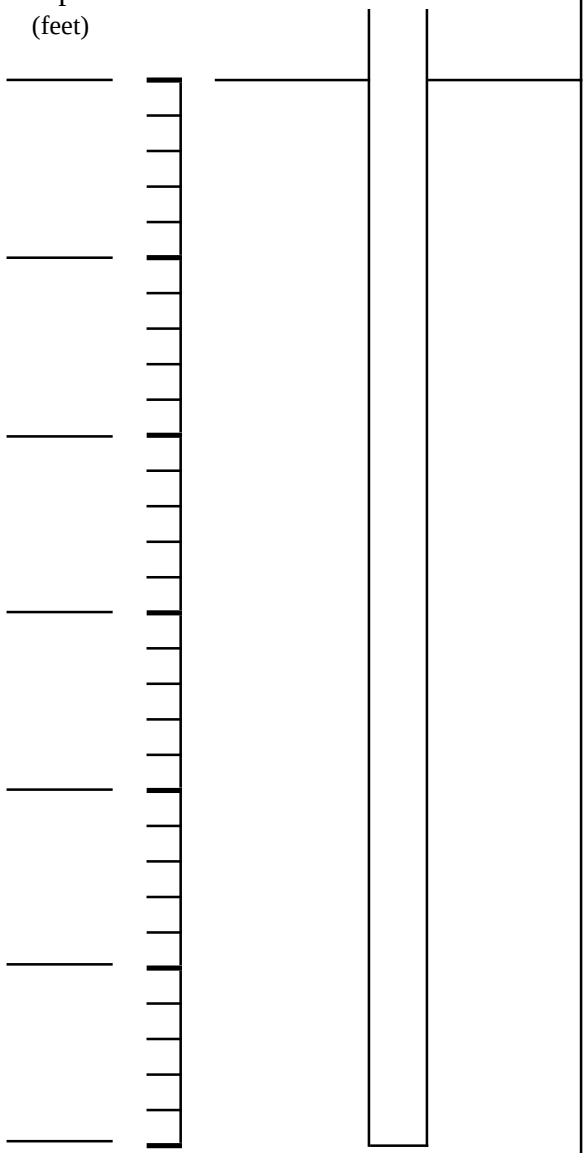
WELL DECOMMISSIONING RECORD

Site Name:	Well I.D.:
Site Location:	Driller:
Drilling Co.:	Inspector:
	Date:

DECOMMISSIONING DATA
(Fill in all that apply)

OVERDRILLING	
Interval Drilled	
Drilling Method(s)	
Borehole Dia. (in.)	
Temporary Casing Installed? (y/n)	
Depth temporary casing installed	
Casing type/dia. (in.)	
Method of installing	
CASING PULLING	
Method employed	
Casing retrieved (feet)	
Casing type/dia. (in)	
CASING PERFORATING	
Equipment used	
Number of perforations/foot	
Size of perforations	
Interval perforated	
GROUTING	
Interval grouted (FBLS)	
# of batches prepared	
For each batch record:	
Quantity of water used (gal.)	
Quantity of cement used (lbs.)	
Cement type	
Quantity of bentonite used (lbs.)	
Quantity of calcium chloride used (lbs.)	
Volume of grout prepared (gal.)	
Volume of grout used (gal.)	

WELL SCHEMATIC*



COMMENTS:

* Sketch in all relevant decommissioning data, including: interval overdrilled, interval grouted, casing left in hole, well stickup, etc.

Drilling Contractor

Department Representative

APPENDIX A - REPORTS

APPENDIX A1 - INSPECTOR'S DAILY REPORT

APPENDIX A2 - PROBLEM IDENTIFICATION REPORT

APPENDIX A3 - CORRECTIVE MEASURES REPORT

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Appendix A1

Inspector's Daily Report

CONTRACTOR:
ADDRESS:

TELEPHONE:
LOCATION FROM TO
WEATHER _____ TEMP _____ A.M. P.M. _____ DATE

CONTRACTOR'S WORK FORCE AND EQUIPMENT										
DESCRIPTION	*H*	*#*	*DESCRIPTION*	*H*	*# DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*
Field Engineer					Equipment			Front Loader Ton		
Superintendent			Ironworker		Generators			Bulldozer		
					Welding Equip.					
Laborer Foreman			Carpenter							
Laborer								Backhoe		
Operating Engineer			Concrete Finisher							
Carpenter					Paving Equip. & Roller					
					Air compressor					

SEE REVERSE SIDE FOR SKETCH YES ☐ NO ☐ _____

WORK PERFORMED: _____

PAY ITEMS

CONTRACT		STA		DESCRIPTION	QUANTITY	REMARKS
Number	ITEM	FROM	TO			

TEST PERFORMED: _____
PICTURES TAKEN: _____

VISITORS: _____

QA PERSONNEL
SIGNATURE _____

REPORT NUMBER _____
SHEET _____ Of _____

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PROBLEM IDENTIFICATION REPORT

Date _____

Project _____ Job Number _____

Day | Su | M | T | W | Th | F | Sa |

Contractor _____

Subject _____

Sky/Precip.

	Clear	Partly Cloudy	Cloudy	Rainy	Snow
TEMP.	<32F	32-40F	40-70F	70-80F	80-90F
WIND	No	Light	Strong		
HUMIDITY	Dry	Mod.	Humid		

PROBLEM DESCRIPTION Reference Daily Report Number 1: _____

PROBLEM LOCATION - REFERENCE TEST RESULTS AND LOCATION (Note: Use sketches on back of form as appropriate):

PROBABLE CAUSES: _____

SUGGESTED CORRECTIVE MEASURES: _____

APPROVALS:

QA ENGINEER: _____

PROJECT MANAGER: _____

Distribution:
1. Project Manager
2. Field Office
3. File
4. Owner

QA Personnel
Signature: _____

MEETINGS HELD AND RESULTS

REMARKS

REFERENCES TO OTHER FORMS

SKETCHES

SAMPLE LOG

SAMPLE NUMBER

APPROXIMATE LOCATION OF STOCKPILE

NUMBER OF STOCKPILE

DATE OF COLLECTION

CLIMATIC CONDITIONS

FIELD OBSERVATION

SHEETS OF

CORRECTIVE MEASURES REPORT

Date _____

Project _____ Job Number_____

Day | Su | M | T | W | Th | F | Sa |

Sky/Precip.

Contractor _____

Subject _____

	Clear	Partly Cloudy	Cloudy	Rainy	Snow
TEMP.	<32F	32-40F	40-70F	70-80F	80-90F
WIND	No	Light	Strong		
HUMIDITY	Dry	Mod.	Humid		

CORRECTIVE MEASURES TAKEN (Reference Problem Identification Report No.): _____

RETESTING LOCATION:

SUGGESTED METHOD OF MINIMIZING RE-OCCURRENCE:

SUGGESTED CORRECTIVE MEASURES:

APPROVALS:

QA ENGINEER: _____

PROJECT MANAGER:

Distribution:

1. Project Manager
2. Field Office
3. File
4. Owner

QA Personnel

Signature: _____

Section 5

SAMPLE COLLECTION AND FIELD SCREENING (SC)

SUMMARY GUIDANCE

SC-001 General Guidance on Sample Collection

Overview

The primary objective of all sampling activities is to characterize a site accurately so that its impact on human health and the environment can be properly evaluated. It is only through sampling and analysis that site hazards can be measured and the job of cleanup and restoration can be accomplished effectively with minimal risk. The sampling itself must be conducted so that every sample collected retains its original physical form and chemical composition. In this way, sample integrity is insured, quality assurance standards are maintained, and the sample can accurately represent the larger body of material under investigation. The extent to which valid inferences can be drawn from a sample depends on the degree to which the sampling effort conforms to the project's objectives. For example, one sample may produce adequate, technically valid data to address the project's objectives. Meeting the project's objectives requires thorough planning of sampling activities, and implementation of the most appropriate sampling and analytical procedures.

Sample Purposes

In relation to the media to be sampled, two basic types of samples can be considered:

Waste Characterization Sample

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, soil, groundwater, soil vapor, fresh spills, or areas previously identified as contaminated, and require special handling procedures because of their potential toxicity or hazard. These samples can be further subdivided based on their degree of hazard; however, care should be taken when handling and shipping any wastes believed to be concentrated regardless of the degree.

Environmental Sample

Environmental samples are those collected from streams, ponds, lakes, wells, and are off-site samples that are not expected to be contaminated with hazardous materials. They usually do not require the special handling procedures typically used for concentrated wastes. However, in certain instances, environmental samples can contain elevated concentrations of pollutants and in such cases would have to be handled as hazardous samples.

The importance of making the distinction between environmental and hazardous samples is two-fold:

- Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner which ensures the safety of both field and laboratory personnel.
- Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to the International Air Transport Association (IATA) Dangerous Goods Regulations or the Department of Transportation (DOT) regulations and U.S. Environmental Protection Agency (EPA) guidelines.

Sample Collection Techniques

In general, two basic types of sample collection techniques are recognized, both of which can be used for either environmental or hazardous samples.

Grab Samples

A grab sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease.

Composite Samples

Composites are non-discrete samples composed of more than one specific aliquot collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can in certain instances be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask problems by diluting isolated concentrations of some hazardous compounds below detection limits. Compositing of hazardous waste is often performed after compatibility tests have been completed to determine an average value over a number of different locations (group of drums). This procedure generates data that can be useful by providing an average concentration within a number of units, can serve to keep analytical costs down, and can provide information useful to transporters and waste disposal operations.

For sampling situations involving hazardous wastes, grab sampling techniques are generally preferred because grab sampling minimizes the amount of time sampling personnel must be in contact with the wastes, reduces risks associated with compositing unknowns, and eliminates chemical changes that might occur due to compositing.

Types of Sampling Strategies

The number of samples that should be collected and analyzed depends on the objective of the investigation. There are three basic sampling strategies: random, systematic, and judgmental sampling.

- Random sampling involves collection of samples in a nonsystematic fashion from the entire site or a specific portion of a site.
- Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established.
- When judgmental sampling is performed, samples are collected only from the portions) of the site most likely to be contaminated.

Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

Sample Hold Time, Container, and Preservation Methods

The following table provides general required Holding Time, Container, and Preservation Methods. Most of the information is specific to the EPA analytical method and should be pertinent to all sampling schemes. However, some analytical preservation and analytical methods are state specific. The QAPP should clearly identify preservation methods and hold times prior to sampling.

Samples should be submitted to the laboratory as soon as possible. It is preferable to send samples from the field via courier service rather than bringing to the office for later pickup.

Aqueous

Parameter	Holding Time	Container	Volume	Preservative
Acidity	14 days	P, G	100 ml	Cool, 4°C
Alkalinity	14 days	P, G	100 ml	Cool, 4°C
Biological Oxygen Demand (BOD)	48 hours	P, G	1000 ml	Cool, 4°C
Chemical Oxygen Demand (COD)	28 days	P, G	100 ml	Cool, 4°C, H_2SO_4 to pH<2
Chloride	28 days	P, G	100 ml	Cool, 4°C
Chromium, Hexavalent	24 hours	P, G	250 ml	Cool, 4°C
Cyanide				
Amenable	14 days[1]	P, G	500 ml	Cool, 4°C, NaOH to pH>12
Free	14 days[1]	P, G	500 ml	Cool, 4°C, NaOH to pH>12
Total	14 days[1]	P, G	500 ml	Cool, 4°C, NaOH to pH>12
Fluoride	28 days	P	100 ml	Cool, 4°C
Hardness, Total	6 months	P, G	100 ml	HNO_3 to pH<2
Metals (except Cr+6, Hg)	6 months	P	500 ml	Cool, 4°C, HNO_3 to pH<2
MBAS	48 hours	G	500 ml	Cool, 4°C
Mercury	28 days	P, G	500 ml	HNO_3 to pH<2
N, Ammonia	28 days	P, G	100 ml	H_2SO_4 to pH<2
N, T. Kjeldahl	28 days	P, G	500 ml	H_2SO_4 to pH<2
N, Nitrate	48 hrs/ 28 days preserved	P, G	100 ml	Cool, 4°C or add H_2SO_4 to pH<2
N, Nitrite	48 hours	P, G	100 ml	Cool, 4°C
Oil and Grease	28 days	G	1000 ml	Cool, 4°C, H_2SO_4 or HCl to pH<2
Petroleum Hydrocarbons	14 days	G	1000 ml	Cool, 4°C, H_2SO_4 to pH<2
pH	Analyze Immediately	P, G	50 ml	N/A
Phenols,Recoverable	28 days	G	500 ml	Cool, 4°C, H_2SO_4 to pH<2
Phosphorus, Ortho	48 hours	P, G	100 ml	Filter, Cool, 4°C
Phosphorus, Total	28 days	P, G	100 ml	Cool, 4°C, H_2SO_4 to pH<2
Radiological Tests				
Alpha, Beta & Radium	6 months	P, G	4 L	Cool, 4°C, HNO_3 to pH<2
Solids, Total	7 days	P, G	100 ml	Cool, 4°C

Aqueous (cont)

Parameter	Holding Time	Container	Volume	Preservative
Solids, Total Dissolved	7 days	P, G	100 ml	Cool, 4°C
Solids, Total Suspended	7 days	P, G	100 ml	Cool, 4°C
Solids, Volatile Suspended	7 days	P, G	100 ml	Cool, 4°C
Sulfate	28 days	P, G	100 ml	Cool, 4°C
Total Organic Carbon	28 days	P, G	100 ml	Cool, 4°C, H_2SO_4 to pH<2
Halogenated Volatiles	14 days	40 ml vials	2x40 ml	Cool, 4°C3
Purgeable Aromatics	14 days[4]	40 ml vials	2x40 ml	Cool, 4°C, HCl to pH<2
Phenols by GC/MS	7 days/40 days[5]	G	1 L	Cool, 4°C
Pesticides/PCBs	7 days/40 days[5]	G	1 L	Cool, 4°C
Polynuclear Aromatics	7 days/40 days[5]	G	1 L	Cool, 4°C
Acid/Base-Neutral Extractables	7 days/40 days[5]	G	1 L	Cool, 4°C

Solid

Parameter	Holding Time	Container	Volume	Preservative
Metals (except Hg)	6 months	P, G	100 g	Cool, 4°C
Mercury	28 days	P, G	100 g	Cool, 4°C
Halogenated Volatile Organics	14 days	G	10 g/10 ml methanol, 10 g/10 Ml DI water	Methanol and deionized water preserved in field[6]
Halogenated Volatile Organics	14 days	Encore Samplers	Three 5 gram samples	Must be frozen within 48 hours
Purgeable Aromatics	14 days	G	10 g/10 ml methanol, 10 g/10 Ml DI water	Methanol and deionized water preserved in field[6]
Phenols	14 days/40 days[5]	G	100 g	Cool, 4°C
Pesticides/PCBs	14 days/40 days[5]	G	100 g	Cool, 4°C
Polynuclear Aromatics	14 days/40 days[5]	G	100 g	Cool, 4°C
Acid/Base-Neutral Extractables	14 days/40 days[5]	G	100 g	Cool, 4°C

NOTES:
P = Plastic
G = Glass

Holding times in red indicate 48 hours or less holding times.

1. If residual chlorine is present, add 0.6 gm. ascorbic acid.

2. Maximum holding time is 24 hours when sulfide is present. Test with lead acetate paper prior to pH adjustment. Remove sulfide with addition of lead nitrate until a negative spot test is obtained. Filter and add NaOH to pH>12.

3. If samples contain residual chlorine, add 0.008% sodium thiosulfate at the time of sampling.

4. With pH adjustment; without, holding time is 7 days.

5. Seven days prior to extraction. Samples must be analyzed within 40 days after extraction.

6. Encore samplers may be used, but must be received in lab and extracted within 48 hours.

5. References

DER-10, Technical Guidance for Site Investigation and Remediation. New York State Department of Environmental Conservation. May 3, 2010.

Analytical Service Protocol, New York State Department of Environmental Conservation. July 2005.

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory.

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

STANDARD OPERATING PROCEDURE

SC-002 Sample Handling

Objective

Sample handling involves the collection and shipping of environmental samples to a laboratory for chemical analysis. The overall objective of sample handling is to ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported to laboratories.

Execution

- Prior to mobilizing to the field, select a shipper or arrange for a courier for sample delivery to the laboratory. If using a shipper (i.e., FedEx, or UPS) determine the time constraints for pickup requests, the location and hours of the nearest shipping office, and any size/weight restrictions.
- Label all laboratory glassware with waterproof ink prior to collecting the respective samples. The label should have an adhesive and be placed on the jar or bottle, not on the cap.
- Record the following information on the label and in the field notebook (see *Field Notebook* SOP FD-001): project number, sample identification (i.e., MW201 or SS-2), date, and time (military time) of collection, sampler′s initials, and preservative, if present.
- If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples must be collected in order of volatility, most volatile first. Samples collected for volatile analysis must be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis must be collected without air bubbles. Soil samples for volatile analysis should be compacted to eliminate as much headspace as possible. Other laboratory glassware should also be filled when possible. Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing of samples is performed in the field, specify basis for composite (i.e., volume, weight, spoon recovery, etc.) and record procedure for compositing sample in the field book.
- Once samples have been collected, place samples in a cooler with ice or a blue pack and start the chain of custody (COC) form (SOP FD- 003, *Sample Handling and Chain of Custody*).

- For shipping, individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles in the cooler with sufficient packing material between samples to avoid breakage.
- Place a layer of packing material above and below the sample bottles. Place blue ice packs or ice bags on top of the packing material. Fill the remaining space in the cooler with packing material to eliminate the possibility of vertical movement of samples.
- Place the completed and signed COC form in a plastic bag and place on top of the packing material in the cooler.
- Fill out the appropriate shipping or courier forms and attach to the top of the cooler. If necessary, place the proper shipping labels on the cooler. Have the courier sign the COC form (or write pickup by FedEx, UPS, etc., with date and time). Place a custody seal on the cooler.
- All samples should be submitted as soon as possible. It is preferable for samples to be mailed prior to returning to the office.
- A copy of the waybills must be kept by the field supervisor to track shipments if necessary.

Notes

- At all times, follow safety procedures as defined in the site-specific Work Plan and Health and Safety Plan.
- Field personnel must be aware of analyses which have short holding times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short holding times must be planned in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information.
- In general, glassware for aqueous samples contains preservatives, (i.e., HNO3, HCl, etc). When collecting the sample, take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for volatile organic compounds (VOCs) in the field. Collect individual aliquots and direct the laboratory to perform compositing.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling or a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.

- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc., unless these materials are of interest.

References

DER-10, Technical Guidance for Site Investigation and Remediation. New York State Department of Environmental Conservation. May 3, 2010.

Analytical Service Protocol, New York State Department of Environmental Conservation. July 2005.

New Jersey Department of Environmental Protection, Field Sampling Procedures Manual, August 2005.

Connecticut Department of Environmental Protection, Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory.

Determination of Volatile Organic Compounds, Version 2.0 February 28, 2006.

Attachments

Attachment A – General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

Attachment A

Table 2. General Guidelines for selecting equipment on the basis of construction material and target analyte(s)

[⊔, generally appropriate for use shown; Si, silica; Cr, chromium; Ni, nickel; Fe, iron; Mn, manganese; Mo, molybdenum; CFC, chlorofluorocarbon; B, boron]

Construction material for sampling equipment		Target analyte(s)	
Material	**Description**	**Inorganic**	**Organic**
		Plastics[1]	
Fluorocarbon ploymers[2] (other varies available for differing applications)	Chemically inert for most analytes	⊔ (potential source of fluoride)	⊔ (Sorption of some organics)
Polypropylene	Relatively inert for inorganic analytes	⊔ (not appropriate for Hg)	**Do not use**
Polypropylene (linear)	Relatively inert for inorganic analytes	⊔ (not appropriate for Hg)	**Do not use**
Polyvinyl chloride (PVC)	Relatively inert for inorganic analytes	⊔ (not appropriate for Hg)	**Do not use**
Silicone	Very porous. Relatively inert for most inorganic analytes	⊔ (potential source of Si)	**Do not use**
		Metals	
Stainless steel 316 (SS 316)	SS-316-metal having the greatest corrosion resistance. Comes in various grades. Used for submersible pump casing.	⊔ (Potential source of Cr, Ni, Fe, and possible Mn and Mo) **Do not use** for surface water unless encasted in plastic.	⊔ Do not use if corroded[3]
Stainless steel 304	Similar to SS-316, but less corrosion resistant	**Do not use**	⊔ Do not use if corroded[3]
Other metals: brass, iron, copper, aluminum, galvanized and carbon steels	Refrigeration-grade copper or aluminum tubing are used routinely for collection of CFC samples	**Do not use**	⊔ Routinely used for CFCs Do not use if corroded[3]
		Glass	
Glass, borosilicate (laboratory grade)	Relatively inert. Potential sorption of analytes	⊔ **Do not use** for trace element analyses. Potential source of B and Si	⊔

[1]Plastic used in connection with inorganic trace-element sampling should be uncolored or white. Tubing used for trace metal sampling should be cleaned by soaking in 5-10 percent HCl solution for 8-24 hours, rinsing with reagent water (metals free) and allowed to air dry in mercury-free environment. After drying, the tubing is doubled-bagged in clear polyethylene bags, serialized with a unique number, and stored until used.

[2] Fluorocarbon polymers include materials such as Teflon™, Kynar™, and Tefzel™ that are relatively inert for sampling inorganic or organic analytes. Only fluoropolymer should be used for samples that will analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting in either contaminated or biased results.

[3] Corroded/weathered surfaces are active sorption sites for organic compounds.

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

Objective

The objective is to provide guidelines for the proper management of Investigation Derived Waste (IDW) resulting from site investigation activities. This Standard Operating Procedure (SOP) addresses IDW generated during field tasks typically performed for environmental site investigations. The intent of this SOP is to provide a set of guidelines for proper assessment and handling of these IDWs.

Execution

- Determine the suspected contamination type and impacted media anticipated based on previous investigations, current analytical data, and/or site history.
- Consider the following issues when selecting IDW management option(s):
    i. anticipated volume of IDW to be generated during on-site activities
    ii. potential contaminants and their concentrations
    iii. location of the nearest populations and the likelihood and/or degree of site access
    iv. potential exposures to workers
    v. potential for environmental impacts
    vi. community concerns
    vii. potential storage areas
    viii. regulatory constraints
    ix. potential on-site treatment options
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- In addition to the issues considered above for the selection of IDW management strategies/disposal options, more specific considerations/guidelines include:

Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.
- Backfill test pits with uncontaminated soil.
- For situations where returning contaminated soil to the test pit is deemed protective by the project manager, backfill soil in the same order as the soil was excavated from the test pit.

- For contaminated soil pile, collect representative sample(s) for test pit(s) for waste disposal characterization
- Ensure that the pile is appropriately covered with polysheeting and secured until disposed offsite.

Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if deemed appropriate by the project manager. IDW may be placed in an appropriate area or container pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55- gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-inner diameter [ID] augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground in the Area of Concern (AOC) or containerizing the fluid in drums or tanks.

Water Development/Sampling

- Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling should be containerized at the project manager's discretion.

Decontamination Fluids

- Decontamination fluids should be containerized in drums or tanks.

Disposable Personal Protective Equipment (PPE)

- Disposable PPE must be managed like any other IDW. It should only be removed from the site with the project manager's approval, and may be disposed of as ordinary rubbish only if it has not come into contact with hazardous materials.

Notes

- The preferred IDW management option is to return the IDW to its source. However, this is not always an option.
- The IDW selected must be in accordance with state/federal regulations.

- The Client contracts directly with the transportation and disposal contractor for the disposal of IDW, should disposal be necessary.

References

Guide to Management of Investigation - Derived Wastes (April 1992), United States Environmental Protection Agency, Publication 9345.3-03FS.

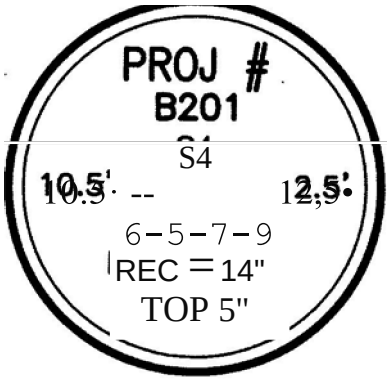
Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, Publication No. WSC-310-91.

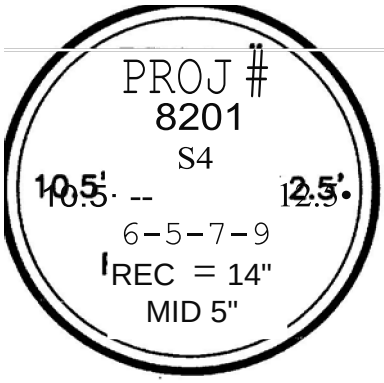
Connecticut Department of Environmental Protection Connecticut's RCRA "Contained-In" Policy, Updated June 2005

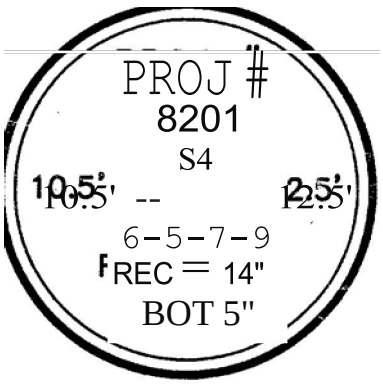
Attachment A

LABELING SPLIT SPOON SAMPLE JARS

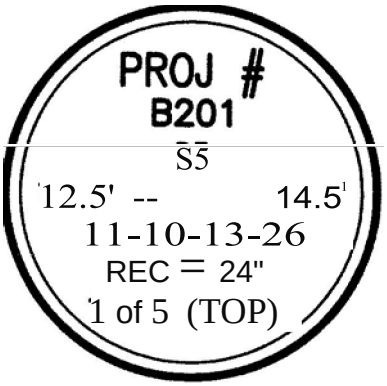
MULTIPLE **JARS:** OPTION ONE





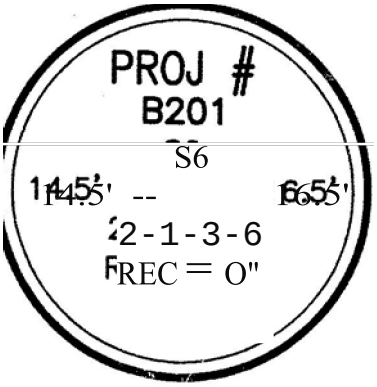


MULTIPLE **JARS:** **OPTION TWO**



...5 of 5 (BOT)

EMPTY JAR REQUIRED IF NO RECOVERY



STANDARD OPERATING PROCEDURE

SC-004 Head Space VOC Screening

Objective

To obtain a site-specific indication of the volatile organic compounds (VOC) concentrations present in soil. This information can be used: 1) to segregate soil based on degree of contamination, 2) to identify samples for quantitative analysis of VOCs, or 3) as a qualitative method to evaluate the presence or absence of VOCs in soil.

Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar head space (JHS) screening. Select the appropriate instrument, lamp, and calibration gas for the site-specific contaminants. Calibrate the instrument in accordance with the manufacturer's instructions before JHS screening begins. Record the type of calibration gas, detector, and lamp in the field notebook.
- Note the highest VOC concentration that the instrument measures in air in the work area before performing JHS screening. Record this as the initial background concentration.
- Half-fill a clean, glass jar with the soil. Use a clean trowel or soil spatula. Quickly cover the open top with one or two sheets of clean, aluminum foil and screw on the cap to tightly seal the jar. Label the sample location and depth from which the sample was collected on the jar.
- Allow headspace development for at least 10 minutes at an ambient temperature of 50°F or greater. Vigorously shake the jar for 15 seconds at the beginning and end of the headspace development period. When ambient temperatures are below 50°F, place the jar in a heated van or building during the headspace development period.
- After headspace development, remove the screw cap to expose the foil seal. Quickly puncture the foil seal with the instrument's sampling probe and insert it to a point at about one-half of the headspace depth.
- Record the highest VOC concentration that the instrument displays as the JHS concentration. The highest concentration should occur between 2 and 5 seconds after probe insertion.

Notes

- The instruments may work poorly in the rain and in freezing temperatures. PIDs may not function in high-humidity conditions. Under such conditions, operate the instrument in a heated vehicle or building.

- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform JHS screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- JHS screening is a guide that helps the screener to segregate soils into broadly defined categories. JHS screening results may differ by orders of magnitude from laboratory testing results.

References

Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. (April 1994), Massachusetts Department of Environmental Protection, Policy #WSC-94-400.

STANDARD OPERATING PROCEDURE

SC-005 SiteLAB™ UVF-3100 Ultraviolet Fluorescence (UVF) detection method

Objective

To establish standard procedures for the field analysis of petroleum hydrocarbons in soil and water using the SiteLAB™ UVF-3100 Ultraviolet Fluorescence (UVF) detection method.

Ultraviolet Fluorescence is a very selective detection method useful for testing many types of environmental contaminants. The principle of operation relies on the electronic configuration of the molecular structure for each contaminant. When a hydrocarbon molecule is exposed to certain wavelengths of light, the molecule emits energy at a specific wavelength. The light energy emitted by an environmental sample exposed to a UV source is directly proportional to the concentration of hydrocarbons present. The fluorescence response of each sample is then quantified using a 5 point linear calibration curve. A specific range of target compounds can be quantified by first selecting the appropriate wavelengths of light to be detected by the UVF- 3100 and then using certified standards sensitive to the wavelengths of interest, to establish the linear range of the calibration curve. The UVF-3100 can be calibrated to detect the following types of hydrocarbon ranges:

- Volatile Petroleum Hydrocarbons (C9-C10 molecular weights) including benzene, toluene ethylbenzene and xylene (BTEX).
- Gasoline Range Organics (C5-C10) including BTEX.
- Extractable Petroleum Hydrocarbons (C11-C22).
- Extractable Diesel Range Organics (C10-C40) (weathered Diesel).
- Polycyclic Aromatic Hydrocarbons (PAH Mix).
- #2 Fuel Oil.
- #6 Fuel Oil.
- Motor Oil Range Organics.
- Polychlorinated Biphenyls (PCBs).

After calibrating the instrument and performing the sample extraction step, the UVF-3100's actual analysis time is less than 5 seconds.

Execution

- On receipt of the instrument, inspect all shipping cartons to ensure that all components have been received and verify that the unit is operational.
- On site, assemble the unit according to the manufacturer’s instructions. Install the UVF-3100 software onto the field notebook computer.

- The UVF-3100 is equipped with an internal battery. However, the AC adapter may be needed for extended operation. Be prepared to switch to AC power if necessary.
- Operate the UVF-3100 for 20 minutes prior to use to ensure that the instrument is operating at full performance.
- Select the applicable standards based on the target hydrocarbon range (i.e., BTEX, PAHs, etc.).
- Calibrate the UVF-3100 in accordance with the instructions provided with the appropriate calibration kit. PROPER CALIBRATION OF THE INSTRUMENT IS CRITICAL.
- For optimal use of the UVF-3100, approximately 20 samples (maximum of 20 samples) should be screened during each run.
- Extract samples using the SiteLAB™ UVF Analytical Test Kit (Product Number EXTR010-20).
- Sample extracts can be stored for up to three months if kept refrigerated.
- Field personnel should be familiar with both the sample extraction and the calibration procedure before attempting to record data.
- Operate instrument as per manufacturer's instructions.
    1. Select the appropriate optical filter for the specific test to be run.
    2. Select the proper wavelength for the specific test to be run.
    3. Perform the 5-point calibration using the appropriate standards.
    4. Perform the sample extraction procedure.
    5. Make any necessary dilutions.
    6. Analyze the samples and record the results on the record sheet included with the extraction kit. Include test run number, Sample ID, Fluorescence, Sample Concentration, and Dilution Factor on the sheet.
    7. Calculate result by multiplying the sample result by the dilution factor.
    8. Repeat for each sample. Make addition dilutions if necessary.
- **Sample dilution** – Samples exhibiting a yellowish color should be diluted until a minimal yellow tint is observed. Analyze both the diluted sample and the undiluted sample for comparison. Follow dilution procedure outlined in the manual. Addition methanol may be necessary for further dilution.
- **Field duplicate** – a duplicate sample should be collected from a sample location suspected of being contaminated with the target hydrocarbon and extracted in a manner identical to the original sample.

Field duplicates should be taken at a frequency of one per twenty samples or one per weekly sampling whichever is the greater.

3. References

Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. (April 1994), Massachusetts Department of Environmental Protection, Policy #WSC-94-400.

Innovative Technology Verification Report, Field Measurement Technologies for Total Petroleum Hydrocarbons in Soil United States Office of Research and EPA/600/R-01/080.

Environmental Protection Development September 2001, Agency Washington, DC 20460
siteLAB® Corporation, siteLAB® Analytical Test Kit UVF-3100A.

Section 6

SOLID MATRIX SAMPLING (SM)

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

Objective

This Standard Operating Procedure (SOP) is used primarily to collect surface, shallow subsurface, and stockpile soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface (bgs). The shallow subsurface interval may be considered to extend from approximately 12 inches bgs to a site-specific depth at which sample collection using manual methods becomes impractical.

Execution

1.1. At-Depth Sampling

When sampling at depth, utilize the procedures outlined in the following SOPs for the drilling method used:

Hollow Stem Auger (split spoon): SOP DM-002
Sonic Drilling: SOP DM-003
Geoprobe or Direct Push (macrocore): SOP DM-005

Surface Soil Sampling

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample. This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.

- Either place the sample into appropriate labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.
- Label, preserve, and store the sample in accordance with SOP SC-002 *Sample Handling*.

Stockpile Sampling

- Collection of samples from stockpiles can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material from the stockpile is removed and a stainless steel or plastic scoop is then used to collect the sample.
- Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling stockpile.
- When collecting composite samples, place a sample from another sampling location into the homogenization container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.
- Label, preserve, and store the sample in accordance with SOP SC-002 *Sample Handling*.

References

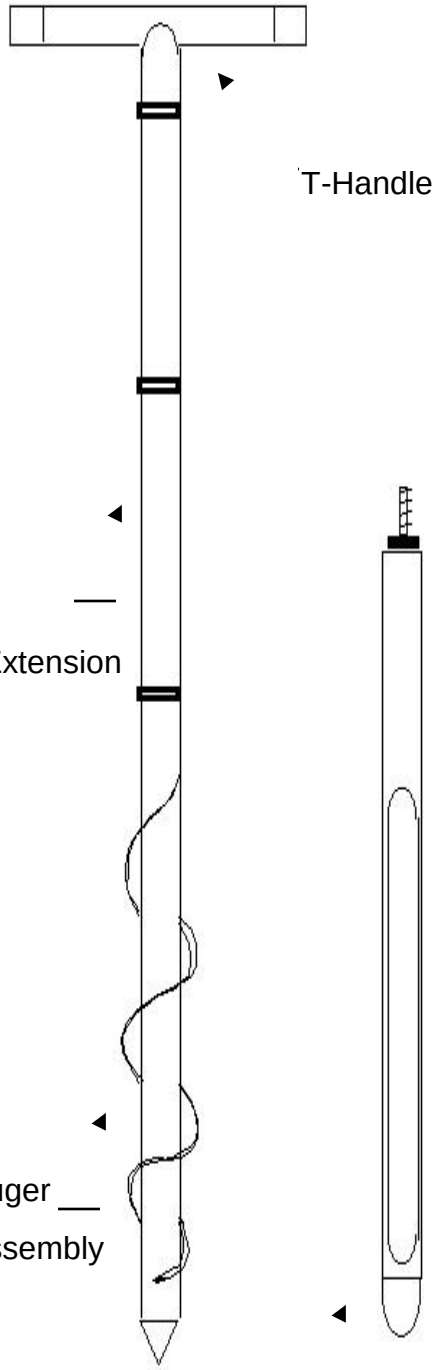
ASTM D1585-98, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils . 1998.

United States Environmental Protection Agency, SOP 2012 "Soil Sampling", Revision 0.0, February 18, 2000.

Attachment A

SM-001

Attachment A – Sampler Design Assembly

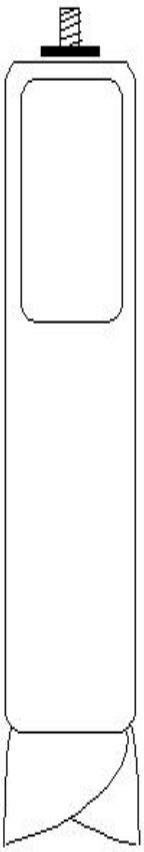


T-Handle

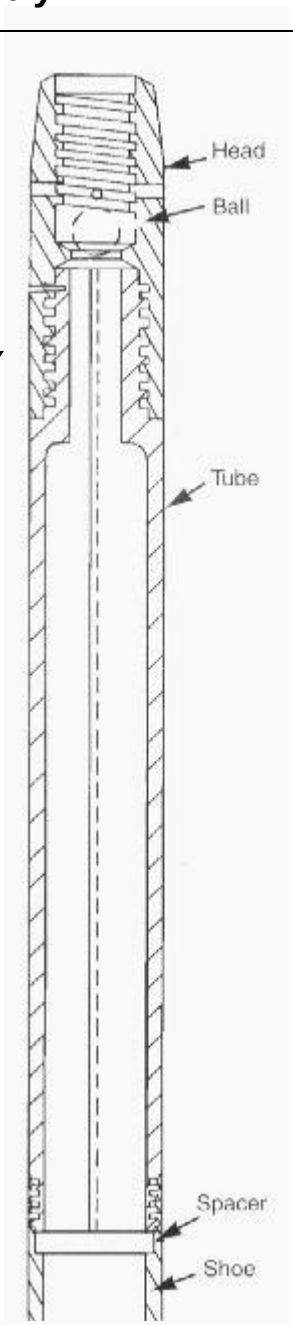
Extension

Auger Assembly

Thin-walled Sampler



Auger Bucket



Split-Spoon Assembly

GEI Consultants

STANDARD OPERATING PROCEDURE

SM-002 VOC Soil Collection and Preservation Method (if necessary)

Objective

To establish a standard for preserving soil samples for analysis of Volatile Organic Compounds (VOCs).

Execution

The soil sample collection procedure for determination of VOCs is a two-step process.

- Step 1 – Collect an undisturbed soil sample from the subsurface, or expose the targeted area from where a sub-sample for lab analysis will be collected.
- Step 2 – Collect a representative sub-sample from the undisturbed sample or directly from the exposed surface.

If samples are to be analyzed for VOCs, they should be collected in a manner that minimizes disturbance of the sample. Samples for VOC analysis are not homogenized. Preservatives may be required for some samples with certain variations of Method 5035. Consult the method or the principal analytical chemist to determine if preservatives are necessary.

When the soil sample is collected for VOC analysis, it must be placed within the laboratory container immediately. It must not be allowed to sit exposed for more than 5 minutes. In addition, the sample must not be exposed to extreme weather conditions (i.e., rain, extreme sunlight, wind, etc.).

Sub-samples are a portion of the undisturbed sample that will be sent to the lab for VOC analysis. Sub-samples must be obtained utilizing a small diameter core sampler. Some of the acceptable small diameter core samplers include: a 10 milliliter (ml) plastic disposable syringe, a Purge and Trap Soil Sampler, En Core Samplers, or an Easy Draw Syringe. The En Core Sampler is the only small diameter core sampler that can be used to collect the sample, store the sample, and transport the sample to the lab.

The procedure for the collection of sub-samples is as follows:

- Once the sampling interval has been selected, trim off the exposed surface of the matrix, with a decontaminated trowel or spatula, to expose a fresh surface. Then sample immediately.
- Push the En Core sampler into the matrix to collect a volume of material that will yield the required mass of sample (wet weight) as determined by the analytical method.

- Push the En Core sampler into the material at an angle as many times as is needed to obtain the required sample weight.
- Wipe the exterior of the sampler clean.
- Seal the En Core sampler as explained in the manufacturer's instructions.
- Collect the required number of En Core samplers based on the chosen preservation and analytical methods, as discussed in the section on soil preservation methods below.
- Collect a separate sample for head space screening and moisture content determination.
- Make sure that the threads of the En Core sampler are free of particles (by cleaning with a paper towel).
- Mark the samplers with a permanent marker and not an adhesive label (due to weight considerations).
- Once the samples have been collected, sealed, and labeled, place the samples into an iced cooler. It is recommended to place each sample container in separate zip lock bag.

If collecting VOC soil samples during drilling, please refer to SM-001: *Soil Sampling Techniques Including Split-Spoon* for detailed information.

Preservation of Soil Samples

When collecting soil samples for determination of VOCs, three types of samples may be required:

- High concentration sample (Section 2.2 below).
- Low concentration sample (Section 2.3 below).
- Synthetic Precipitation Leaching Procedure/Toxicity Characteristic Leaching Procedure (SPLP/TCLP) sample (Section 2.4 below).

Two options for the collection of a suspected "high" concentration sample

- Collect one 10 gram sample in a pre-weighted vial containing 10 ml methanol.
- Use an "En Core" sampler.

Option 1 – Methanol Preservation Method

Supplies include: two pre-weighed vials (per sample) with 10 ml methanol, and a sampling device to collect a 10 gram sample.

Sampling Procedure:

- Label vials using permanent marker.
- Scrape away surface to be sampled to expose fresh soil.

- Collect the sample using the sampling device and extrude the sample into the preserved vial. Wipe the threads and cap clean and seal the vial.
- Store the sample in an iced cooler.
- Collect a separate sample for percent solids and head space sampling.

Option 2 – En Core Sampling Method

Supplies needed: One 5 or 10 ml En Core sampler.

Sampling Procedure:

- Label the En Core sampling container.
- Locate the sampling area, scrape a fresh face, collect the sample quickly, and clean and seal the sampler.
- Place sampler in a clean zip lock bag and place on ice.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen, or preserved, or analyzed within 48 hours (coordinated with the lab).

Option 2 (En Core Sampler) is preferred due to possible problems with minimum detection levels when using the methanol method.

Four different options for the collection of "low" concentration samples for VOC analysis

- Collect two vials each of 5 grams of sample into a pre-weighted 40 ml vial with 5 ml of water and a magnetic stirrer.
- Collect two vials each of 5 grams of sample into a pre-weighted 40 ml vial with a magnetic stirrer.
- Collect two 5 gram En-Core type samples.
- Collect two vials each of 5 grams of sample into a pre-weighted vial containing sodium bisulfate with a magnetic stirrer.

Option 1 – Collection in Volatile Organic Compound (VOC) vials containing water

Supplies required: an electronic field balance, two VOC 40 ml vials pre-weighted and containing 5 ml of water, a magnetic stirrer, and a sampling device.

Sampling procedure:

- Label vials using permanent marker.
- Select the area to be sampled.
- Test sample and weigh to verify the amount of sample needed.
- Scrape a clean surface to be sampled.

- Collect the sample using the sampling device and extrude the sample into one of the two vials containing water. Wipe the threads and cap clean and seal the vial.
- Repeat the last step for the second vial.
- Weigh the vials and record the weights.
- Store the sample in an iced cooler.
- Collect a separate sample for percent solids and head space sampling.

Option 2 – Collection in empty VOC vials

Supplies required: electronic field balance, two VOC 40 ml vials pre-weighted, a magnetic stirrer, and a sampling device.

Sampling Procedure:

- Label vials using permanent marker.
- Select the area to be sampled.
- Test sample and weigh to verify the amount of sample needed.
- Scrape a clean surface to be sampled.
- Collect the sample using the sampling device and extrude the sample into the vial. Wipe the threads and cap clean and seal the vial.
- Repeat the last step for the second vial.
- Weigh the vials and record the weights.
- Store the sample in an iced cooler.
- Collect a separate sample for percent solids and head space sampling.
- Samples must be frozen or analyzed within 48 hours.

Option 3 – Collection in VOC vials preserved with Sodium Bisulfate

Supplies required: electronic field balance, two VOC vials with 5 ml of sodium bisulfate, a magnetic stir bar, and a sampling device.

Sampling Procedure:

- Label vials using permanent marker.
- Select the area to be sampled.
- Test sample and weigh to verify the amount of sample needed.
- Scrape a clean surface to be sampled.
- Collect the sample using the sampling device and extrude a 5 gram sample into the vial containing the sodium bisulfate. Wipe treads and cap and seal the vial.
- Repeat the last two steps for the second vial.
- Weigh the vial and record the weight.
- Store the sample in an iced cooler.
- Collect a separate sample for percent solids and head space sampling.

Option 4 – Collection of the sample with an En Core Sampler

Supplies required: two 5 gram En Core samplers.

Sampling Procedure:

- Label samplers using permanent marker.
- Select the area to be sampled.
- Scrape a clean surface to be sampled.
- Collect the sample using one En Core devise, wipe the contact areas clean and seal, and place into a re-sealable zip lock bag.
- Repeat the last two steps with the second En Core device.
- Store the sample in an iced cooler.
- Collect a separate sample for percent solids and head space sampling.
- Samples must be frozen or analyzed within 48 hours.

Collection of samples being analyzed for VOCs by the TCLP or SPLP method

Supplies required: a 25 gram En Core Sampler.

Sampling Procedure

- Label sampler using permanent marker.
- Select the area to be sampled.
- Scrape a fresh surface to be sampled.
- Collect the sample using one En Core devise, wipe the contact areas clean and seal, and place into a re-sealable zip lock bag.
- Store the sample in an iced cooler.
- Samples must be frozen or analyzed within 48 hours.

To determine percent solids, approximately 20 grams of soil sample must be collected in a separate glass or plastic sampling container. The percent solids sample is **NOT** to be taken from the VOC samples.

Holding Times

- Field investigators should note that the holding time for an un- preserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

STANDARD OPERATING PROCEDURE

SM-003 Soil Classification

Objective

To describe and classify soil samples collected in the field in a consistent and useful manner. GEI has adopted the (ASTM) Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) D2488..

Execution

- Describe soil samples according to the ASTM Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) D2488 (see Attachment A – Visual Manual Descriptions).
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), group symbol, group name, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately, and obtain separate jars of each type.
- Record sampler type, blow counts, soil description, etc., on the boring log.
- One modification to the ASTM standard: Use widely graded and narrowly graded instead of well-graded and poorly graded.
- Based on the percent volume, the following descriptions should be used:
    1. “and” = 35-50%
    2. “some” = 20-35%
    3. “little” = 10-20%
    4. “trace” = 1-10%

Notes

- Some soil characteristics, such as plasticity and dilatancy, are difficult to identify in the field during extremely cold or wet weather. The field classification should be verified in the office after the samples have returned to room temperature if samples were collected during extreme weather conditions.

- The ASTM Standard Test Method for Classification Soils for Engineering Purposes, D2487 may be used in conjunction with the Visual-Manual Method to confirm the soil classification.

References

Annual Book of ASTM Standards (1993), Section 4, v. 4.08 Soil and Rock; Building Stones; Geosynthetics, D2488-90, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), American Society of Testing Materials (ASTM).

Attachments

Attachment A – Visual Manual Descriptions with example boring log

Attachment A

COARSE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

GEI Consultan1s

	GROUP SYMBOL	GROUP NAME
		<15% Sand – – – – WIDELY GRADED GRAVEL
5% Fines	GW	WIDELY GRADED – – – – – – – – – – – – – – – – 15% Sand – – – – WIDELY GRADED GRAVEL WITH SAND
5% Fines	GP	NARROWLY GRADED – – – – – – – – – – – – <15% Sand – – – – NARROWLY GRADED GRAVEL; 15% Sand – – – – NARROWLY GRADED GRAVEL WITH SAND
GRAVEL, % Gravel > % Sand, ~10% Fines	GW-GM	WIDELY GRADED, Fines = ML or MH – – <15% Sand – – – – WIDELY GRADED GRAVEL WITH SILT; 15% Sand – – – – WIDELY GRADED GRAVEL WITH SILT AND SAND
GRAVEL, % Gravel > % Sand, ~10% Fines	GW-GC	Fines = CL or CH – – <15% Sand – – – – WIDELY GRADED GRAVEL WITH CLAY; 15% Sand – – – – WIDELY GRADED GRAVEL WITH CLAY AND SAND
GRAVEL, % Gravel > % Sand, ~10% Fines	GP-GM	NARROWLY GRADED, Fines = ML or MH – – <15% Sand – – – – NARROWLY GRADED GRAVEL WITH SILT; 15% Sand – – – – NARROWLY GRADED GRAVEL WITH SILT AND SAND
GRAVEL, % Gravel > % Sand, ~10% Fines	GP-GC	Fines = CL or CH – – <15% Sand – – – – NARROWLY GRADED GRAVEL WITH CLAY; 15% Sand – – – – NARROWLY GRADED GRAVEL WITH CLAY AND SAND
GRAVEL, % Gravel > % Sand, >15% Fines	GM	Fines = ML or MH – – <15% Sand – – – – SILTY GRAVEL; 15% Sand – – – – SILTY GRAVEL WITH SAND
GRAVEL, % Gravel > % Sand, >15% Fines	GC	Fines = CL or CH – <15% Sand – – – CLAYEY GRAVEL; 15% Sand – – – – CLAYEY GRAVEL WITH SAND
SOILS WITH <50% FINES, <5% Fines	SW	WIDELY GRADED – – – – – – – – – – – – – – – – <15% Gravel – – – WIDELY GRADED SAND; 15% Gravel – – – WIDELY GRADED SAND WITH GRAVEL
SOILS WITH <50% FINES, <5% Fines	SP	NARROWLY GRADED – – – – – – – – – – – – – – – – <15% Gravel – – – NARROWLY GRADED SAND; 15% Gravel – – – – NARROWLY GRADED SAND WITH GRAVEL
SAND, % Sand ≥ % Gravel, ~10% Fines	SW-SM	WIDELY GRADED, Fines = ML or MH – – <15% Gravel – – – – WIDELY GRADED SAND WITH SILT; 15% Gravel – – – WIDELY GRADED SAND WITH SILT AND GRAVEL
SAND, % Sand ≥ % Gravel, ~10% Fines	SW-SC	Fines = CL or CH – – <15% Gravel – – – WIDELY GRADED SAND WITH CLAY; 15% Gravel – – – – WIDELY GRADED SAND WITH CLAY AND GRAVEL
SAND, % Sand ≥ % Gravel, ~10% Fines	SP-SM	NARROWLY GRADED, Fines = ML or MH – – <15% Gravel – – – – NARROWLY GRADED SAND WITH SILT; 15% Gravel – – – NARROWLY GRADED SAND WITH SILT AND GRAVEL
SAND, % Sand ≥ % Gravel, ~10% Fines	SP-SC	Fines = CL or CH – – <15% Gravel – – – – NARROWLY GRADED SAND WITH CLAY; 15% Gravel – – – NARROWLY GRADED SAND WITH CLAY AND GRAVEL
SAND, % Sand ≥ % Gravel, 15% Fines	SM	Fines = ML or MH – – <15% Gravel – – – – SILTY SAND WITH GRAVEL
SAND, % Sand ≥ % Gravel, 15% Fines	SC	Fines = CL or CH – <15% Gravel – – – – CLAYEY SAND; 15% Gravel – – – CLAYEY SAND WITH GRAVEL

YELLOW

OLIVE

LIGHT BROWN

BROWN

REDDISH BROWN

RED

GRAY

BLACK

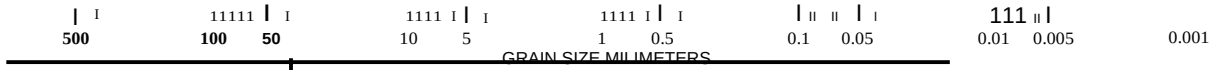
U.S. STANDARD SIEVE OPENING IN INCHES: 12, 3, ¾, 4

U.S. STANDARD SIEVE NUMBERS: 10, 40, 200

HYDROMETER

COBBLES | GRAVEL: COARSE, FINE | SAND: COARSE, MEDIUM, FINE | SILT OR CLAY

1. GROUP NAME and (SYMBOL)
2. Structure, if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max



gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.

4. Color

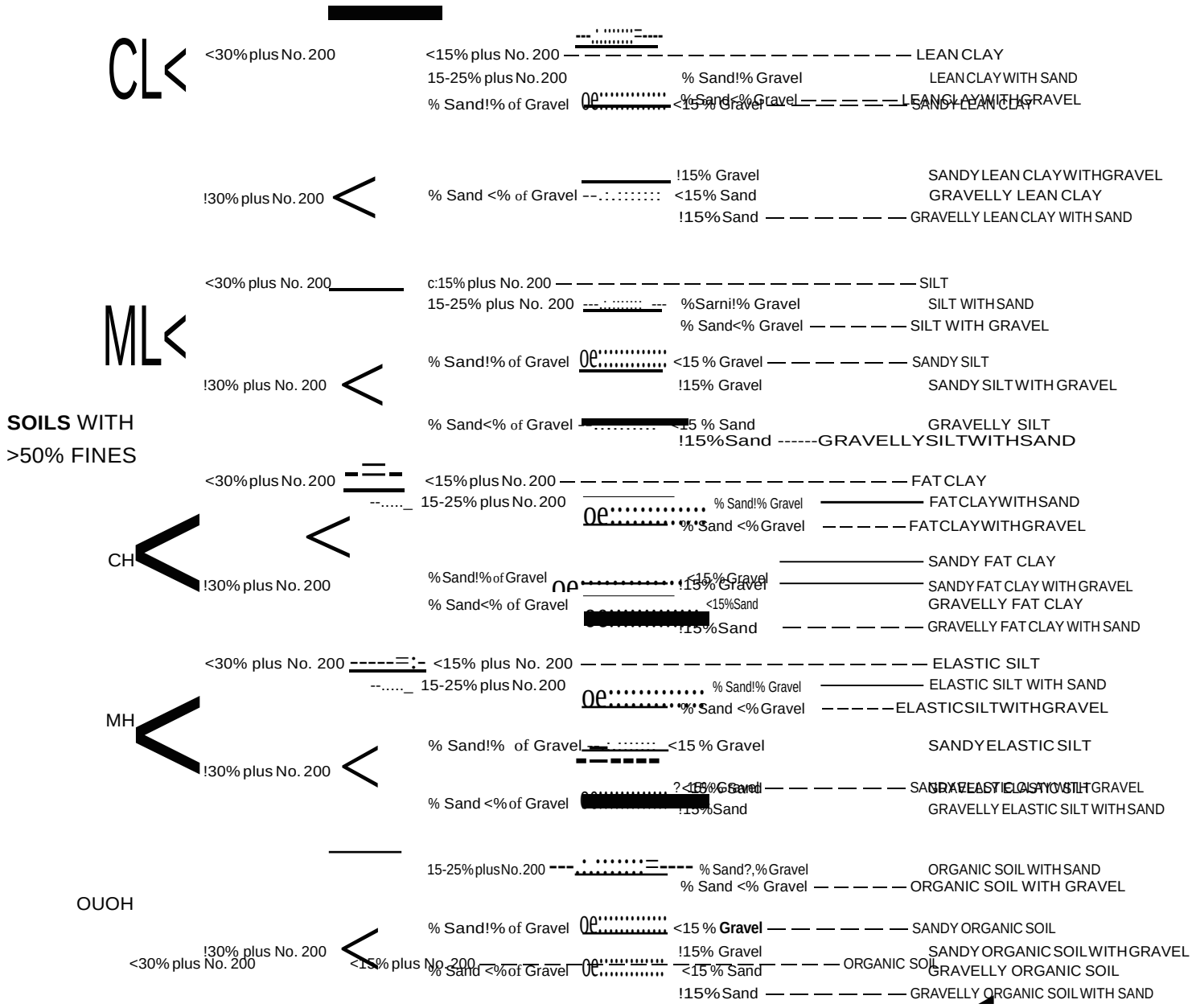
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.

6. "Fill," local name or geologic name, if known

FINE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

GEI Consultants



ID OF **INORGANIC** FINE SOILS **FROM MANUAL** TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic **ML**	**A** 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH,CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

1. GROUP **NAME** and **(SYMBOL)**
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include

4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.

5. "Fill," local name or geologic name, if known

percentages of sand, gravel or fines.

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

BORING LOCATION Maple Ave Sidewalk
GROUND ELEVATION (NGVD) _____
GROUNDWATER EL_____ DATE_____

DATE START/FINISH 2/14/07 - 2/15/07
DRIII.ED BY Geologic: M. Costigan
LOGGED BY T. Kahl/M. *Yako* TOTAL DEPTH (FT) ...I2-

e,101

PG. I OF I

EL FT.	DEPTH FT.	SAMPLE TYPE and NO.	SAMPLE BLOWS PER 6 IN.	SAMPLE PEN IN.	SAMPLE REC IN.	PIO JAR HS / REMARKS	SOIL AND ROCK DESCRIPTIONS
	-2.5	SI	13-9 17-14	24	0	0.5 ppm	r-... 4" pavement SI: Redrove O.5 to 3 .5 ft. Recovery 11": WIDELY GRADED SAND *(SW)* ,,_.e,5'X, sand, "'I 0% gravel to I", <5'1 nonplastiG fines, brown. Contains brick. fragment!> and ash. RII.
	- 5					hard drilling 3 to 4 ft, pos!iible boulder	
		52	7-7 11-13	24	e,	2.0 ppm	52: NAl<l<OWLY Gl<ADED SAND WITH SILT AND Gl<AVEL (SP-SM) "'65% mostly fine sand, -25% gravel to 3/ 4 inch "'I 0% non-plastic. fines, brown. RII.
	-7.5	53	9-10 2-1	24	16	0.0 ppm	[\ 53 (0-10"): Similar to 52. /
	- 10						53 (I0"-16"Y': ORGANIC SILi (OL) "'IOO'X. 56ghtly plastic fine!>, dark gray, organic odor, contain& white shell fraqment&.
	-12.5	54	WOH 1-2 I	24	15	0.0 ppm	54: Similar to 53, bot 6[11].
	- 15					hard drilling at 15.5 ft	
	-17.5	55	20-35 /3"	15	e,	Top of rock "'19 ft. Roller bit to 20 ft.	55: SILiY SAND WITH GRAVEL (SM) "'60% mostly fine 5and, "'25 56ghtly plastic fines, "'15 gravel to 1/2 inc.h, **o&ve.** Glacial 1ill.
	-20						
	-22.5	Cl	RQD 70%	60	54	lo&t -10 gallons drill fluid from 23 to 25 ft	Cl: SCHIST, hard, &light weathering at joint surface&, joint!> at "'.30 **degree!>** from horizontal and generally parallel to foliation, gray. Marlborooqh Formation.
	- 25						
	-27.5						Bottom of Boring 25 ft Truck-moonted drill *riq.* 4-inch Ga5inq to 19 ft. Safety-hammer with rope and cathead for SPi. Backfilled with drill GUttinqs.
	- 30						

BLOWS PER 6 IN.-140 LB. HAMMER FALLING 30 IN. TO DRIVE A 2.0 IN. OD SPLIT SPOON SAMPLER
PEN-PENETRATION LENGTH OF SAMPLER OR CORE BARREL
REC-RECOVERY LENGTH OF SAMPLE
ROD-LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, "
S-SPL SPOON SAMPLE
U-UNDISTURBED SAMPLES, UF-FIXED PISTON UC-OSTERBERG
¥ GROUNDWATER

NOTES:
I: Groondwater at IO ft depth at &tart of day 2/15/07.

PROJECT 07999-0
OATE

GEi

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) "'60% !>liqhtly pla5tic fines, ,..,,40% mo5tly fine !:>and, I" thic layer of fine to medium !:>and with <20% fines, *qray*.

LEAN CLAY (CL) ,..,,*qo'l*, moderately plastic fines, ,..,,I**0%** fine !:>and, offve. Boston Blue Clay. Sv • 0.5, 0.5, 0.B tsf, Op • I.0, 1.5, 1.6 tsf

Stratified CLAYEY SAND (5C) and WIDE:L*Y* GRADED SAND (5W) 5C layers I to 2 inche& thic consi&t of fine 5and with ,..,,30'1, moderately pla&tic. fine5, *qray*. 5W layers I to 4 inches thick c.onsist of fine to c.oarse 5and, ,..,,10% gravel to 1/2 inch, <5% tine!>, brown. Hydrauric. Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one **piec.e,** joint surfac.e slightly weathered, pink..
(6-60"): PHYLLITE, jointe, ,..,, 45" generally parallel to foliation, *Cf'* to 44" moderate to **severe** jointinq and joint weatherinq. 44" to 60" single piec.e, green--qray.

ARGILLITE, medium hard, moderately weathered joints, gray. Cambridge Arqillite.

GEOPROBE AND ROTOSONIC

When SPTs are not perfonned, note sample density (sands) or stiffness {clays) in description.

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

SPT: Standard Penetration Test

30-inch drop with 140-lb hammer
1 3/4 to 2 1/4 turns around cathead
2-inch 0.D. split spoon sampler

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

- **Ash** - Typically silt-size to medium sand-size.
- Do not use the term "cinders.• This is not a technical term. Instead, use·ash,·"burnt **wood,"** "burnt material," or a similar term.
- **Coal-like material** - If it looks like coal but you aren't sure.
- **Clinker-** Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag** - Similar to clinker, but normally refers to residue from metal ore processing.
- **Sheen** - Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained** - Use with a color (•brown-stained•) to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated** - Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor:)
- **Saturated** - The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending onviscosity, the NAPL may drain from a soil sample. (wSample saturated with green, sticky substance.")
- **Blebs** - Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. c·occasional blebs of reddish-brown tar.")
- **Oil** - Exhibits a petroleum odor, different from MGP odors.
- **Tar-** Exhibits an MGP odor (e.g. naphthalene-like odor).
- **Odors** - Use terms such as "naphthalene-like odor" or "petroleum-like odor: Use modifiers (strong, moderate, slight) to indicate odor intensity.

Section 7

GROUNDWATER (GW)

STANDARD OPERATING PROCEDURE

GW-001 Water Level Measurement

1. Objective

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the determination of the depth to water in an open borehole, cased borehole, monitoring well, or piezometer.

2. Execution

- Prior to mobilizing onto a site, notification requirements must be followed.
- Prior to collecting water level measurements, all wells should be opened to the atmosphere and allowed to equilibrate prior to collecting groundwater elevation measurements, if practical.
- All groundwater level measurements need to be performed in the shortest possible timeframe (no more than four hours, if practical).
- Groundwater levels are measured using a decontaminated electronic groundwater level indicator, which has a cable divided into incremental measurements of 0.01 feet and two conductors forming a probe. When groundwater is encountered, the circuit is completed and a light, meter, or audible buzzer is activated. The depth to groundwater is then measured from this point to the reference mark on the inner casing of the monitor well.
- All groundwater-level measurements should be made from the same marked reference point at the top of the inner well casing. A licensed surveyor must mark the reference point.
- If no discernable survey mark is observed on the inner casing, the groundwater-level measurement should be read from the highest point of the inner casing.
- If no survey mark is observed on the inner casing, it should be noted with the ground water-level data and the highest point of the casing must be marked for future reference.
- Measurements should be made three to four times to confirm the measurement. Each time a measurement is made, it should be determined to the nearest one-hundredth of a foot (0.01).
- Certain situations may necessitate that all water level measurements at a given site should be collected within a shorter than 24-hour period. These situations may include:
    1. The magnitude of the observed changes between wells appears too large.
    2. Changes in atmospheric pressure.
    3. Aquifers which are tidally influenced.

4. Aquifers affected by river stage, impoundments, and/or unlined ditches.
5. Aquifers stressed by intermittent pumping of production wells.
6. Aquifers being actively recharged due to precipitation events.
7. Occurrence of pumping.

- All well measurements should, if practical, be performed the same day, prior to the evacuation of any wells which may influence groundwater elevations in the area of the investigation.
- The following items should be recorded on field data sheets while collecting groundwater level measurements:
    1. Project name.
    2. Well identification.
    3. Date and time of measurements.
    4. If applicable, the time and cycle of the tide.
    5. Thickness of non-aqueous phase liquids (NAPL) product, if any. (See SOP GW-002, *NAPL Measurement*.)
    6. Note any miscellaneous information, such as recent damage, well box in need of repair, car parked over well, etc.

3. Notes

- Do not measure the total-well-depth with an electronic groundwater level indicator.
- Groundwater levels should be obtained from all wells in a network prior to sampling the first well.
- Local water body elevations may need to be measured. Check site-specific work plan for this requirement.
- Weak batteries in electronic groundwater-level indicators frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water. As such, it is recommended that electronic groundwater-level indicators be tested before they are brought out into the field.
- Note that electronic groundwater-level indicators will not respond to distilled water, so distilled water should not be used to test these units.
- Wells that are not plumb may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with groundwater in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface.

The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new groundwater-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe may need to be reeled up to the surface and dried off before re- attempting another measurement.

- Accumulation of sediment, organic material, or floating debris on the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible groundwater-level measurements because the inner sides of the well casing are conductive.
- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that the probe is not allowed to come in contact with the inner casing. Groundwater-level- measuring equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Once a well has been located and properly identified, the field measurements listed below should be noted in a field logbook. Be certain that the proper well is being measured. The misidentification of a sampling point in the field will result in erroneous data that may result in incorrectly constructed contour maps.

4. References

U. S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 10/03/94.

U. S. EPA Environmental Response Team Standard Operating Procedures SOP: 2044," Monitor Well Development" REV: 0.1, 10/23/01.

5. Attachments

Attachment A – Monitoring Well Sampling Record

Attachment A

Monitoring Well Sample Data Form

Project: _____ **Well ID:** _____ **Date:** _____

Total Well Depth (from top of casing): _____

Depth to Water (from top of casing): _____

Well Diameter: _____

Pump Intake Depth: _____

Sampling Crew: _____

Purge Time: *Start:* _____ *Finish:* _____

Purging Method: _____

Sample Time: *Start:* _____ *Finish:* _____

Sampling Method: Low Flow

Sample Analysis: _____

Purge Data										
Sample Time	**Flow Rate** *(lpm/gpm)*	**Volume Purged** *(liters/gals.)*	**pH** *(std. Units)*	**Conductivity** *(mS/cm)*	**Turbidity** *(NTU)*	**Dissolved Oxygen** *(mg/l)*	**Temperature** *(Cel.)*	**Salinity** *(%)*	**ORP** *(mV)*	**Comments/Observations**
										Well Headspace PID =

Final Stabilization Data										
Sample Time	**Flow Rate** *(lpm/gpm)*	**Volume Purged** *(liters/gals.)*	**pH** *(std. Units)*	**Conductivity** *(mS/cm)*	**Turbidity** *(NTU)*	**Dissolved Oxygen** *(mg/l)*	**Temperature** *(Cel.)*	**Salinity** *(%)*	**ORP** *(mV)*	**Comments/Observations**

STANDARD OPERATING PROCEDURE

GW-002 Non-Aqueous Phase Liquid (NAPL) Measurement

1. Objective

To obtain accurate and repeatable measurement of the thickness of Non-Aqueous Phase Liquids (NAPL) contained in monitoring wells. These methods can be applied to light non-aqueous phase liquids (LNAPL) and dense non-aqueous phase liquids (DNAPL).

2. Execution

Three procedures for measuring NAPL are provided below using a clear bailer, Interface Probe, and graduated tape.

2.1. Clear Bailer (LNAPL Measurement)

- Determine depth to the surface level of the LNAPL layer utilizing an interface probe.
- Record depth.
- Lower a clear bailer into the well and slowly into the product, being careful not to submerge the bailer.
- Raise the bailer and measure product thickness.
- Once the product thickness is known, the depth to ground water may be determined (see calculation below).
- This method has inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.

2.2. Interface Probes (LNAPL Measurement)

- Decontaminate Interface Probe prior to use.
- Check battery and replace if necessary.
- Check the unit is functioning correctly. Note: De-ionized water will not provide a correct reading.
- Measure the hydrocarbon/air interface first by going from air to the LNAPL surface to prevent dripping hydrocarbons from enhancing the thickness reading.
- Record the reading.
- Measure the hydrocarbon/water reading by lowering the Interface Probe past the LNAPL layer quickly minimizing the contact time of the probe within the hydrocarbon phase.
- DNAPL can also be measured by quickly lowering the Interface Probe past the LNAPL layer and to the bottom of the well noting any audio or visual indications of DNAPL.

- The optical sensor on interface probes may become damaged if solvents are used to clean product from the probes.
- The optical sensor may become smeared when used to measure product, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.

2.3. Graduated Tape (DNAPL Measurement)

- Outfit a measuring tape with a narrow cylindrical weight that is heavy enough to sink through a viscous DNAPL.
- Open the well box or unlock the protective casing
- Lower the tape slowly through the water column in the well. When the tape reaches the bottom, stop releasing tape and measure the total well depth. Any extra tape released after the bottom of well was encountered will give a false reading of the DNAPL thickness. Repeat this procedure, if necessary.
- While extracting the tape, use absorbent rags and/ or GOJO Wipes to clean the tape. When the DNAPL line of demarcation is encountered on the measuring tape, record the thickness of DNAPL in the well.
- Clean the DNAPL from the tape over the well so excess DNAPL flows back into the well. This can lessen or eliminate the need to clean DNAPL from in or around the well box.
- Clean up any DNAPL in or around the well box.
- Repeat these steps as necessary to clean the tape and clean up the area around the well box.
- Decontaminate tape in accordance with SOP QA-001.
- Dispose of waste in accordance with SOP SC-003.
- Secure the well box or close and lock the protective casing.

3. Notes

- When measuring DNAPL, care must be taken when encountering the well bottom so a false measurement is not recorded.
- When a LNAPL thickness is measured in a monitoring well, it will usually exhibit an apparent thickness rather than an actual thickness. This apparent thickness is caused when LNAPL from within and above the capillary fringe migrates into the monitoring well causing the ground water-level to become depressed below the surrounding capillary fringe area. As a result, LNAPL will continue to flow into the well until equilibrium is reached causing

an apparent LNAPL thickness, which is greater than the actual thickness**.**

- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPLs can pose a problem when measuring the level of ground water. Floating LNAPLs can depress the ground water-level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown below should be applied to ground water- level measurements in monitoring points where LNAPLs are present:

CDTW = Static DTW – (PT x G)

CDTW = Corrected Depth to Ground water
DTW = Depth to Ground Water (Static)
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4. References

U. S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043,"Water Level Measurement" REV: 0.0, 10/03/94.

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

1. Objective

Provide a method to collect groundwater samples that accurately and precisely represent the aquifer conditions. Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Background for Implementation

- Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 nephelometric turbity units (NTUs), and stable drawdowns of less than 0.3 feet are recommended.
- It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions (e.g., insulation) will need to be taken to prevent the groundwater from freezing in the equipment.
- Direct sunlight and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, pipe insulation, etc.).
- The tubing exiting the monitoring well should be kept as short as possible to avoid sunlight or ambient air from heating up the groundwater. Tubing lengths greater than 6 feet should be fitted with 0.5-inch diameter pipe insulation.

3. Execution

- Complete site-access notification requirements prior to mobilization.
- Wait at least one week following well development before sampling.
- Record all activities in the field notebook (see SOP FD-001, *Field Notebook*) and on Attachment A – Monitoring Well Sample Data Form. Use a separate form for each sampling location and event.
- Calibrate the photoionization detector (PID), pH, temperature, specific conductance (SC), turbidity, dissolved oxygen (DO), and oxidation-reduction potential (ORP) meters and record data on Attachment B – Portable Equipment Calibration Log.
- Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Record observations.

- Remove well cap and, if appropriate, measure VOCs at the rim of the well with a PID or flame ionization detector (FID) instrument and record the reading in field notebook or well logs.
- Being careful to not disturb the water column, slowly and gently measure the depth to water with a water level probe and/or oil water interface probe. Do not measure depth to well bottom at this time (wait until sampling has been completed). Measure water level to the nearest 0.01 foot from the top of casing or the highest point (or V notch) on the polyvinyl chloride (PVC). If the top of casing cannot be used, note the reference location. Mark the datum point with an indelible marker and note reference location in field book.
- Check newly constructed wells for the presence of light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) before the initial sampling event.
- If LNAPL is present, the tubing intake should be at the mid-point of the well screen. Initial purge water should not be sent through the field parameter meter flow cell but sent directly to the purge water container. After the initial column of purge water is poured, the field parameter meters may be placed inline and the collection of data may be started.
- If DNAPL is present, the tubing intake should be placed approximately 1 foot below the water table or to the approximate depth below the known drawdown depth (refer to previous sample logs).
  - Calculate the well volume (V_w [gallons]) using the measured depth to water ($Depth_{water}$ [feet]), total well depth ($Depth_{total}$ [feet]), and well diameter:

    - $V_w = n \times (Depth_{total} - Depth_{water})$

    - 1-inch well: n = 0.04
    - 2-inch well: n = 0.16
    - 4-inch well: n = 0.65
    - 6-inch well: n = 1.47

  - Purge 1.5 well volumes at low flow rates checking for DNAPL migration. If no DNAPL migration is observed during the last 15 minutes of purging, begin collecting field data. If DNAPL migration occurs during the last 15 minutes of purging, abort sampling and document on sample log.
  - For wells without LNAPL and/or DNAPL, slowly and gently insert the pump intake tubing to the middle of the saturated screened interval, open borehole, or to the pre-determined sampling depth. The pump intake must be kept at least 2 feet above the bottom of

the well to prevent disturbance or suspension of any sediment or DNAPL present in the bottom of the well. Record the depth of the pump intake.

- Place decontaminated flow-cell inline with tubing and connect calibrated Horiba U-22 Multiparameter Water Quality Meter, or equivalent. Place flow-cell in shade or insulate.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less, if achievable). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min). Measure rates with a graduated container.

- While purging, record water levels every five minutes, or as appropriate. A steady state flow rate will be maintained that results in a stabilized water level with a drawdown of 0.3 feet or less, if achievable.
- During purging, monitor and record, every five minutes, the water quality indicator parameters that include: pH, temperature, SC, turbidity, DO, and ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:
    1. pH (+/- 0.1 standard units)
    2. temperature (3%)
    3. SC (3%)
    4. turbidity (10% for values greater than 5 NTU; if three turbidity values are less than 5 NTU, consider the values as stabilized)
    5. DO (10% for greater than 0.5 milligram per liter [mg/L] or 3 consecutive values less than 0.5 mg/L)
    6. ORP (+/- 20 millivolt [mV] or 10%, whichever is greater)
- Containerize purge water in tanks or 55 gallon steel drums.
- Collect the samples.
- Following purge, disconnect the flow-through cell and fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to the steady state purge rate.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds [VOC] samples will be collected first; see SOP SC-002, *Sampling Handling*).
- Label each sample collected and store samples in a cooler (SC-002, *Sampling Handling*).
- Secure the well cap and manhole cover and restore well area to pre-sampling conditions.

4. Notes

- Prior to the field activities, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If using dedicated equipment, to the extent achievable install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.
- To minimize the potential of cross-contamination between wells, dedicated, in-place pumps (and tubing) can be used.
- If the water quality indicator parameters do not stabilize after 2 hours, then either continue purging or, contact the Project Manager.
- All sample containers are to be filled with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

5. References

Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samles From Monitoring Wells (January 19, 2010), USEPA Region-1, EQASOP-GW 001.

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures (1996), R.W. Puls and M.J. Barcelona, U.S. Environmental Protection Agency, EPA/540/S-95/504.

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

6. Attachments

Attachment A – Monitoring Well Sample Data Form
Attachment B – Portable Equipment Calibration Log

Attachment A

Monitoring Well Sample Data Form

Project: _____ **Well ID:** _____ **Date:** _____

Total Well Depth (from top of casing): _____

Depth to Water (from top of casing): _____

Well Diameter: _____

Pump Intake Depth: _____

Sampling Crew: _____

Purge Time: *Start:* _____ *Finish:* _____

Purging Method: _____

Sample Time: *Start:* _____ *Finish:* _____

Sampling Method: Low Flow

Sample Analysis: _____

Purge Data										
Sample Time	**Flow Rate** *(lpm/gpm)*	**Volume Purged** *(liters/gals.)*	**pH** *(std. Units)*	**Conductivity** *(mS/cm)*	**Turbidity** *(NTU)*	**Dissolved Oxygen** *(mg/l)*	**Temperature** *(Cel.)*	**Salinity** *(%)*	**ORP** *(mV)*	**Comments/Observations**
										Well Headspace PID =

Final Stabilization Data										
Sample Time	**Flow Rate** *(lpm/gpm)*	**Volume Purged** *(liters/gals.)*	**pH** *(std. Units)*	**Conductivity** *(mS/cm)*	**Turbidity** *(NTU)*	**Dissolved Oxygen** *(mg/l)*	**Temperature** *(Cel.)*	**Salinity** *(%)*	**ORP** *(mV)*	**Comments/Observations**

Attachment B

Portable Equipment Calibration Log

Date: _____

Equipment Information

Equipment Type: _____

Manufacturer and Model: _____

Identification Number: _____

Calibration Information

Time	Parameter	Initial Reading	Calibration Value	Lot No.	Expiration	Final Reading

Notes:

Record information for all calibrated parameters.

If performing zero and span calibration, use a separate line for each.

Comments/Observations

STANDARD OPERATING PROCEDURE

GW-004 pH and Temperature Measurement

1. Objective

The objective of this Standard Operating Procedure (SOP) is to provide standard methods for determining the pH and temperature of liquids using a combination pH/temperature meter.

2. Execution

- Calibrate the meter according to the equipment manufacturer's instructions at the beginning of each day of use. Calibration for pH shall be performed using at least two buffer solutions from various ranges. Solutions chosen should be similar in pH to the expected level of the samples or liquids tested (pH 7 and four buffer solutions are preferred in most cases for ground or surface water measurements). Record data on Attachment A – Portable Equipment Calibration Log.
- Calibration is checked every two hours or every five monitoring locations, whichever occurs first, and at the end of the day by measuring the two calibration solutions used. The reading and times are recorded. If the readings are outside +/– 0.2 pH units, the meter must be recalibrated.
- Immediately prior to testing a sample, decontaminate testing beaker or container and probe assembly with one rinse of sample solution. Do not use methanol to rinse the probe. Methanol rinses could damage the probe.
- Gently shake the probe and beaker to remove excess solution. Visually inspect the bottom of the probe to ensure that liquid or sediment is not trapped between outer casing and probe.
- Pour the sample into the testing container and insert both temperature and pH probe. Stir sample for 30 seconds using both probes. Let the probes equilibrate in the sample solution for another 30 seconds. Measure and record the temperature. A reading has stabilized if pH units have not changed +/– 0.1 pH units during a five second period.
- Record pH to the nearest 0.1 unit and temperature to the nearest whole number.

3. Notes

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.

- Coatings and particulates may affect the response of the probe; more thorough cleaning with distilled water and gently wiping the probe surface may be required to clean the surface of the probe.
- Temperature affects both the response of the instrument to pH and the actual pH of the sample. The Automatic Temperature Compensation (ATC) function compensates for the variation in the response of the meter only. Therefore, the pH must always be reported with temperature.
- The probe is a fragile thin glass bulb surrounded on three sides by a plastic casing. Care must be taken in handling the probe to avoid breakage.
- Buffer solutions should not be used past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Attachment

Attachment A – Portable Equipment Calibration Log

Attachment A

Portable Equipment Calibration Log

Date: _____

Equipment Information

Equipment Type: _____

Manufacturer and Model: _____

Identification Number: _____

Calibration Information

Time	Parameter	Initial Reading	Calibration Value	Lot No.	Expiration	Final Reading

Notes:

Record information for all calibrated parameters.

If performing zero and span calibration, use a separate line for each.

Comments/Observations

STANDARD OPERATING PROCEDURE

GW-005 Turbidity Measurement

1. Description

A nephelometer/turbidimeter is used in comparing the turbidity of liquids by viewing light through them and determining how much light is eliminated. Turbidity readings are required to be read using a portable (e.g. Horiba or Hach) instrument outside the flow-through cell.

2. Execution

- Turn the meter ON .
- Calibrate the meter according the manufacture's specifications and record data on Attachment A – Portable Equipment Calibration Log.
- Rinse the sample cell three times with organic free or de-ionized water.
- Fill the cell to the fill line with organic free or de-ionized water and then cap the cell.
- Use a non-abrasive lint-free paper or cloth (preferably lens paper) to wipe off excess water and streaks.
- Open the cover and insert the cell (arrow to the front) into the unit and close the cover.
- Press READ and wait for the 'light bulb' icon to go off. Record the reading.
- Using the Gelex standards, repeat steps above. Record all measurements (note anomalies).
- Collect a representative sample or use a portion of the sample that is collected for pH, temperature, or conductivity analysis, and pour off enough to fill the cell to the fill line (about 15 milliliters [ml]) and replace the cap on the cell.
- Wipe off excess water and any streaks with a soft, lint-free cloth (lens paper).
- Press "I/O" and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
- Insert the sample cell in the instrument so the diamond or orientation mark aligns with the raised orientation mark in the front of the cell compartment. Close the lid.
- Select manual or automatic range selection by pressing the range key.

- Select signal averaging mode by pressing the “Signal Average” key. Use signal average mode if the sample causes a noisy signal (display changes constantly).
- Press Read. The display will show “---- NTU” and then the turbidity in nephelometric turbidity units (NTUs). Record the result after the lamp symbol turns off.
- Rinse the cell with de-ionized water.
- Perform an operational check.
- Periodically check the turbidity meter during the day by using the Gelex secondary standards provided.
- Perform a post calibration at the end of the day and record all measurements.

3. Notes

- Turbidity measurements are reported in NTUs. It is important to note that if the turbidity measurements are for National Pollutant Discharge Elimination System (NPDES) reporting purposes, all values above 40 NTU must be diluted with turbidity free water and calculated by multiplying by a dilution factor.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

STANDARD OPERATING PROCEDURE

GW-006 Specific Conductance Measurement

1. Objective

The objective of this Standard Operating Procedure (SOP) is to provide standard methods for determining the conductivity of waters using a field conductivity meter.

2. Execution

- Calibrate the meter according to equipment manufacturer's instructions at the beginning of each day of use and record data on Attachment A – Portable Equipment Calibration Log. Calibration shall be performed using a standard KCl solution of 0.20 mS/cm (200 uS/cm, S=mho).
- Calibration is checked at the beginning of the day immediately prior to sampling, after five sampling locations or two hours (whichever occurs first), and at the end of the day. If the readings are outside +/- 0.02 mS/cm, the meter must be recalibrated. Initial calibration should be conducted under the same conditions (i.e., temperature, and location) of field testing.
- Immediately prior to testing a sample, decontaminate testing beaker or container and probe assembly with one distilled water rinse, and one sample solution rinse.
- Gently shake the probe and beaker to remove excess solution.
- Pour sample into the testing container and insert probe. Stir sample with the probe for approximately 10 seconds. Let the probe equilibrate in the sample solution for another five seconds. Measure conductivity and record in the field notebook.
- Record conductivity to the nearest whole number.

3. Notes

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Coatings and particulates may affect the probe's response; more thorough cleaning using a weak alconox solution and double distilled water rinse and gently wiping the probe surface may be required to clean the surface of the probe.
- If contaminated, (e.g., stained, conductance >750 mhos/cm), rinse probe with clean water immediately after measuring sample to minimize fouling of probe.
- Calibration solutions should not be used past their expiration date and must be discarded after three months of use.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Attachment

Attachment A – Portable Equipment Calibration Log

Attachment A

Portable Equipment Calibration Log

Date: _____

Equipment Information

Equipment Type: _____

Manufacturer and Model: _____

Identification Number: _____

Calibration Information

Time	Parameter	Initial Reading	Calibration Value	Lot No.	Expiration	Final Reading

Notes:

Record information for all calibrated parameters.

If performing zero and span calibration, use a separate line for each.

Comments/Observations

STANDARD OPERATING PROCEDURE

GW-007 Dissolved Oxygen Measurement

1. Objective

To accurately quantify dissolved oxygen (DO) in water.

2. Execution

Typically, the Horiba U-22 Multiparameter Water Quality Meter is used to measure groundwater DO during low-flow purging activities. However, a Hach DO test kit may be utilized, as necessary.

Horiba U-22 Multiparameter Water Quality Meter

1) Calibrate meter in accordance with manufactures specifications.
2) Calibrate the meter according to equipment manufacturer's instructions at the beginning of each day of use and record data on Attachment A – Portable Equipment Calibration Log.
3) In accordance with SOP GW-003, connect decontaminated meter inline with purge/sample tubing utilizing decontaminated flow-cell.
4) Record DO readings during monitoring well purging in accordance with SOP GW-003

Hach DO Test Kit

High Range Test (1 to 20 milligrams per liter [mg/L])

1) Fill the DO bottle (round bottle with glass stopper) with sampling water by allowing the sample water to overflow the bottle for 2 to 3 minutes. Avoid turbulence and bubbles in the sample while filling.
2) Incline the bottle slightly and insert the stopper with a quick thrust to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the test.
3) Remove the stopper and add the contents of one DO 1 Reagent Power Pillow and one DO 2 Reagent Powder Pillow. Stopper the bottle carefully to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the test.
4) Shake the bottle vigorously to mix. Flocculant (floc) precipitate will form. Brownish-orange precipitate indicates oxygen is present.
5) Wait for floc to settle to approximately half the bottle volume. Floc will not settle if high concentrations of chloride are present. In this case, wait 4 to 5 minutes before proceeding.
6) Shake the bottle vigorously again.
7) Wait for the floc to settle halfway. Floc will not settle if high concentrations of chloride are present. In this case, wait 4 to 5 minutes before proceeding.

8) Remove the stopper and add the contents of one DO 3 Reagent Powder Pillow. Stopper the bottle carefully to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the test.
9) Shake the bottle vigorously to mix. Floc will dissolve and the sample will turn yellow if oxygen is present.
10) Fill plastic tube full (to the top) with prepared sample.
11) Save the rest of the prepared sample for the Low Range Test, if necessary.
12) Pour the contents of the tube into a square mixing bottle.
13) Add Sodium Thiosulfate Standard Solution one drop at a time to the mixing bottle. Count each drop. Swirl to mix after each drop. Add drops until the sample becomes colorless. The number of drops of titrant used is equal to the total mg/L.

Low Range Test (0.2 to 4 milligrams per liter [mg/L])

1) Use the prepared sample left from Step 11 of the High Range Test. Pour off the contents of the DO bottle until the level reaches the 30 ml mark on the bottle.
2) Add Sodium Thiosulfate Standard Solution one drop at a time to the DO bottle. Count each drop. Swirl the bottle after each drop is added. Add drops until the sample becomes colorless.
3) Multiply by 0.2 the number of drops of titrant used. This is the total mg/L.

3. Notes

- Collecting measurements from samples in containers will alter the gaseous content of the sample.
- Freshwater can hold more oxygen than saltwater. The dissolved salt forces dissolved gas out of water thereby lowering the solubility of water. A known relationship between salinity and dissolved oxygen concentration allows for a correction for salinity.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Attachment

Attachment A – Portable Equipment Calibration Log

Attachment A

Portable Equipment Calibration Log

Date: _____

Equipment Information

Equipment Type: _____

Manufacturer and Model: _____

Identification Number: _____

Calibration Information

Time	Parameter	Initial Reading	Calibration Value	Lot No.	Expiration	Final Reading

Notes:

Record information for all calibrated parameters.

If performing zero and span calibration, use a separate line for each.

Comments/Observations

STANDARD OPERATING PROCEDURE

GW-008 Temporary Groundwater Sampling Points

1. Description

A well point is a small diameter (1-2 inch) probe constructed of continuously wrapped stainless steel or wrapped stainless steel gauze screen over perforated carbon steel pipe. They may be used as a screening tool to collect ground water samples and piezometric data to aid in the optimal placement of monitor wells. No filter or gravel pack is used in the installation.

2. Execution

2.1. Installation

- The well point can be placed with the use of a conventional hollow- stem auger rig, slide hammer, jack hammer, rotary hammer, or by hand.
- The well point may be driven through the unsaturated zone only in known clean soils. Driving the well point through contaminated soil may carry some contamination with the point resulting in analytical sample results which are biased high. In contaminated unsaturated zones, the well points must be placed with the aid of a hollow-stem auger.
- If the well point is to be installed in an oversized (20% larger than the well point) pre-drilled hole, the hollow-stem augers or bull drive point must be advanced to a point which is just above the targeted sample zone. The well point is then placed in the hole and advanced beyond the bottom of the hole by hammering or pushing into place. The use of pre-drilled holes will reduce clogging of well point screens when driving.
- After sample collection, the well point is removed by back hammering or pulling the tool out with the rig hydraulics.
- If the well point is to be left as a permanent installation, it must be constructed and permitted as per local regulatory monitor well requirements.
- If the well point is used for piezometeric data, a survey mark must be made on top of the casing as a reference point for water level measurements.

2.2. Sampling Procedures

221. Development

Development of a well point is not required except when performing vertical profile sampling. The well point must be developed by one of the standard methods used for well development prior to sampling. If an air lift

development technique is used, the air outlet must be at a minimum of two feet above the screen. Operations must be continuous and not pulsed. The air lift pipe shall not be placed within the screen and only the double pipe method shall be used.

222. Purging

Purging of the well point is required.

223. Sampling

The acquisition of ground water samples and piezometric data must be performed by one of several recommended methods described in the associated SOP.

3. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

Ground Water and Wells. Johnson Division, UOP Inc.; St. Paul, Minn. 1982. p277-294.

Ground Water Manual - A Water Resources Technical Publication; U.S. Dept. of Interior, Bureau of Reclamation. Government Printing Office,Washington DC 1977.

Appendix D

Quality Assurance Project Plan

GEI Consultants

Consulting
Engineers and
Scientists

Quality Assurance Project Plan

Parcel D, Bronx, New York

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau B
625 Broadway, 11th Floor
Albany, NY 12233-7020

Submitted by:
GEI Consultants, Inc., P. C.
1385 Broadway
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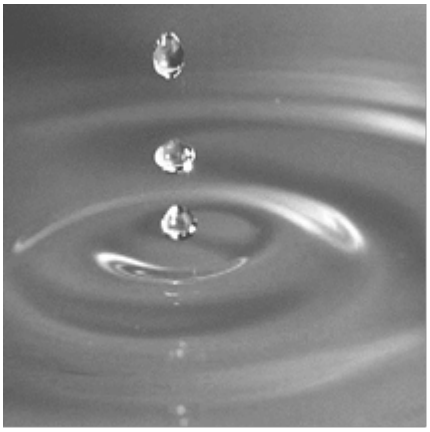
October 2018



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Tables

Appendices

Abbreviations and Acronyms

ASP	Analytical Service Protocol
BOD	Biological Oxygen Demand
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHMM	Certified Hazardous Materials Manager
CMS	Chip Measurement System
CLP	Contract Laboratory Protocol
COC	Chain Of Custody
COD	Chemical Oxygen Demand
DQO	Data Quality Objective
DO	Dissolved Oxygen
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectroscopy
GEI	GEI Consultants, Inc.
H2M	H2M Labs, Inc.
LCS	Labortory Control Sample
LEL	Lower Explosive Limit
LEP	Licenced Environmental Professional (Connecticut)
MDL	Method Detection Limit
MPH	Master of Public Health
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NTU	Nephelometric Turbidity Unit
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation Reductioin Potential
PAH	Polycyclic Aromatic Hydrocarbon
PCE	Perchloroethylene (also know as tetrachloroethene)
PID	Photoionization Detector
PM	Project Manager
PQL	Practical Quantification Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation Recovery Act
RIWP	Remedial Investigation Work Plan
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SD	Standard Deviation
SOP	Standard Operating Procedures

SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCL+30	Target Compound List Plus 30
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compounds
TOC	Total Organic Carbon
USDOT	United States Department of Transporation
VOC	Volatile Organic Compound

Quality Assurance Glossary

"Alteration" means altering a sample collected for analysis in any way other than by adding a preservative, such as nitric acid to lower pH. Examples of alteration include, but are not limited to: filtering, settling and decanting, centrifuging and decanting, and acid extracting.

"Analytical Services Protocol" or "ASP" means the NYSDEC's compendium of approved EPA and NYSDEC laboratory methods for sample preparation and analysis and data handling procedures.

"Correlation Sample" means a sample taken, when using a field-testing technology, to be analyzed by an ELAP-certified laboratory to determine the correlation between the laboratory and field analytical results.

"Confirmatory Sample" means a sample taken after remedial action is expected to be complete to verify that the cleanup requirements have been met. This term has the same meaning as "post remediation sample."

"Contract laboratory program" or "CLP" means a program of chemical analytical services developed by the United States Environmental Protection Agency (EPA) to support CERCLA.

"Data Usability Summary Report, (DUSR)" is a document that provides a thorough evaluation of the analytical data to determine whether or not the data, as presented, meets the site/project specific criteria for data quality and use.

"Effective solubility" means the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate phase mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure phase solubility.

"Environmental Laboratory Accreditation Program" or "ELAP" means a program conducted by the New York State Department of Health (NYSDOH), which certifies environmental laboratories through onsite inspections and evaluation of principles of credentials and proficiency testing.

"Filtration" means the filtering of a groundwater or surface water sample, collected for metals analysis, at the time of collection and prior to preservation. Filtering includes, but is not limited to, the use of any membrane, fabric, paper or other filter medium, irrespective of pore size, to remove particulates from suspension.

"**Final delineation sample**" means a sample taken as an endpoint sample, used to make a decision regarding the extent of contamination at a site, which is to be analyzed by an ELAP-certified laboratory.

"Intermediate Sample" means a sample taken during the investigation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

"Method detection limit" or "MDL" means the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

"Minimum reporting limit" means the lowest concentration at which an analyte can be detected and which can be reported with a reasonable degree of accuracy. It is the lowest concentration that can be measured, a lab-specific number, developed from minimum detection limits, and is also referred to as the practical quantitation limit (PQL).

"Nephelometric Turbidity Unit" or "NTU" is the unit by which turbidity in a sample is measured.

"Non-targeted compound" means a compound detected in a sample using a specific analytical method that is not a targeted compound, a surrogate compound, a system monitoring compound, or an internal standard compound.

"Practical quantitation level" or "PQL" means the lowest quantitation level of a given analyte that can be reliably achieved among laboratories within the specified limits of precision and accuracy of a given analytical method during routine laboratory operating conditions.

"Preservation" means preventing the degradation of a sample due to precipitation, biological action, or other physical/chemical processes between the time of sample collection and analysis. The most common examples involve refrigeration at 4 degrees Celsius and lowering sample pH by the addition of acid to keep dissolved metals in solution or to reduce the biodegradation of dissolved organic analytes.

"PAH" means polycyclic aromatic hydrocarbon as defined by USEPA Method 8270.

"Quality assurance" or "QA" means the total integrated program for assuring the reliability of monitoring and measurement data, which includes a system for integrating the quality planning, quality assessment, and quality improvement efforts to meet data end-use requirements.

"Quality assurance project plan" or "QAPP" means a document, which presents in specific terms the policies, organization, objectives, functional activities, and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of a specific project or operation.

"Quality control" or "QC" means the routine application of procedures for attaining prescribed standards of performance in the monitoring and measurement process.

"Semi-volatile organic compound" or "SVOC" means compounds amenable to analysis by extraction of the sample with an organic solvent. For the purposes of this section, semi-volatiles are those target compound list compounds identified in the statement of work in the current version of the EPA Contract Laboratory Program.

"Target analyte list" or "TAL" means the list of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis. For the purpose of this chapter, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/ elements.

"Targeted compound" means a hazardous substance, hazardous waste, or pollutant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

"Target compound list plus 30" or "TCL+30" means the list of organic compounds designated for analysis (TCL) as contained in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis. For the purposes of this chapter, a Target Compound List+30 scan means the analysis of a sample for Target Compound List compounds and up to 10 non-targeted volatile organic compounds and up to 20 non-targeted semi-volatile organic compounds using GC/MS analytical methods. Non-targeted compound criteria should be pursuant to the version of the EPA "Contract Laboratory Program Statement of Work for

Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"Tentatively identified compound or TIC" means a chemical compound that is not on the target compound list but is detected in a sample analyzed by a GC/MS analytical method. TICs are only possible with methods using mass spectrometry as the detection technique. The compound is tentatively identified using a mass spectral instrumental electronic library search and the concentration of the compound estimated.

"Unknown compound" means a non-targeted compound which cannot be tentatively identified. Based on the analytical method used, the estimated concentration of the unknown compound may or may not be determined.

"Volatile organic compounds" or "VOC" means organic compounds amenable to analysis by the purge and trap technique. For the purposes of this chapter, analysis of volatile organics means the analysis of a sample for either those priority pollutants listed as amenable for analysis using EPA method 624 or those target compounds identified as volatiles in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"**Waste oil"** means used and/or reprocessed engine lubricating oil and/or any other used oil, including but not limited to: fuel oil, engine oil, gear oil, cutting oil, transmission fluid, oil storage tank residue, animal oil, and vegetable oil, which has not subsequently been refined.

"Well development" means the application of energy to a newly installed well to establish a good hydraulic connection between the well and the surrounding formation. During development, fine-grained formation material that may have infiltrated the sand pack and/or well during installation is removed, allowing water from the formation to enter the well without becoming turbid and unrepresentative of groundwater in the formation.

1. Purpose

GEI Consultants, Inc. P.C. (GEI) has prepared this Quality Assurance Project Plan (QAPP) to address analytical groundwater, soil and purifier waste sampling at Parcel D, Bronx, New York (the Site). The QAPP is a companion document and attachment to *the Remedial Investigation Work Plan (RIWP).* The QAPP presents the project scope and goals, organization, objectives, sample handling procedures and Quality Assurance Quality Control (QA/QC) procedures associated with the site.

Furthermore, this QAPP identifies 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 investigation, from field to laboratory are documented to provide data that are technically sound and legally defensible.

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks.

This QAPP was prepared based upon guidance provided by the United States Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) including:

- *DER-10, Technical Guidance for Site Investigation and Remediation.* New York State Department of Environmental Conservation. *May 3, 2010.*
- *Analytical Service Protocol,* New York State Department of Environmental Conservation. *July 2005.*
- *US EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5, March 2001).*
- *Guidance for Quality Assurance Project Plans (EPA QA/G-5, December 2002).*

2. Project Goals and Objectives

A RIWP has been developed to develop a remedial analysis of the Site D Parcel located within Food Center Drive in the borough of Bronx, with the County of Bronx, New York (Site). Groundwater will be sampled for benzene, toluene, ethylbenzene, and xylenes (BTEX), the 16-priority pollutant polycyclic aromatic hydrocarbons (PAHs), cyanide, total dissolved solids, total organic carbon, alkalinity, priority pollutant metals, and major ions. Samples of coal tar, Manufactured Gas Plant (MGP)-related purifier waste, and underlying material will be collected and submitted for geotechnical analysis as well as laboratory analysis for thermal treatment and disposal or proposed In-Situ Stabilization (ISS).

The RIWP program will include:

- Groundwater monitoring well installations
- Groundwater analytical sampling
- Soil borings
- Soil field screening
- Soil analytical sampling
- Soil vapor analytical sampling
- Groundwater sampling for Emerging Contaminants
- Bulk waste sampling for In-Situ Stabilization Treatability Study

3. Project Organization and Responsibility

GEI is responsible for the implementation of the scope of work associated with the RIWP, including the supervision of contractors, field activities, and the evaluation and interpretation of data. GEI will perform the sampling activities and coordinate submittal of samples to testing laboratories. The project organization and key personnel for GEI are listed below:

In-House Consultant: Errol Kitt

Program Manager: Gary Rozmus

Project Manager: Kevin McCarty

Field Team Leader: Richard Crockett

Quality Assurance Officer: Jaimie Wargo

GEI Corporate Health & Safety Officer: Steven Hawkins, CSP

Data Manager: Brian Skelly

The primary responsibilities of each of these personnel are described in the following table.

Key Project Personnel and Responsibilities		
Position	**GEI Personnel**	**Areas of Responsibilities**
In-House Consultant	Errol Kitt	▪ Provide strategic guidance of project activities ▪ Client contact regarding strategic issues ▪ Review of project deliverables
Program Manager	Gary Rozmus	▪ Overall program oversight ▪ Project management ▪ Project schedule ▪ Client contact regarding project related issues ▪ Personnel and resource management ▪ Review of project submittals ▪ Budgeting
Project Manager	Kevin McCarty	▪ Client contact regarding project related issues ▪ Coordination of contractors ▪ Technical development and implementation of RIWP and related documents ▪ Personnel and resource management ▪ Preparation and review of project submittals ▪ Budgeting
Field Team Leader	Richard Crockett	▪ Client contact regarding project related issues on day to day basis as part of field operations ▪ Coordination of contractors ▪ Implementation of RIWP and Field Sampling ▪ Plan personnel and resource management ▪ Preparation of project submittals

Key Project Personnel and Responsibilities		
Position	**GEI Personnel**	**Areas of Responsibilities**
Quality Assurance Officer	Jaimie Wargo	▪ QA/QC for sampling and laboratory performance
Data Manager	Brian Skelly	▪ Manage raw data from the laboratory ▪ Maintain copies of COCs in the project file

Hampton-Clarke Inc. (HCI), located in Fairfield, New Jersey, has been selected to perform the following standard analytical chemistry parameters for groundwater samples including:

- Volatile Organic Compounds (VOCs) according to EPA Method 8260
- Semi-Volatile Organic Compounds (SVOCs) according to EPA Method 8270
- Target Analyte List (TAL) Metals according to EPA Method 6010C/6020A/7471A
- Polychlorinated Biphenyls according to EPA Method 8082A
- Pesticides according to EPA Method 8081B
- Total Cyanide according to EPA Method 9014
- Free Cyanide according to EPA Method 9016
- Total Sulfur according to EPA Method 6010
- Sulfate according to EPA Method 300
- Sulfide according to EPA Method SM4500 52F11
- Chloride according to EPA Method 300
- Fluoride according to EPA Method 300
- Total Phosphorous according to EPA Method 365.4
- Alkalinity Carbonate/Bicarbonate according to EPA Method SM2320B
- Total Organic Carbon according to EPA Method 415.3
- Total Dissolved Solids according to EPA Method SM 2540C
- Target Analyte List Per- and Polyfluoroalkyl Substances (PFAS) according to EPA Method 537
- 1,4 Dioxane according to EPA Method 8270D
- BTEX and Naphthalene according to EPA Method TO-15

Chemtech, located in Mountainside, New Jersey, has been selected to perform the following standard analytical chemistry parameters for soil and soil vapor samples including:

- Volatile Organic Compounds (VOCs) according to EPA Method 8260
- Semi-Volatile Organic Compounds (SVOCs) according to EPA Method 8270
- Target Analyte List (TAL) Metals according to EPA Method 6010B/7471A
- Polychlorinated Biphenyls (PCBs) according to EPA Method 8082A
- Pesticides according to EPA Method 8081B
- BTEX and naphthalene in air according to EPA Method TO-15

Table 1 provides a summary of soil analyses, **Table 2** provides a summary of groundwater analyses, **Table 3** provides a summary of soil vapor analyses, and **Table 4** provides a summary of quality assurance samples, holding times, and analysis for each media.

4. Quality Assurance Objectives

This section establishes the QA objectives for measurements that are critical to the project. The QA objectives are developed for relevant data quality indicators. These indicators include the method detection limit (MDL), reporting limit (RL), precision, accuracy, completeness, representativeness, and comparability. The data quality objectives (DQOs) are based on project requirements and ensure: (1) that the data generated during the project are of known quality and (2) that the quality is acceptable to achieve the project's technical objectives.

Quantitation Limits are laboratory-specific and reflect those values achievable by the laboratory performing the analyses. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy, precision, and completeness. The analytical methods to be used at this site will provide a level of data quality and can be used to evaluate potential impacts to soil, soil vapor, and groundwater compared to New York State Standards, Criteria and Guidance values, and for purposes of risk assessment.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs. Specific procedures for sampling, chain of custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, and corrective action are described in other sections of the QAPP.

The data quality indicators are presented in subsections 4.1 through 4.6. Procedures to assess the data quality indicators are given below in Section 13.

Due to the nature of sampling being completed for the soil and MGP-related purifier material, which are being used for informative purposes only, DQO's, RLs, and MDLs are only required for those soil samples collected as part of the offsite investigation. **Table 5** provides the DQOs, RLs and MDLs for soil samples. The DQOs for soil samples are according to 6 NYCRR Part 375-6.8(b) Commercial Soil Cleanup Objectives. **Table 6** provides the DQOs, RLs, MDLs for groundwater samples. The DQO's for groundwater samples for this project include minimum RLs specified within the 2005 NYSDEC ASP as well as GA groundwater criteria listed in the Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. **Table 7** provides the RLs and MDLs required for the soil vapor samples. There is currently no standard criteria to be met for BTEX and naphthalene in soil vapor.

4.1 Required Quantification Limit

The required quantification limit is the quantitative analytical level for individual analytes needed to make decisions relative to the objectives of the project. Quantitative limits may be expressed as the MDL or some quantitative level defined in terms relative to the program. It should be noted that there is some ambiguity in the definitions and use of terms that define quantification limits. The MDL presented herein is a well-defined and accepted entity, although attainable only under ideal laboratory conditions.

Method Detection Limit: The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDL is determined from analysis of a sample in a given matrix type containing the analyte.

Practical Quantitation Limit: The practical quantitation limit (PQL) [also referred to as the reporting limit (RL)] is the concentration in the sample that corresponds to the lowest concentration standard of the calibration curve.

4.2 Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being used (e.g., sample liners, drilling shoe, or stainless–steel sampling implements).

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of "standards," materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses, or %R of spiked compounds in matrix spikes (MSs), matrix spike duplicates (MSDs) and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds.

4.3 Precision

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. In environmental sampling, precision is the result of field sampling and

analytical factors. Precision in the laboratory is easier to measure and control than precision in the field. Replicate laboratory analyses of the same sample provide information on analytical precision; replicate field samples provide data on overall measurement precision. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision.

Precision in the field is assessed through the collection and measurement of field duplicates. Field duplicates will be collected at a frequency of one per twenty investigative samples per matrix per analytical parameter, with the exception of the waste characterization parameters. Precision will be measured through the calculation of relative percent differences (RPDs) as described below in subsection 13.2. The resulting information will be used to assess sampling and analytical variability. Duplicate samples are described below in subsection 5.1.3. **Table 4** summarizes the number of duplicates per media sampled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples and field duplicates. For the inorganic analyses, laboratory precision will be assessed through the analysis of matrix duplicate pairs and field duplicate pairs. MS/MSD samples or matrix duplicate pairs will be performed at a frequency of one per twenty primary samples per matrix. Duplicate samples are described below in subsection 5.1.3. **Table 4** summarizes the number of duplicates per media sampled.

4.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. “Normal conditions” are defined as the conditions expected if the sampling plan was implemented as planned. The objective for completeness is a sufficient amount of valid data to achieve a predetermined statistical level of confidence. Critical samples must be identified and plans must be formulated to secure requisite valid data for these samples.

Field completeness is a measure of the amount of 1) valid measurements obtained from all the measurements taken in the project and 2) valid samples collected. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

To ensure that these percentages are met, materials for crucial parameters will be retained if re-sampling is required and strict adherence to holding times will be required.

4.5 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that any future work plans are followed and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times.

4.6 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the RIWP is followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized EPA or equivalent analytical methods and the reporting of data in standardized units. To facilitate data comparison, the data-reporting format as presented below will be used:

- Conventions (units reported as): for solids (weight/unit weight [i.e., mg/kg]); for liquids (weight/unit volume [i.e., µg/L]); for air (weight/unit volume [i.e., µg/m3]).
- Use common chemical name with corresponding chemical abstracts service (CAS) code.
- Report all data for soils on a dry-weight basis.

5. Sampling Plan

Environmental sampling will include subsurface soil, purifier waste and groundwater. Direct push (Geoprobe®) will be the method used for obtaining subsurface soil and purifier waste samples. Groundwater samples will be collected utilizing low-flow sampling methods. Sampling methods and procedures are presented in Appendix C of the RIWP.

5.1 Sample Type, Location, and Frequency

5.1.1 Subsurface Soil Samples

Subsurface soil samples will be collected using the Geoprobe® drilling method. The depth, location and number of soil borings will be specified in a job specific Work Plan. Soil and purifier waste samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and Field Sampling Plan (FSP). Due to the nature of sampling being completed for the soil and MGP-related purifier material, which are being used for informative purposes only, QA/QC samples will only be submitted for those samples collected from the offsite investigation. Probes will be advanced throughout the site to fully evaluate the location, depths and limit of the purifier bed material as well as to delineate the limits of coal tar identified during the initial investigation. A summary of soil samples and analysis are depicted on **Table 1**. Data Usability Summary Reports (DUSRs) are not expected to be performed as part of the RIWP soil sampling unless specific samples are used to make a determination of no further action for the site.

5.1.2 Groundwater Samples

Low-flow groundwater samples will be collected from three (3) shallow overburden monitoring wells and four (4) deep overburden monitoring wells. Groundwater samples will be collected and submitted for laboratory analysis in general accordance with the RIWP. Water quality parameters including temperature, pH, turbidity, salinity, dissolved oxygen (DO), oxidation reduction potential (ORP), and specific conductance, will be collected prior to laboratory analysis. A summary of groundwater samples and analysis are depicted on **Table 2**.

Four (4) of the monitoring wells described above will be analyzed with an expanded analyte list to also include total dissolved solids, total organic carbon, alkalinity, priority pollutant metals, and major ions. These four (4) monitoring wells will consist of the well pair between the MGP-related waste footprint and the river, and the monitoring well pair closest to the center of the Site MGP-related waste footprint.

QA/QC samples will be collected according to the QAPP (**Table 4**) for all groundwater samples. DUSRs will only be prepared for those samples collected and analyzed for emerging contaminants (1,4 Dioxane and TAL PFAS) unless specific samples are used to make a determination of no further action for the site.

5.1.3 Soil Vapor Samples

Soil vapor samples will be collected and submitted for laboratory analysis in general accordance with the RIWP. A total of 6 soil vapor samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and FSP. A summary of soil vapor samples and analysis as depicted on **Table 3.** QA/QC samples and DUSRs are not expected to be performed for soil vapor analysis since there is no current standard criteria to be met for soil vapor of BTEX and naphthalene.

5.1.4 Field QC Sample Collection

Field QC samples are used to monitor the reproducibility and representativeness of field sampling activities. The field QC samples are handled, transported and analyzed in the same manner as the associated field samples. Field QC samples will include equipment blanks, trip blanks, field duplicates and MS/MSDs. The quantity, field QC sample type and analysis is detailed on **Table 4**.

Field Blank Samples are used to monitor the adequacy of decontamination procedures and possible sources of contamination such as potential laboratory methodologies. Equipment blanks will consist of laboratory-supplied, distilled or de-ionized water and will be used to check for potential contamination of the equipment which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through a decontaminated piece of sampling equipment into laboratory supplied bottles. Non-dedicated field equipment will be decontaminated as specified below in subsection 5.3. Equipment blanks will be submitted to the laboratory at a frequency of one per 20 samples per matrix per type of equipment being used per parameter. Equipment blanks will not be completed for waste characterization sampling activities or if only disposable sampling equipment is used.

Trip Blank Samples will consist of analyte free water and will be prepared by the laboratory. Trip blanks are used to assess the potential for VOC contamination of samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the project location unopened, stored with the site characterization samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler which contains samples submitted for VOC analysis.

Field Duplicate Samples, also referred to as blind duplicate samples, are two samples that are submitted from the same interval using the same sample procedures. Field duplicates

will be used to assess the sampling and analytical reproducibility. Both samples are collected utilizing the same methods and are submitted for the same laboratory analysis however different sample identification numbers are used. Field duplicates will be submitted at a frequency of one per 20 samples for all matrices and all parameters. Field duplicates will not be completed for waste characterization sampling activities.

MS/MSD Samples are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs will be submitted at a frequency of one per 20 investigative samples per matrix for organic and inorganic parameters. MS/MSDs will not be completed for waste characterization sampling activities.

Refer to **Table 4** for a summary of QC sample preservation and container requirements.

5.2 Sample Preservation and Containerization

The analytical laboratory will supply the sample containers for the chemical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest EPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to EPA specifications. The containers will be pre-preserved, where appropriate. Sample preservation and containerization details are outlined in **Table 4**.

5.3 Equipment Decontamination

All non-dedicated sampling equipment shall be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface.
- Tap water rinse.
- Wash and scrub with Alconox (or non-phosphate soap) and water mixture.
- Tap water rinse.
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

6. Documentation and COC

6.1 Sample Collection Documentation

6.1.1 Field Notes

Field notes documenting field activities will be maintained in a field notebook in general accordance with the FSP. Field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. The logbook will be a bound notebook with water-resistant pages. Logbook entries will be dated, legible, and contain accurate and inclusive documentation of the activity. No erasures or obliterations of field notes will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The correction shall be written adjacent to the error.

6.1.2 COC Records

Sample custody is discussed in detail below in subsection 6.2. COC records are initiated by the samplers in the field. The field portion of the custody documentation should include:

- The project name
- Signature(s) of sampler (s) responsible for sample custody
- Sample ID number
- Date and time of collection
- Whether the sample is grab or composite
- Names of individuals involved in sampling
- Air bill or other shipping number (if applicable)

On a regular basis (daily or on such a basis that all holding times will be met), samples will be transferred to the custody of the respective laboratories, via third-party commercial carriers or via laboratory courier service. Sample packaging and shipping procedures, and field COC procedures are described below in subsection 6.2.1 of this Plan. Sample receipt and log-in procedures at the laboratory are described below in subsection 6.2.2 of this Plan.

6.1.3 Sample Labeling

Each sample will be labeled with a pre-printed adhesive label using indelible ink. The label should include the date and time of collection, sampler's initials, tests to be performed,

preservative (if applicable), and a unique identification. The following identification scheme will be used:

PRIMARY SAMPLES TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES Boring -ID (SAMPLE DEPTH-FEET) SB-01 (10-15) **GROUNDWATER SAMPLES** Monitoring Well-ID MW-01S	**FIELD BLANKS** SAMPLE-ID – [DATE] SS-FB-033110 **MATRIX SPIKE/DUP** SAMPLE [ID] [DEPTH] [EITHER MS OR MSD] SS-01 (10-15) MS/MSD **TRIP BLANKS** SAMPLE- ID [DATE] TB-033110 **BLIND DUPLICATES** SAMPLE -ID[XX][DATE] SS-XX-033110

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples or the Data Manager and/or the Project QA Officer.

6.1.4 Sample Handling

Samples will be handled in general accordance with the FSP.

6.2 Sample Custody

The COC provides a record of the custody of any environmental field sample from the time of collection to the delivery to the laboratory. Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample is considered to be under a person's custody if:

- The item is in the actual possession of a person
- The item is in the view of the person after being in actual possession of the person
- The item was in the actual physical possession of the person but is locked up to prevent tampering
- The item is in a designated and identified secure area

6.2.1 Field Custody Procedures

Samples will be collected following the sampling procedures indicated in the FSP. A summary of samples and collection methods are provided above in Section 5 of this QAPP. Documentation of sample collection is described above in subsection 6.1. Sample COC and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory with the COC intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented above in subsection 6.1.3.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions.
- Samples will be accompanied by a completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, and to the laboratory facility.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and provided to the data manager and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the cooler and covered with clear plastic tape after being signed by field personnel.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature of the laboratory sample custodian on COC document as receiving the samples and signature of sampler as relinquishing samples.

6.2.2 Laboratory Custody Procedures

After accepting custody of the shipping containers, the laboratory will document the receipt of the shipping containers by signing the COC record. The laboratory will:

- Examine the shipping containers to verify that the custody tape is intact
- Examine all sample containers for damage
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC records
- Compare samples received against those listed on the COC
- Verify that sample holding times have not been exceeded
- Examine all shipping records for accuracy and completeness
- Determine sample pH (if applicable) and record on COC forms
- Sign and date the COC immediately (if shipment is accepted) and attach the air bill
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory project manager, who will be responsible for contacting the GEI data manager
- Attach laboratory sample container labels with unique laboratory identification and test
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The completed COC, air bills, and any additional documentation will be placed in the project file.

7. Calibration Procedure

7.1 Field Instruments

Field instruments will be calibrated according to the manufacturer's specifications. Air monitoring instruments will be calibrated to a known reference gas standard and ambient air outside the work zone. Calibration will be completed daily. If concentrations of VOCs are encountered above the reference gas standard, the soil screening photoionization detector (PIDs) may be calibrated or re-checked against the reference gas standard. Water quality meters will be calibrated with known reference solutions. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and the readings. The following equipment may be used during sampling activities.

Subsurface Soil Sampling Activities:

- RAE Systems MiniRAE 2000 (PID) with 10.6 eV lamp or equivalent.
- MIE pDR 1200 with cyclone and pump [particulate monitor] or equivalent.

Groundwater Sampling Activities:

- Horiba U22 or equivalent.

7.2 Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's quality assurance plan, which describe the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration.

The laboratory quality plan for Hampton Clarke Laboratory and Chemtech is located in **Appendix A**.

8. Sample Preparation and Analytical Procedures

Analytical samples will be collected in general accordance with the FSP and as specified in the RIWP. **Table 1** provides sample collection matrices for soil, **Table 2** provides sample collection matrices for groundwater, and **Table 3** provides sample collection matrices for soil vapor.

9. Data Reduction and Reporting

Appropriate QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in this project. Data Management will be performed under the direction of Jaimie Wargo, Senior Technician – Data Management.

9.1 Field Data Evaluation

Measurements and sample collection information will be transcribed directly into the field logbook or onto standardized forms. If errors are made, results will be legibly crossed out, initialed and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Reviews of the field records by the field team leader, site manager, and project manager will ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good record keeping procedures, i.e., entries are signed and dated, data are not obliterated, changes are initialed, dated, and explained.
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the FSP and Work Plan, and that any deviations were documented and approved by the appropriate personnel.

9.2 Analytical Data

Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements. All data generated as part of the remedial investigation (RI) will be submitted to NYSDEC in the appropriate Electronic Data Deliverable (EDD) format. DUSRs are only proposed for the groundwater samples to be collected and analyzed for emerging contaminants. No additional DUSRs will be performed unless specific samples will be used to make a determination of no further action for the remediation of the site.

10. Internal Quality Control

Laboratory and field quality internal control checks will be used to ensure the data quality objectives. At a minimum, this will include:

- Matrix spike and/or matrix spike duplicate samples
- Matrix duplicate analyses
- Laboratory control spike samples
- Instrument calibrations
- Instrument tunes for VOC 8260B analyses
- Method and/or instrument blanks
- Surrogate spikes for organic analyses
- Internal standard spikes for VOC 8260B analyses
- Detection limit determination and confirmation by analysis of low-level calibration standard

Field quality control samples, as identified in **Table 4**, will include:

- Equipment blanks as outlined
- Field duplicate samples as outlined
- Trip blanks as outlined
- MS/MSDs as outlined

11. Performance and System Audits

Audits are an independent means of: 1) evaluating the operation or capability of a measurement system, and 2) documenting the use of QC procedures designed to generate data of known and acceptable quality.

Field audits may be completed to assess sample collection protocols, determine the integrity of COC procedures, and evaluate sample documentation and data handling procedures. Field audits may be scheduled by the QA officer, Project Manager (PM), site manager or in-house consultant, at their discretion. Written records of audits and any recommendations for corrective action will be submitted to the PM.

The QA officer is the interface between management and project activities in matters of project quality. The QA officer will review the implementation of the QAPP. Reviews will be conducted at the completion of field activities and will include the results of any audits and an evaluation of the data quality.

12. Preventative Maintenance

Preventative maintenance will be performed on field equipment in accordance with the manufacturer's recommendations. Preventative maintenance to rented field equipment will be provided by Pine Environmental Services.

Laboratory equipment calibration and maintenance procedures are specified in Hampton Clarke's and Chemtech's laboratory quality assurance manual provided in **Appendix A**.

13. Specific Procedures to Assess Data Quality Indicators

QC analyses conducted as a part of the testing program will provide a quantitative quality assessment of the data generated and their adherence to the data quality indicators. The data quality indicators ensure that the quality assurance objectives for the project are met.

13.1 Detection Limits

13.1.1 Method Detection Limit

The MDL is defined as follows for all measurements:

MDL = (t[n-1,1-a=0.99]) x (s)

where: s = standard deviation of the replicate analysis,
t(n-1, 1-a=0.99) = student's t-value for a one-sided, 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom

The MDLs calculated by the laboratory are determined under ideal conditions. MDLs for environmental samples are dependent on the sample aliquot, the matrix, the concentration of analyte, and interference present in the matrix, the percent of moisture, dilution factor, etc. The MDL for each sample analysis will be adjusted accordingly.

13.1.2 *Reporting Limit*

The RL is the concentration of an analyte in the sample that corresponds to the lowest concentration standard of the calibration curve. As with the MDLs, the RLs are dependent on the sample aliquot, the final sample volume, the percent of moisture, dilution factor, etc.

The RL is determined as follows:

$$RL = \frac{Lowest\ conc.\ std\ (ng)}{Volume\ injected\ (uL)} x \frac{Sample\ aliquot\ (mL\ or\ g)}{Final\ volume\ (mL)} x\ DF\ x \frac{100}{(100 - \%M)}$$

where:

DF = dilution factor, including all dilutions or lost samples not accounted for in a sample aliquot/final volume ratio
%M = percent moisture for solid samples.

13.2 Precision

Variability will be expressed in terms of the RPD when only two data points exist. The RPD is calculated as:

$$RPD = \frac{(Larger\ Value - Smaller\ Value)}{[(Larger\ Value + Smaller\ Value)/2]} x\ 100\%$$

For data sets greater than two points, the percent relative standard deviation (percent RSD) is used as the precision measurement. It is defined by the equation:

$$Percent\ RSD = \frac{Standard\ Deviation}{Mean} x\ 100\%$$

Standard deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n - 1}}$$

where: SD = standard deviation
yi = measured value of the ith replicate
y = mean of replicate measurements
n = number of replicates

For measurements such as pH, where the absolute variation is more appropriate, precision is usually reported as the absolute range (D) of duplicate measurements:

D = | first measurement - second measurement |

or as the absolute standard deviation previously given. RPD, %RSD, and D are independent of the error of the analyses and reflect only the degree to which the measurements agree with each other, not the degree to which they agree with the true value for the parameter measured.

13.3 Accuracy

Accuracy is related to the bias in a measurement system. Accuracy describes the degree of agreement of a measurement with a true value. Accuracy will be expressed as percent recovery for each matrix spike analyte by using the following equation:

$$\% \ Recovery = \frac{Css - Cus}{Csa} \ X \ 100\%$$

where: Css = measured concentration in spiked sample
Cus = measured concentration in unspiked sample
Csa = known concentration added to the sample

Accuracy for a measurement such as pH is expressed as bias in the analysis of a standard reference sample according to the equation:

$$Bias = pH_m - pH_t$$

where: pH_m = measured pH
pH_t = the true pH of the standard reference sample

13.4 Completeness

Data completeness is a measure of the amount of usable data resulting from a measurement effort. For this program, completeness will be defined as the percentage of valid data obtained compared to the total number of measurements necessary to achieve our required statistical level of confidence for each test. The confidence level is based on the total number of samples.

Data completeness is calculated as:

$$Completeness = \frac{Number\ of\ valid\ data\ points}{Number\ of\ data\ points\ necessary\ for\ confidence\ level} x\ 100\%$$

The completeness goal is to generate a sufficient amount of valid data. It is anticipated that 95 percent of the data will be complete. Data validation criteria discussed in Section 9 of this QAPP will be used to determine data completeness. Any data deficiencies and their effect on project goals will be evaluated in the DUSR.

13.5 Representativeness

Representativeness is a qualitative statement that expresses the extent to which the sample accurately and precisely represents the characteristics of interest of the study. Representativeness is primarily concerned with the proper design of the sampling program and is best ensured by proper selection of sampling locations and the taking of a sufficient number of samples. It is addressed by describing the sampling techniques, the matrices sampled, and the rationale for the selection of sampling locations, which are discussed in the FSP and RIWP.

13.6 Comparability

Comparability is a qualitative parameter expressing the confidence that one set of data can be compared to another. Comparability is possible only when standardized sampling and analytical procedures are used.

14. Corrective Action

If unacceptable conditions are identified as a result of audits or are observed during field sampling and analysis, the PM, Field Team Leader, and QA officer will document the condition and initiate corrective procedures. The specific condition or problem will be identified, its cause will be determined, and appropriate action will be implemented.

The entire sampling program will be under the direction of the PM and QA officer. The emphasis in this program is on preventing problems by identifying potential errors, discrepancies, and gaps in the data collection, laboratory analysis, and interpretation process. Any problems identified will be promptly resolved. Likewise, follow-up corrective action is always an option in the event that preventative corrective actions are not effective.

The acceptance limits for the sampling and analyses to be conducted in this program will be those stated in the method or defined by other means in the Work Plan and FSP. Corrective actions are likely to be immediate in nature and most often will be implemented by the contracted laboratory analyst or the PM. The corrective action will usually involve recalculation, reanalysis, or repeating a sample run.

14.1 Immediate Corrective Action

Corrective action in the field may be needed when the sample requirements are changed (i.e., more/less samples, sampling locations other than those specified in the Work Plan), or when sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The Field Team Leader, Site Manager, and PM will approve the corrective action and notify the QA officer. The PM and QA officer will approve the corrective measure. The Field Team Leader and Site Manager will ensure that the corrective measure is implemented by the field team.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action
- The action taken in response
- The final resolution
- Any necessary approvals

Corrective action in the laboratory will be completed in accordance with the quality assurance procedures located in **Appendix A**. Any corrective actions completed by the

laboratory will be documented in both the laboratory's corrective action files, and the narrative data report sent from the laboratory to the PM. If the corrective action does not rectify the situation, the laboratory will contact the PM, who will determine the action to be taken and inform the appropriate personnel.

If potential problems are not solved as an immediate corrective action, the contractor will apply formalized long-term corrective action if necessary.

Tables

Table 1. Soil and Purifier Waste Field Sampling Matrix
Parcel D
Bronx, New York

Typical Sample I.D.	TYPICAL SOIL BORING SAMPLE SELECTION RATIONALE: 1. Soil/sediment sample within heaviest observed impacts (if present). 2. Soil/sediment sample beneath zone of deepest impacts. 3. Refer to job specific Work Plan for specific sampling details.								Analysis						Analysis					
	Samples																			
	Number Samples Proposed	Number Samples Collected	Date Collected	Within Historic Fill Layer	Heaviest Impacted Zone below 10 feet (if Present)	Water Table Interface	Subsurface soil/sediment below deepest observed visual impacts	Completion depth of boring	Loss On Ignition	Moisture	Acidity	Grain Size	Hydraulic Conductivity	Strength Test Post Grout Mix	TCL VOCs (EPA Method 8260B)	TCL SVOCs (EPA Method 8270)	TAL Metals (EPA Method 6010B/7470A)	PCBs (EPA Method 8082A)	Pesticides (EPA Method 8081B)	Cyanide (EPA Method 9012B)
Subsurface Soil/Purifier Waste																				
SB-XX (Soil)	36	TBD	TBD				X	Varies	X	X		X	X							
SB-XX (PW)	36	TBD	TBD	X				Varies	X	X	X		X	X						
SB-XX (Soil)	3	TBD	TBD		X	X		15-20 ftbg							X	X	X	X	X	X

Notes:
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
TCL - Target Compound List
TAL - Target Analyte List
TBD - To Be Determined
EPA - Environmental Protection Agency
Samples will be analyzed in accordance with the Field Sampling Plan

Table 2. Groundwater Field Sampling Matrix
Parcel D
Bronx, New York

Sample I.D.	Sample Location	SAMPLE SELECTION RATIONALE: 1. Groundwater Sample locations and depth intervals will be specified within a job specific Work Plan				Analysis																		
		Sample Number			Sample Zone	TCL VOCs/BTEX (EPA Method 8260B/8260C)	TCL SVOCs (EPA Method 8270D)	TAL Metals (EPA Method 6010B/7471A)	PCBs (EPA Method 8082A)	Pesticides (EPA Method 8081B)	Total Cyanide (EPA Method 9012B)	Free Cyanide (EPA Method 9016)	Total Sulfur (EPA Method 6010)	Sulfate (EPA Method 300)	Sulfide (EPA Method SM4500 52F11)	Chloride (EPA Method 300)	Fluoride (EPA Method 300)	Total Phosphorous (EPA Method	Alkalinity-Carbonate EPA Method SM2320B)	Alkalinity-Bicarbonate (EPA Method SM2320B)	Total Organic Carbon (EPA Method 415.3)	Total Dissolved Solids (EPA Method SM2540C)	1,4-Dioxane (EPA Method 8270-SIM)	TAL PFAS (EPA Method 537)
		Number Samples Proposed	Number Samples Collected	Date Collected	Water Table																			
Monitoring Well Sample Locations																								
MW-XX	Onsite	4	TBD	TBD	TBD	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X		
MW-XX	Onsite	3	TBD	TBD	TBD	X	X	X			X	X												
MW-XX	Onsite	4	TBD	TBD	TBD																		X	X
TW-XX	Offsite	3	TBD	TBD	TBD	X	X	X	X	X	X													

Notes:

VOCs - Volatile Organic Compounds
SVOCs - Semi-volatile Organic Compounds
PCBs - Polychlorinated Biphenyls
TCL - Target Compound List
TAL - Target Analyte List
EPA - Environmental Protection Agency
PFAS - Per- and Polyfluoroalkyl Substances
TBD - To Be Determined based on field observations
Samples will be collected in accordance with the Field Sampling Plan

Table 3. Soil Vapor Field Sampling Matrix
Parcel D
Bronx, New York

Typical Sample I.D.	SAMPLE SELECTION RATIONALE: 1. The soil vapor probes will be installed to a depth of 2' below surface grade						Analysis	Soil Vapor Quality Measurements
	Sample Number							
	Number Samples Proposed	Number Samples Collected	Date Collected	Sampling Duration	Flow Rate	Soil Vapor Probe Installation Depth	USEPA Method TO-15*	Tracer Gas (Helium)
Soil Vapor Sample								
SV-XX	6	TBD	TBD	2 hours	0.2 L/min	2 ftbg	X	X

Notes:
1. Installation depth below gound surface dependent on parking area asphalt and base slab thickness.
TBD - To Be Determined based on field observations
Samples will be collected in accordance with the Field Sampling Plan
***** Samples to be analyzed for BTEX and Naphthalene only
BTEX - Benzene, Toluene, Ethylbenzene, Xylene

Table 4. Analytical Methods/Quality Assurance Summary Table
Parcel D
Bronx, New York

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB	DUP	MS/MSD						
Groundwater	10	1/Cooler	1/20	1/20	1/20	TBD	TCL VOCs/BTEX	8260B/8260C	pH<2 with HCl, Cool to 4°C	10 days	(2)* 40 mL VOA vials
	10	N/A	1/20	1/20	1/20	TBD	TCL SVOCs	8270C	Cool to 4°C	5 days	(2) Liter amber glass
	10	N/A	1/20	1/20	1/20	TBD	TAL Metals	6010C/6020A/7471A	pH<2 with HNO3 Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	(1) 500 mL Polyethylene container
	10	N/A	1/20	1/20	1/20	TBD	Total CN	9014	NaOH, Cool to 4°C	14 days	(1) 500 mL amber glass
	7	N/A	1/20	1/20	1/20	TBD	Free CN	9016	NaOH, Cool to 4°C	14 days	(1) 500 mL amber glass
	4	N/A	1/20	1/20	1/20	TBD	Sulfur	6010	HNO3, Cool to 4°C	180 days	(1) 1L Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	Sulfate	300	Cool to 4°C	28 days	(1) 500 mL Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	Sulfide	SM4500 52F11	ZnAc, NaOH, Cool to 4°C	7 days	(1) 500 mL Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	Chloride	300	Cool to 4°C	28 days	(1) 250 mL Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	Fluoride	300	Cool to 4°C	28 days	(1) 250 mL Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	Phosphorous	365.4	H2SO4, Cool to 4°C	28 days	(1) 500 mL Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	ALK-CO3	SM2320B	Cool to 4°C	14 days	(1) 250 mL amber glass
	4	N/A	1/20	1/20	1/20	TBD	ALK-HCO3	SM2320B	Cool to 4°C	14 days	(1) 250 mL amber glass
	4	N/A	1/20	1/20	1/20	TBD	TDS	SM 2540C	Cool to 4°C	7 days	(1) 250 mL Polyethylene container
	4	N/A	1/20	1/20	1/20	TBD	TOC	415.3	Cool to 4°C	28 days	(1) 250 mL Polyethylene container
	3	N/A	1/20	1/20	1/20	TBD	PCBs	8082A	Cool to 4°C	7 days	(2) 1-liter amber glass
	3	N/A	1/20	1/20	1/20	TBD	Pesticides	8081B	Cool to 4°C	7 days	(2) 1-liter amber glass
	4	N/A	1/20	1/20	1/20	TBD	1,4 Dioxane	8270D	Cool to 4°C	7 days	(1-2)* 1-liter amber glass
	4	N/A	1/20	1/20	1/20	TBD	TAL PFAS	537	Trizma, Cool to 4°C	14 days until extraction, 28 days after extraction	(3)* 250-mL HDPE or polypropylene containers
Soil&Purifier Waste	36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Soil	3	1/Cooler	1/20	1/20	1/20	TBD	TCL VOCs	8260B	Cool to 4°C	48 hours to lab prep, then 14 days preserved	(3) 40-mL vials (2 with stir bars) or (3) 5-gram Encores
	3	NA	1/20	1/20	1/20	TBD	TCL SVOCs	8270D	Cool to 4°C	10 days	(1) Wide mouth 4-oz. clear glass jar
	3	NA	1/20	1/20	1/20	TBD	TAL Metals	6010B/7471A	Cool to 4°C	28 days for mercury; 6 months for other metals	(1) Wide mouth 2-oz. clear glass jar
	3	NA	1/20	1/20	1/20	TBD	PCBs	8082A	Cool to 4°C	14 days	(1) Wide mouth 4-oz. clear glass jar
	3	NA	1/20	1/20	1/20	TBD	Pesticides	8081A	Cool to 4°C	14 days	(1) Wide mouth 4-oz. clear glass jar
	3	NA	1/20	1/20	1/20	TBD	Cyanide	9012B	Cool to 4°C	14 days	(1) Wide mouth 2-oz amber jar
Soil Vapor	6	NA	NA	1/20	NA	TBD	BTEX, Naphthalene	USEPA Method TO-15	None	30 Days	(1) 2-liter, stainless steel SUMMA canister

Notes:
*Sample volume required dependent on laboratory
Field blanks only collected if non-dedicated equipment will be used and decontaminated

VOCs - Volatile organic compounds
SVOCs - Semivolatile organic compounds
PCBs - Polychlorinated Biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
TCL - Target Compound List
TAL - Target Analyte List

°C- Degrees Celsius
L - Liter
oz. - Ounce
mL - Milliliter
TBD - To be Determined

Table 5. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Parcel D
Bronx, New York

CAS Number	Analyte	DQO's		Chemtech	
		ASP 2005	Commercial Use [1]		
		CRQL	SCO	RL	MDL
TCL Volatile Organic Compounds (µg/Kg) via Method 8260 B					
71-55-6	1,1,1-Trichloroethane	3	500,000	5	0.5
79-34-5	1,1,2,2-Tetrachloroethane	10	NE	5	0.46
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	NE	NE	5	0.5
79-00-5	1,1,2-Trichloroethane	10	NE	5	0.9
75-34-3	1,1-Dichloroethane	10	240,000	5	0.5
75-35-4	1,1-Dichloroethene	10	500,000	5	0.5
87-61-6	1,2,3-Trichlorobenzene	10	NE	5	0.5
120-82-1	1,2,4-Trichlorobenzene	10	NE	5	0.5
96-12-8	1,2-Dibromo-3-chloropropane	100	NE	5	0.87
106-93-4	1,2-Dibromoethane (EDB)	10	NE	5	0.5
95-50-1	1,2-Dichlorobenzene	10	500,000	5	0.5
107-06-2	1,2-Dichloroethane	10	30,000	5	0.5
78-87-5	1,2-Dichloropropane	10	NE	5	0.26
541-73-1	1,3-Dichlorobenzene	10	280,000	5	0.37
106-46-7	1,4-Dichlorobenzene	10	130,000	5	0.41
123-91-1	1,4-Dioxane	NE	130,000	100	100
78-93-3	2-Butanone (MEK)	10	500,000	25	3.11
591-78-6	Methyl Butyl Ketone (2-Hexanone)	10	NE	25	2.5
108-10-1	4-Methyl-2-pentanone (MIBK)	10	NE	25	2.5
67-64-1	Acetone	10	500,000	25	2.5
71-43-2	Benzene	10	44,000	5	0.38
74-97-5	Bromochloromethane	10	NE	5	0.5
75-27-4	Bromodichloromethane	10	NE	5	0.5
75-25-2	Bromoform	10	NE	5	0.74
74-83-9	Bromomethane	10	NE	5	1
75-15-0	Carbon disulfide	10	NE	5	0.5
56-23-5	Carbon tetrachloride	10	22,000	5	0.5
108-90-7	Chlorobenzene	10	500,000	5	0.5
75-00-3	Chloroethane	10	NE	5	0.5
67-66-3	Chloroform	10	350,000	5	0.5
74-87-3	Chloromethane	10	NE	5	0.74
156-59-2	cis-1,2-Dichloroethene	10	500,000	5	0.5
10061-01-5	cis-1,3-Dichloropropene	10	NE	5	0.5
110-82-7	Cyclohexane	NE	NE	5	0.5
124-48-1	Dibromochloromethane	10	NE	5	0.23
75-71-8	Dichlorodifluoromethane (FREON 12)	10	NE	5	0.5
100-41-4	Ethylbenzene	10	390,000	5	0.5
98-82-8	Isopropylbenzene	10	NE	5	0.48
79-20-9	Methyl Acetate	NE	NE	5	1
1634-04-4	Methyl tert-butyl ether (MTBE)	NE	500,000	5	0.5
108-87-2	Methylcyclohexane	NE	NE	5	0.5
75-09-2	Methylene chloride	10	500,000	5	0.5
100-42-5	Styrene	10	NE	5	0.45
127-18-4	Tetrachloroethene	10	150,000	5	0.5
108-88-3	Toluene	10	500,000	5	0.5
156-60-5	trans-1,2-Dichloroethene	10	500,000	5	0.5
10061-02-6	trans-1,3-Dichloropropene	10	NE	5	0.5
79-01-6	Trichloroethene	10	200,000	5	0.5
75-69-4	Trichlorofluoromethane (FREON 11)	10	NE	5	0.5
75-01-4	Vinyl chloride	10	13,000	5	0.5
1330-20-7	Total Xylene	10	500,000	5	1.4

Table 5. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Parcel D
Bronx, New York

CAS Number	Analyte	DQO's		Chemtech	
		ASP 2005	Commercial Use [1]		
		CRQL	SCO	RL	MDL
TCL Semivolatile Organic Compounds (µg/Kg) via Method 8270					
92-52-4	1,1´-Biphenyl	NE	NE	330	12.6
95-94-3	1,2,4,5-Tetrachlorobenzene	330	NE	330	13.1
52438-91-2	2,2-oxybis[1-Chloropropane]	330	NE	330	13.8
95-95-4	2,4,5-Trichlorophenol	330	NE	330	10.2
88-06-2	2,4,6-Trichlorophenol	330	NE	330	23.4
120-83-2	2,4-Dichlorophenol	330	NE	330	12.7
105-67-9	2,4-Dimethylphenol	330	NE	330	18.9
51-28-5	2,4-Dinitrophenol	800	NE	330	33.9
121-14-2	2,4-Dinitrotoluene	330	NE	330	13.6
606-20-2	2,6-Dinitrotoluene	330	NE	330	13.6
91-58-7	2-Chloronaphthalene	330	NE	330	7.6
95-57-8	2-Chlorophenol	330	NE	330	17.6
91-57-6	2-Methylnaphthalene	330	NE	330	8.4
95-48-7	2-Methylphenol (o-Cresol)	330	500,000	330	18.1
88-74-4	2-Nitroaniline	800	NE	330	14.8
88-75-5	2-Nitrophenol	330	NE	330	16.5
91-94-1	3,3-Dichlorobenzidine	660	NE	330	21.4
99-09-2	3-Nitroaniline	800	NE	330	21.4
534-52-1	4,6-Dinitro-2-methylphenol	800	NE	330	19.1
101-55-3	4-Bromophenyl phenyl ether	330	NE	330	6.5
59-50-7	4-Chloro-3-methylphenol	330	NE	330	14.8
106-47-8	4-Chloroaniline	330	NE	330	23.5
7005-72-3	4-Chlorophenyl phenyl ether	330	NE	330	18.1
106-44-5	4-Methylphenol (p-Cresol)	330	NE	330	11
100-01-6	4-Nitroaniline	800	NE	330	43.4
100-02-7	4-Nitrophenol	800	NE	330	61.9
83-32-9	Acenaphthene	330	500,000	330	9.4
208-96-8	Acenaphthylene	330	500,000	330	8.4
98-86-2	Acetophenone	330	NE	330	57.7
120-12-7	Anthracene	330	500,000	330	6.8
108-95-2	Atrazine	NE	NE	330	17.6
100-52-7	Benzaldehyde	NE	NE	330	17.4
56-55-3	Benz[a]anthracene	330	5,600	330	9.6
50-32-8	Benzo[a]pyrene	330	1,000	330	13.1
205-99-2	Benzo[b]fluoranthene	330	5,600	330	10.9
191-24-2	Benzo[g,h,i]perylene	330	500,000	330	13.5
207-08-9	Benzo[k]fluoranthene	330	56,000	330	15.7
111-91-1	Bis(2-chloroethoxy)methane	330	NE	330	19.2
111-44-4	Bis(2-chloroethyl)ether	330	NE	330	16
117-81-7	Bis(2-ethylhexyl)phthalate	330	NE	330	16
85-68-7	Butyl benzyl phthalate	330	NE	330	11.8
105-6--2	Caprolactam	NE	NE	330	15.5
86-74-8	Carbazole	330	NE	330	7.3
218-01-9	Chrysene	330	56,000	330	15.1
84-74-2	Di-n-butyl phthalate	330	NE	330	26.2
117-84-0	Di-n-octyl phthalate	330	NE	330	3.8
53-70-3	Dibenz[a,h]anthracene	330	560	330	37.9
132-64-9	Dibenzofuran	330	350,000	330	13
84-66-2	Diethyl phthalate	330	NE	330	5.2
131-11-3	Dimethyl phthalate	330	NE	330	41.5
206-44-0	Fluoranthene	330	500,000	330	6.7
86-73-7	Fluorene	330	500,000	330	12.6
118-74-1	Hexachlorobenzene	330	6,000	330	13.6
87-68-3	Hexachlorobutadiene	330	NE	330	12.1
77-47-4	Hexachlorocyclopentadiene	330	NE	330	8.1
67-72-1	Hexachloroethane	330	NE	330	14.9
193-39-5	Indeno[1,2,3-cd]pyrene	330	5,600	330	36.6
78-59-1	Isophorone	330	NE	330	11
621-64-7	N-Nitrosodi-n-propylamine	330	NE	330	16.8
86-30-6	N-Nitrosodiphenylamine	330	NE	330	8
91-20-3	Naphthalene	330	500,000	330	11.5
98-95-3	Nitrobenzene	330	69,000	330	12.6
87-86-5	Pentachlorophenol	800	6,700	330	22.8
85-01-8	Phenanthrene	330	500,000	330	9
108-95-2	Phenol	330	500,000	330	7.7
129-00-0	Pyrene	330	500,000	330	8

Table 5. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Parcel D
Bronx, New York

CAS Number	Analyte	DQO's		Chemtech	
		ASP 2005	Commercial Use [1]		
		CRQL	SCO	RL	MDL
Inorganic Analytes (mg/Kg) via Methods 6010 & 7471					
7429-90-5	Aluminum	NE	NE	5	0.84
7440-36-0	Antimony	60	NE	2.5	0.56
7440-38-2	Arsenic	10	16	1	0.33
7440-39-3	Barium	200	400	5	0.40
7440-41-7	Beryllium	5	590	0.3	0.06
7440-43-9	Cadmium	5	9.3	5	0.38
7440-70-2	Calcium	NE	NE	0.3	0.06
7440-47-3	Chromium (sum of Cr III and Cr IV)	10	1,900	100	1.07
7440-48-4	Cobalt	50	NE	0.5	0.13
7440-50-8	Copper	25	270	1.5	0.57
7439-89-6	Iron	NE	NE	1	0.32
7439-92-1	Lead	5	3,900	5	1.33
7439-95-4	Magnesium	NE	NE	100	0.12
7439-96-5	Manganese	NE	10,000	1	4.58
7439-97-6	Mercury	0.2	2.8	0.01	0.00
7440-02-0	Nickel	40	210	2.00	0.46
7440-09-7	Potassium	NE	NE	100.00	3.50
7782-49-2	Selenium	5	1,500	1.00	0.41
7440-22-4	Silver	10	1,500	0.50	0.15
7440-23-5	Sodium	NE	NE	100.00	2.52
7440-28-0	Thallium	10	NE	2.00	0.27
7440-62-2	Vanadium	50	NE	2.00	0.59
7440-66-6	Zinc	20	10,000	2.00	0.70
Pesticides (mg/Kg) via Method 8081					
72-54-8	4,4´-DDD	16	92	1.7	0.13
72-55-9	4,4´-DDE	16	62	1.7	0.18
50-29-3	4,4´-DDT	16	47	1.7	0.1
309-00-2	Aldrin	8	1	1.7	0.15
319-84-6	alpha-BHC	8	3	1.7	0.14
5103-71-9	alpha-Chlordane	NE	24	1.7	0.1
319-85-7	beta-BHC	8	3	1.7	0.16
319-86-8	delta-BHC	8	500	1.7	0.15
60-57-1	Dieldrin	16	1	1.7	0.13
959-98-8	Endosulfan I	16	200	1.7	0.2
33213-65-9	Endosulfan II	16	200	1.7	0.18
1031-07-8	Endosulfan sulfate	16	200	1.7	0.14
72-20-8	Endrin	16	89	1.7	0.17
7421-93-4	Endrin Aldehyde	32	NE	1.7	0.15
53494-70-5	Endrin Ketone	NE	NE	1.7	0.14
58-89-9	gamma-BHC (Lindane)	8	9	1.7	0.17
5103-74-2	gamma-Chlordane	NE	NE	1.7	0.13
76-44-8	Heptachlor	8	15	1.7	0.15
1024-57-3	Heptachlor epoxide	8	NE	1.7	0.14
72-43-5	Methoxychlor	8	NE	1.7	0.13
8001-35-2	Toxaphene	160	NE	1.7	3.33
PCBs (mg/Kg) via Method 8082					
12674-11-2	Aroclor-1016	80	1	17	3.33
11104-28-2	Aroclor-1221	80	1	17	3.33
11141-16-5	Aroclor-1232	80	1	17	3.33
53469-21-9	Aroclor-1242	80	1	17	3.33
12672-29-6	Aroclor-1248	80	1	17	3.33
11097-69-1	Aroclor-1254	160	1	17	1.49
37324-23-5	Aroclor-1262	160	NE	17	3.33
11100-14-4	Aroclor-1268	160	NE	17	3.33
11096-82-5	Aroclor-1260	160	1	17	3.33

Notes:

mg/kg - milligrams per kilogram
µg/Kg - micrograms per kilogram
RL - Reporting Limits
MDL - Method Detection Limit
DQO - Data Quality Objectives
NE - Not Established
TCL - Target Compound List
SCO - Site Cleanup Objective
1 - DQOs are based on 6 NYCRR Part 375 -6.8(b) Residential Use Soil Clean-up Objectives
2 - RLs and MDLs are based on Pace Analytical's Reporting Limits and Method Detection limits as of October 2010.

Table 6. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Parcel D
Bronx, New York

CAS Number	Analyte Name	DQO's		Hampton-Clarke	
		ASP 2005	NY AWQS GA [1]		
		CRQL	H(WS)	RL	MDL
Volatile Organic Compounds Method 8260 B (µg/L)					
71-55-6	1,1,1-Trichloroethane	3	5	1	0.385
79-34-5	1,1,2,2-Tetrachloroethane	1	5	1	0.727
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	NE	5	1	0.973
79-00-5	1,1,2-Trichloroethane	1	1	**1**	0.857
75-34-3	1,1-Dichloroethane	1	5	1	0.312
75-35-4	1,1-Dichloroethene	1	0.07	**1**	0.772
87-61-6	1,2,3-Trichlorobenzene	1	5	1	0.635
120-82-1	1,2,4-Trichlorobenzene	1	5	1	0.532
96-12-8	1,2-Dibromo-3-chloropropane	1	0.04	**1**	0.944
106-93-4	1,2-Dibromoethane (EDB)	1	0.0006	**1**	0.745
95-50-1	1,2-Dichlorobenzene	1	3	**1**	0.463
107-06-2	1,2-Dichloroethane	1	NE	0.5	0.401
78-87-5	1,2-Dichloropropane	1	1	**1**	0.561
541-73-1	1,3-Dichlorobenzene	1	3	**1**	0.416
106-46-7	1,4-Dichlorobenzene	1	3	**1**	0.463
123-91-1	1,4-Dioxane	NE	NE	50	46.9
78-93-3	2-Butanone (MEK)	5	50*	1	0.711
591-78-6	Methyl Butyl Ketone (2-Hexanone)	5	50*	1	0.439
108-10-1	4-Methyl-2-pentanone (MIBK)	5	NE	1	0.548
67-64-1	Acetone	5	50*	5	3.91
71-43-2	Benzene	1	1	**0.5**	0.445
74-97-5	Bromochloromethane	1	5	1	0.602
75-27-4	Bromodichloromethane	1	50*	1	0.488
75-25-2	Bromoform	1	50*	1	0.683
74-83-9	Bromomethane	1	5	1	0.602
75-15-0	Carbon disulfide	1	60*	1	0.454
56-23-5	Carbon tetrachloride	1	5	1	0.407
108-90-7	Chlorobenzene	1	5	1	0.322
75-00-3	Chloroethane	1	5	1	0.684
67-66-3	Chloroform	1	7	1	0.702
74-87-3	Chloromethane	1	5	1	0.261
156-59-2	cis-1,2-Dichloroethene	1	5	1	0.567
10061-01-5	cis-1,3-Dichloropropene	1	0.4	**1**	0.646
110-82-7	Cyclohexane	NE	NE	5	0.438
124-48-1	Dibromochloromethane	1	50*	1	0.822
75-71-8	Dichlorodifluoromethane (FREON 12)	1	5	1	0.485
100-41-4	Ethylbenzene	1	5	1	0.727
98-82-8	Isopropylbenzene	1	5	1	0.393
79-20-9	Methyl Acetate	NE	NE	1	0.419
1634-04-4	Methyl tert-butyl ether (MTBE)	NE	10*	1	0.371
108-87-2	Methylcyclohexane	NE	NE	1	0.768
75-09-2	Methylene chloride	2	5	1	0.684
100-42-5	Styrene	1	5	1	0.319
127-18-4	Tetrachloroethene	1	5	1	0.956
108-88-3	Toluene	1	5	1	0.487
156-60-5	trans-1,2-Dichloroethene	1	5	1	0.723
10061-02-6	trans-1,3-Dichloropropene	1	0.4	**1**	0.433
79-01-6	Trichloroethene	1	5	1	0.633
75-69-4	Trichlorofluoromethane (FREON 11)	1	5	1	0.449
75-01-4	Vinyl chloride	1	2	**1**	0.494
1330-20-7	Total Xylene	1	5	1	0.448

Table 6. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Parcel D
Bronx, New York

CAS Number	Analyte Name	DQO's		Hampton-Clarke	
		ASP 2005	NY AWQS GA [1]		
		CRQL	H(WS)	RL	MDL
Semivolatile Organic Compounds (µg/L) via Method 8270					
92-52-4	1,1´-Biphenyl	NE	5	2	0.4748
95-94-3	1,2,4,5-Tetrachlorobenzene	10	5	2	0.3989
52438-91-2	2,2´-oxybis(1-chloropropane)	10	NE	2	0.595
95-95-4	2,4,5-Trichlorophenol	10	NE	2	0.4211
88-06-2	2,4,6-Trichlorophenol	10	NE	2	0.3588
120-83-2	2,4-Dichlorophenol	10	5	2	0.3759
105-67-9	2,4-Dimethylphenol	10	50*	0.5	0.3135
51-28-5	2,4-Dinitrophenol	25	10*	10	3.1732
121-14-2	2,4-Dinitrotoluene	10	5	2	0.2946
606-20-2	2,6-Dinitrotoluene	10	5	2	0.395
91-58-7	2-Chloronaphthalene	10	10**	2	0.4628
95-57-8	2-Chlorophenol	10	NE	2	0.3146
91-57-6	2-Methylnaphthalene	10	NE	2	0.4396
95-48-7	2-Methylphenol (o-Cresol)	10	1**	**0.5**	0.3114
88-74-4	2-Nitroaniline	25	5	10	0.3785
88-75-5	2-Nitrophenol	10	NE	2	0.3927
91-94-1	3,3-Dichlorobenzidine	20	5	2	0.9093
99-09-2	3-Nitroaniline	25	5	2	0.3611
534-52-1	4,6-Dinitro-2-methylphenol	25	NE	10	2.9089
101-55-3	4-Bromophenyl phenyl ether	10	NE	2	0.3741
59-50-7	4-Chloro-3-methylphenol	10	NE	0.5	0.3732
106-47-8	4-Chloroaniline	10	5	2	0.3104
7005-72-3	4-Chlorophenyl phenyl ether	10	NE	2	0.3197
106-44-5	4-Methylphenol (p-Cresol)	10	1**	**2**	0.2576
100-01-6	4-Nitroaniline	25	5	2	0.3278
100-02-7	4-Nitrophenol	25	NE	2	0.3121
83-32-9	Acenaphthene	10	20**	2	0.2892
208-96-8	Acenaphthylene	10	NE	2	0.3403
98-86-2	Acetophenone	10	NE	2	0.711
120-12-7	Anthracene	10	50*	2	0.2973
108-95-2	Atrazine	NE	7.5	2	0.3161
100-52-7	Benzaldehyde	NE	NE	2	0.4777
56-55-3	Benz[a]anthracene	10	0.002*	**2**	8.7905
50-32-8	Benzo[a]pyrene	10	ND	2	0.3606
205-99-2	Benzo[b]fluoranthene	10	0.002*	**2**	0.5740
191-24-2	Benzo[g,h,i]perylene	10	NE	2	0.3884
207-08-9	Benzo[k]fluoranthene	10	0.002*	**2**	0.419
111-91-1	Bis(2-chloroethoxy)methane	10	5	2	0.2590
111-44-4	Bis(2-chloroethyl)ether	10	1	0.5	0.3226
117-81-7	Bis(2-ethylhexyl)phthalate	10	5	2	0.4888
85-68-7	Butyl benzyl phthalate	10	50*	2	0.4842
105-6--2	Caprolactam	NE	NE	2	0.4078
86-74-8	Carbazole	10	NE	2	0.2547
218-01-9	Chrysene	10	0.002*	**2**	0.2528
84-74-2	Di-n-butyl phthalate	10	50	2	0.3488
117-84-0	Di-n-octyl phthalate	10	50*	2	0.5902
53-70-3	Dibenz[a,h]anthracene	10	NE	2	0.3108
132-64-9	Dibenzofuran	10	NE	0.5	0.2677
84-66-2	Diethyl phthalate	10	50*	2	0.3176
131-11-3	Dimethyl phthalate	10	50*	2	0.223
206-44-0	Fluoranthene	10	50*	2	0.2137
86-73-7	Fluorene	10	50*	2	0.2596
118-74-1	Hexachlorobenzene	10	0.04	2	0.3377
87-68-3	Hexachlorobutadiene	10	0.5	2	0.642
77-47-4	Hexachlorocyclopentadiene	10	5	2	0.4211
67-72-1	Hexachloroethane	10	5	2	0.473
193-39-5	Indeno[1,2,3-cd]pyrene	10	0.002*	**2**	0.3406
78-59-1	Isophorone	10	50*	2	0.3035
621-64-7	N-Nitrosodi-n-propylamine	10	NE	0.5	0.2924
86-30-6	N-Nitrosodiphenylamine	10	50*	2	0.463
91-20-3	Naphthalene	10	10**	0.5	0.3836
98-95-3	Nitrobenzene	10	0.4	**2**	0.4588
87-86-5	Pentachlorophenol	25	1**	**10**	2.6901
85-01-8	Phenanthrene	10	50*	2	0.2682
108-95-2	Phenol	10	1**	**2**	0.2543
129-00-0	Pyrene	10	50*	2	0.2220

Table 6. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Parcel D
Bronx, New York

CAS Number	Analyte Name	DQO's		Hampton-Clarke	
		ASP 2005	NY AWQS GA [1]		
		CRQL	H(WS)	RL	MDL
Inorganic Analytes (mg/L) via Methods 6010, 6020 & 7471					
7429-90-5	Aluminum	NE	NE	0.2	0.14343
7440-36-0	Antimony	60	3	0.02	0.155246
7440-38-2	Arsenic	10	25	0.02	0.0129589
7440-39-3	Barium	200	1000	0.05	0.0008098
7440-41-7	Beryllium	5	3*	0.1	0.014047
7440-42-8	Boron			0.012	0.000312
7440-43-9	Cadmium	5	5	0.012	0.0010993
7440-70-2	Calcium	NE	NE	5	0.329166
7440-47-3	Chromium (sum of Cr III and Cr IV)	10	50	0.05	0.0014165
7440-48-4	Cobalt	50	NE	0.02	0.0018063
7440-50-8	Copper	25	200	0.05	0.0042669
7439-89-6	Iron	NE	300	0.3	0.089 5939
7439-92-1	Lead	5	25	0.012	0.0108435
7439-95-4	Magnesium	NE	35000*	5	0.101735
7439-96-5	Manganese	NE	300	0.04	0.0030397
7439-97-6	Mercury	0.2	0.7	0.02	0.002826
7440-02-0	Nickel	40	100	0.05	0.0030737
7440-09-7	Potassium	NE	NE	0.04	0.0209161
7782-49-2	Selenium	5	10	0.02	0.0020204
7440-22-4	Silver	10	50	0.02	0.0117844
7440-23-5	Sodium	NE	20000	0.05	0.010 2217
7440-28-0	Thallium	10	0.5*	0.05	0.0005654
7440-62-2	Vanadium	50	NE	0.05	0.0023475
7440-66-6	Zinc	20	2000*	0.05	0.0136066

Notes:

* = Guidance Value

mg/L - milligrams per Liter

µg/L - micrograms per Liter

RL - Reporting Limit

MDL - Method Detection Limit

DQO - Data Quality Objectives

1 - DQOs are based on TOGS Ambient Water Quality Standards and Guidance Values and Groundwater designation

2 - RLs and MDLs are based on Hampton-Clarke's Reporting Limits and Method Detection limits.

Bolding - RL does not meet the DQO

Table 7. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Vapor Samples
Parcel D
Bronx, New York

CAS Number	Analyte	Chemtech [1]	
		RL	MDL
EPA TO-15 Compounds (ppbv)			
71-43-2	Benzene	1.60	0.0536
100-41-4	Ethyl Benzene	2.17	0.0728
136777-61-2	m/p-Xylene	4.34	0.1330
95-47-6	o-Xylene	2.17	0.0728
108-88-3	Toluene	1.88	0.0447
91-20-3	Naphthalene	2.62	0.2274

Notes:

ppbv - parts per billion per volume

RL - Reporting Limits

MDL - Method Detection Limit

1 - RLs and MDLs are based on Chemtech's Reporting Limits and Method Detection limits as of October 2010.

Appendix A

Hampton-Clarke Inc. Laboratory Quality Assurance Manual (electronic only)

Chemtech Laboratory Quality Assurance Manual (electronic only)

QUALITY ASSURANCE MANUAL

for

Hampton-Clarke, Inc.
175 Route 46 West
2 Madison Road
Fairfield, New Jersey 07004
And
137-D Gaither Drive
Mount Laurel, NJ 08054

Responsible Parties

Name	Function (Unit)	Phone	Signatures	Date
Jean Revolus	Laboratory Director	973-244-9770		9/25/2017
Robin Cousineau	Quality Assurance Manager	973-244-9770		9/25/2017
Akmal Hamid	Technical Director	973-244-9770		9/25/2017

Revision Number:	**22**	**Effective Date:**	**09/25/17**
Distribution List:	Project Management Sample Receiving Organics Department Inorganics/Wet Chemistry Department Field Services Department		

SECTION 2 - TABLE OF CONTENTS

SECTION 3 – INTRODUCTION AND SCOPE

The purpose of this *Quality Assurance Manual* is to outline the quality system for the laboratory. The Hampton-Clarke, Inc. *Quality Assurance Manual* defines the policies, procedures, and documentation that assures analytical services continually meet a defined standard of quality that is designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance.

The Quality Assurance Manual sets the standard under which all laboratory operations are performed including the laboratory's organization, objectives, and operating philosophy.

3.1 Scope of Testing

The laboratory scope of analytical testing services includes those listed in Appendix 1.

3.2 Table of Contents, References and Appendices

The table of contents is in Section 2 of this Manual. This *Quality Assurance Manual* uses the references from the 2009 TNI Standard, Module 1, 2 and 4.

3.3 Glossary and Acronyms Used

See Appendix 4 for a list of Acronyms and Definitions.

SECTION 4 – ORGANIZATIONAL ROLES AND RESPONSIBILITIES

Hampton-Clarke, Inc. is a legally identifiable organization. Through application of the policies and procedures outlined in this chapter, the laboratory assures that it is impartial and that personnel are free from undue commercial, financial, or other undue pressures that might influence their technical judgment. The laboratory is responsible for carrying out testing activities that meet the requirements of the 2009 TNI Standard and that meet the needs of the client, such as complying with the QSM DOD and ISO/IEC 17025.

4.1 Laboratory Organizational Structure

Hampton-Clarke, Inc. is a commercial environmental testing laboratory. The tax ID number is available upon request, if applicable. The laboratory operates in Fairfield, New Jersey. The main laboratory is located at 175 Route 46 West in Fairfield. The Volatile Organics laboratory and Field Services Department is located at 2 Madison Road, also in Fairfield, New Jersey. The Service Center is located in Mt. Laurel, New Jersey at 137-D Gaither Dr.

4.2 Roles, Responbilites and Authority of Management

Management includes the Laboratory Director, Technical Director and the Quality Assurance Director. Management has the overall responsibility for the technical operations and authority needed to generate the required quality of laboratory operations. Management's commitment to quality and to the Quality System is stated in the Quality Policy, which is upheld through the application of related policies and procedures. Management ensures technical competence of personnel, operating equipment, performing tests, evaluating results, or signing reports, and limits authority to perform laboratory functions to those appropriately trained and/or supervised. The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests is documented in Section 17.

Management bears specific responsibility for maintenance of the Quality System. This includes defining roles and responsibilities to personnel, approving documents, providing required training, providing a procedure for confidential reporting of data integrity issues, and periodically reviewing data, procedures, and documentation. Management ensures that audit findings and corrective actions are completed within required time frames.

Management is responsible for defining the minimal level of education, qualifications, experience, and skills necessary for all positions in the laboratory and assuring that technical staffs have demonstrated capabilities in their tasks.

Designated alternates (Deputies) are appointed by management during the absence of the Laboratory Manager, Technical Director or the Quality Assurance Director.

SECTION 5 – QUALITY SYSTEMS

The laboratory's Quality System is documented in this *Quality Assurance Manual* and associated quality system documents. Together they describe the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of the organization for ensuring quality in its work processes, products, and services.

5.1 Quality Policy

A Quality Policy statement, including objectives and commitments by top management is required in the Quality Assurance Manual. The quality policy is signed and dated, and is issued under the authority of the highest level of laboratory management, which demonstrates management's commitment to integrity, ethics, the quality system and associated standards.

Quality Policy Statement

The objective of the quality system and the commitment of management are to consistently provide our customers with data of known and documented quality that meets their requirements. Hampton-Clarke, Inc. policy is to use good professional practices to maintain quality, to uphold the highest quality of service and to comply with the all state and federal requirements, as well as comply with the NELAC Standard, the DOD QSM and ISO/IEC 17025 requirements. The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work. This policy is implemented and enforced through the unequivocal commitment of management at all levels to the Quality Assurance (QA) principles and practices outlined in this manual. However, the primary responsibility for quality rests with each individual within the laboratory organization. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize him or herself with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality.

5.2 Quality Assurance Manual

Management ensures that the laboratory's policies and objectives for quality are documented by reference or by inclusion in the *Quality Assurance Manual*, and that the *Quality Assurance Manual* is communicated to, understood by, and implemented by all personnel concerned. All employees must sign a form, which is kept with their training records that states that they have read and understood the *Quality Assurance Manual*, including the quality policy. The *Quality Assurance Manual* is maintained current and up-to-date by the Quality Assurance Director.

SECTION 6 – DOCUMENT MANAGEMENT

Document management is through controlled documents. A CONTROLLED DOCUMENT is one that is uniquely identified, issued, tracked, and kept current as part of the quality system. Controlled documents may be internal documents or external documents.

OBSOLETE DOCUMENTS are documents that have been superseded by more recent versions.

6.1 Controlled Documents

Documents are reviewed and approved for use by management prior to issue. They are reviewed annually to ensure their contents are suitable and in compliance with the current quality systems requirements, and accurately describe current procedures. Approved copies of documents are available at all locations where operations are essential to the effective functions of the laboratory. These documents are located on the W drive (W:\QAQC Documents). Each time an

updated controlled document is posted, an e-mail notification is sent to appropriate supervisors for distribution. Laboratory personnel are required to read the document and submit documentation indicating that he/she has read and understood the document.

Controlled internal documents are uniquely identified with 1) date of issue, 2) revision identification, 3) page number, and 4) the signatures of the issuing authority (i.e. management).

A master list of controlled internal documents is maintained that includes distribution, location, and revision dates. The controlled document list is maintained by the Quality Assurance Director.

6.1.1 Document Changes to Controlled Documents

6.1.1.1 Document Changes

All document changes must be approved. The modified document is then copied and distributed, and obsolete documents are removed. Amendments to documents are incorporated into a new revision and reissued as soon as practicable

6.2 Obsolete Documents

All invalid or obsolete documents are removed from general distribution, or otherwise prevented from unintended use. Obsolete documents retained for legal use or historical knowledge preservation are appropriately marked and retained.

6.3 Standard Operating Procedures

Standard Operating Procedures (SOPs), reference methods and manuals are available to laboratory personnel. Current versions are located on the W: drive under the folder QA/QC Documents. Any deviations from published methods are documented in the laboratory SOPs. SOPs are submitted to client for review upon request.

Each SOP indicates the effective date, the revision number, and the signature(s) of the preparer, the Laboratory Director and Quality Assurance Director.

6.3.1 Test Method SOPs

The laboratory has SOPs for all test methods within its scope, located in the Quality Assurance office, and for procedures that are part of the Quality System that accurately reflect how the analytical process is performed. Where equipment manuals or published methods accurately reflect laboratory procedures in detail, a separate SOP is not required.

Any deviation from a test method is documented, including both a description of the change made and a technical justification. The deviation from a test method is reported to the client in the nonconformance summary.

Each Test Method SOP includes or references (as applicable) the following:

a) identification of the test method;
b) applicable matrix or matrices;
c) detection limit;
d) scope and application, including components to be analyzed;
e) summary of the method;
f) definitions;
g) interferences;
h) safety;
i) equipment and supplies;
j) reagents and standards;
k) sample collection, preservation, shipment and storage;
l) quality control, including acceptance criteria
m) calibration
n) procedure;
o) data analysis and calculations;
p) method performance;
q) pollution prevention;
r) data assessment and acceptance criteria for quality control measures;
s) corrective actions for out-of-control ;
t) contingencies for handling out-of-control or unacceptable data;
u) waste management;
v) references; and,
w) any tables, diagrams, flowcharts and validation data.

SECTION 7 – REVIEW OF REQUESTS, TENDERS AND CONTRACTS

The review of all new work assures that oversight is provided so that requirements are clearly defined, the laboratory has adequate resources and capability, and the test method is applicable to the customer's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality.

Contracts for new work may be formal bids, signed documents, verbal, or electronic.

7.1 Procedure for the Review of Work Requests

The Laboratory Director and Quality Assurance Director determine if the laboratory has the necessary accreditations, resources, including schedule, equipment, deliverables, and personnel to meet the work request. The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to the complete the work satisfactorily.

The client is informed of any deviation from the contract including the test method or sample handling processes. All differences between the request and the final contract are resolved and recorded before any work begins. It is necessary that the contract be acceptable to both the laboratory and the client. The review process is repeated when there are amendments to the original contract by the client. The participating personnel are given copies of the amendments.

For routine projects and other simple tasks, a review by the Account Executive is considered adequate. The Quality Assurance Director confirms that the laboratory

has any required certifications, that it can meet the client's data quality and reporting requirements, and that the lab has the capacity to meet the client's turn around needs.

For a new, complex or large project, the proposed work contract review is a function of the following departments:

- Hampton-Clarke Officers
  - VP of Laboratory Services; sales and marketing
  - Partner: financial, sales and marketing
  - Partner: technical and operational evaluation

- Administration: contract review – legal and insurance issues
- Controller: financial – client financial status
- Directors: technical
- Insurance Agent, Attorney (as needed)]\

7.2 Documentation of Review

Records are maintained for every contract or work request, when appropriate. This includes pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract.

SECTION 8 – SUBCONTRACTING OF TESTS

A SUBCONTRACT LABORATORY is defined as a laboratory external to this laboratory, or at a different location than the address(es) indicated on the front cover of this manual, that performs analyses for this laboratory. When subcontracting analytical services, the laboratory assures work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests.

A list of subcontractors is maintained. The laboratory notifies the client of the intent to subcontract the work in writing. When possible, the laboratory gains the approval of the client to subcontract their work prior to implementation.

The laboratory performing the subcontracted work is identified in the final report.

SECTION 9 – PURCHASING SERVICES AND SUPPLIES

The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality by using approved suppliers and products.

The responsibility for the review and approval of the supplier of services and supplies and approves technical content of purchasing documents prior to ordering lies with the department Supervisor or Director. Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality by signing packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

SECTION 10 – SERVICE TO THE CLIENT

The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring of the laboratory performance related to their work. Each request is reviewed to determine the nature of the request and the laboratory's ability to comply with the request within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients.

10.1 Client Confidentiality

The laboratory confidentiality policy is to not divulge or release any information to a third party without proper authorization.

All electronic data (storage or transmissions) are kept confidential, based on technology and laboratory limits, as required by client or regulation.

The following confidentiality statement appears on all outgoing emails:

PLEASE NOTE: The information being transmitted by this email message is being sent by Hampton-Clarke Inc. it is intended for the exclusive use of the addressee named above and may constitute information that is privileged or confidential or otherwise legally exempt from disclosure. If you are not the named addressee or an employee or agent responsible for delivering this message to the named addressee, you are not authorized to retain, read, copy or disseminate this message or any part of it. If you received this email message in error, please notify us immediately by telephone and delete the email. Thank you.

SECTION 11 – COMPLAINTS

The purpose of this section is to assure that customer complaints are addressed and corrected. This includes requests to verify results or analytical data. Verification of analytical results takes place through the initiation of a Data Validation/Inquiry form. The person receiving the inquiry initiates the document and forwards to the appropriate personnel. Upon completion, the client is notified of the findings. Additionally, the laboratory reviews all complaints and determines appropriate action. All customer complaints are documented by the person receiving the complaint and addressed by appropriate personnel. If it is determined that a complaint is without merit, it is documented, and the client is contacted. If it is determined that the complaint has merit, a corrective action is initiated. See Section 13 for corrective action procedures.

All data/validations and corrections actions are controlled and maintained in the Quality Assurance departments.

SECTION 12 – CONTROL OF NON-CONFORMING WORK

NON-CONFORMING WORK is work that does not meet acceptance criteria or requirements. Non-conformances can include unacceptable quality control results (see Section 24 Assuring the Quality of Results) or departures from standard operating procedures or test methods. Requests for departures from laboratory procedures are approved by the Quality Assurance Director and documented.

The policy for control of non-conforming work is to identify the non-conformance, determine if it will be permitted, and take appropriate action. All employees have the authority to stop work on samples when any aspect of the process does not conform to laboratory

requirements. The procedure for investigating and taking associated corrective actions of non-conforming work are described in Section 13.

The laboratory evaluates the significance of the nonconforming work, and takes corrective action. Employees must immediately notify their Supervisor or Technical Director of any non-conformance. The Supervisor or Director reviews the significance of non-conformance and takes a course of action. The client is notified if their data has been impacted. Resumption of work after non-conformance is authorized by the Technical Director or Quality Assurance Director.

SECTION 13 – CORRECTIVE ACTION

CORRECTIVE ACTION is the action taken to eliminate the causes of an existing nonconformity, defect, or other undesirable situation in order to prevent recurrence. Deficiencies cited in external assessments, internal quality audits, data reviews, client complaints, or managerial reviews are documented and require corrective action.

The Quality Assurance department is responsible for initiating corrective action on routine data reviews. The Quality Assurance department is responsible for monitoring and recording all corrective actions. All deficiencies are investigated and a corrective action plan developed and implemented if determined necessary. The implementation is monitored for effectiveness.

13.1 Selection and Implementation of Corrective Actions

Once an exceedance or nonconformance is noted, the first action is an investigation to determine the root cause. Any employee can initiate a corrective action.

Records are maintained of nonconformances requiring corrective action to show that the root cause(s) was investigated, and includes the results of the investigation.

The appropriate Technical Director ensures that corrective actions are discharged within the agreed upon time frame.

13.2 Monitoring of Corrective Action

The Quality Assurance department is responsible for monitoring corrective action through a follow up investigation to ensure that the correction actions were effective.

13.3 Technical Corrective Action

Sample data associated with a failed quality control are evaluated for the need to be reanalyzed or qualified. Unacceptable quality control results are documented, and if the evaluation requires cause analysis, the cause and solution are recorded.

The analyst is responsible for initiating or recommending corrective actions and ensuring that exceedances of quality control acceptance criteria are documented. Analysts routinely implement corrective actions for data with unacceptable QC measures. First level correction may include re-analysis without further assessment.

If the test method SOPs addresses the specific actions to take, they are followed. Otherwise, corrective actions start with assessment of the cause of the problem.

Technical directors review corrective action reports and suggest improvements, alternative approaches, and procedures where needed. If the data reported are affected adversely by the nonconformance, the client is notified.

The discovery of a non-conformance for results that have already been reported to the client must be immediately evaluated for significance of the non-conformance, its acceptability to the client, and determination of the appropriate corrective action.

13.4 Permitted Departures from Documented Policies and Procedures

The laboratory allows the release of non-conforming data only with the approval of the appropriate Technical Director or their designee on a case-by-case basis. Planned departures from procedures or policies do not require audits or investigations.

An example of a departure from a procedure that may be allowed includes insufficient sample volume for reanalysis. An example of a planned departure from a procedure includes receiving insufficient sample volume for a requested analysis and when informed of this deviation, the client want the analysis performed anyway.

Permitted departures for non-conformances such as QC failures, are fully documented and include the reason for the departure, the data and the impact of the departure on the data.

SECTION 14 – PREVENTIVE ACTION

PREVENTIVE ACTION, rather than corrective action, aims at minimizing or eliminating inferior data quality or other non-conformance through scheduled maintenance and review, before the non-conformance occurs.

Preventive action includes, but is not limited to, review of QC data to identify quality trends, regularly scheduled staff quality meetings, annual managerial reviews, scheduled column clipping, running a new LIMS system in tandem with the old system to assure at least one working system, and other actions taken to prevent problems.

All employees have the authority to recommend preventive action procedures, however management is responsible for implementing preventive action.

CORRECTIVE ACTION/PREVENTATIVE ACTION

CORRECTIVE ACTION NUMBER: _____
Department: _____
Date of Nonconformance: _____
Analysis: _____
Initiated by: _____
Date Issued: _____

Description of Nonconformance:

Cause:

Samples/Projects affected by Nonconformance (if any):

Corrective Actions:

Preventative Actions:

Follow-up:

Department Supervisor (print):_____
Signature/Date_____/_____

QA Review (print):_____
Signature/Date:_____/_____

Data Inquiry/Data Validation

Inquiry #: _____
Date: _____
Initiated by: _____
Project/Sample ID: _____
Client: _____
Analysis/Department: _____

Description:

Findings:

Resolution:

Signature: _____ Date: _____

Supervisor Signature: _____Date:_____

QA review date: _____

QA Signature:_____

Corrective Action required?: Yes or No
If Yes, see CA# _____

SECTION 15 – CONTROL OF RECORDS

RECORDS are a subset of documents, usually data recordings that include annotations, such as daily refrigerator temperatures posted to a laboratory form, lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample-handling and analysis.

The laboratory retains scanned electronic copies of all original observations, calculations and derived data, calibration records, and the test report for a minimum of five years unless otherwise specified by a client. Retained records contain the following information:

- identity of personnel involved in sampling, sample receipt, preparation or testing
- information related to equipment, test methods, sample receipt, sample preparation and data verification
- changes to records are signed or initialed by laboratory staff
- records, except those generated by automated systems, are generated directly, promptly and legibly in permanent ink.
- Entries are not obliterated by methods such as erasures, over-writings, or markings. All changes are made by one line marked through the entry with the entry signed/initialed and dated by the individual making the change
- Hardcopy data is scanned into pdf format for record storage

Records of all procedures to which a sample is subjected while in the possession of the laboratory are kept. This includes but is not limited to:

- Sample preservation including appropriateness of sample container and compliance with holding time requirement
- Laboratory sample id, receipt, rejection or acceptance at time of login
- Sample storage and tracking (COC, Internal COC)
- All original raw data, whether hardcopy or electronic, for calibrations, samples and QC measures (chromatograms, strip charts)
- Electronic copies of final reports
- Archived SOPs
- Correspondences relating to laboratory activities for a specific project
- Date of analysis and time of analysis is required if the holding time is 72 hours or less or when time critical steps are part of the anlaysis (i.e. extractions, incubations
- sample preparation including volumes, weights, meter readings, calculations, reagents
- Analysis type
- All manual calculations, integrations
- Analysts initials/signature
- Standard and reagent origin, receipt, preparation and use
- Corrective and preventative actions

15.1 Records Management and Storage

Records, including electronic records, are easy to retrieve, legible, and protected from deterioration or damage; held secure and in confidence; and are available to accrediting authorities for five years. For Drinking water programs (all states) the required retention time is 10 years.

The laboratory maintains a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage, and reporting.

In the event that the laboratory transfers ownership or goes out of business, records are maintained or transferred according to the clients' instructions.

All electronic records are backed-up daily. Access to protected records is limited to laboratory management or their designees to prevent unauthorized access or amendment. Procedures are outlined in SOP 7005.

SECTION 16 – AUDITS AND MANAGEMENT REVIEW

AUDITS measure laboratory performance and verify compliance with accreditation/ certification and project requirements. Audits specifically provide management with an on-going assessment of the quality system. They are also instrumental in identifying areas where improvement in the quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system.

Notification of clients for events that cast doubt on the validity of the results is completed within three days.

16.1 Internal Audits

Annually, the Quality Assurance Director prepares a schedule of internal audits to be performed during the year. These audits verify compliance with the requirements of the quality system, including analytical methods, SOPs, ethics policies, other laboratory policies, and the NELAC Standard. The area audited, the audit findings, and corrective actions are recorded.

All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, **and all appropriate notifications of clients** (If an internal audit reveals an issue which impact results, the affected projects are investigated and the clients are informed of the possible problem with their analytical results within 1 week of discovery).

The Laboratory Director reviews the internal audits after completion to assure that corrective actions were implemented and effective.

16.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance-testing samples for analysis. The laboratory

makes every effort to provide auditors with access to personnel, documentation and assistance. Any findings related to an external audit follow corrective action procedures. Management ensures that corrective actions are carried out within the timeframe specified by the auditor(s).

16.3 Performance Audits

Performance audits may be Proficiency Test Samples, internal single-blind samples, double-blind samples through a provider or client, or anything that tests the performance of the analyst and method.

The policy and procedures for Proficiency Test Samples are discussed in Section 23.7.

16.4 System Audits and Management Reviews

The Quality Assurance department reviews the quality system and maintains records of review. The quality system is reviewed annually, and findings are recorded in the form of a 'year end summary', which include the following elements:

- Certifications, including new certifications
- The outcome of recent internal audits
- Corrective and preventive actions
- External audits
- The results of Proficiency Tests
- Changes in the volume and type of the work
- Client feedback
- Complaints
- Other relevant factors, such as:
- Quality control activities
- Resources
- Staff training

After the year end report is assembled, the executive team reviews the information, assesess the overall objective of the laboraotory's quality system and its policies. The executive team will assemble a response that will address the following items and determines if any further action is warranted.:

- The management's commitment to good professionsional practice and to the quality of its testing in servicing its customers
- The management's statement iof the laboratory's service of standard
- The purpose of the management system related to quality
- A requirement that all personel concerned with testng and calibration activities within the laboratory familiarize themselves with the quality documentation and implement the policies and procedures in their work
- The laboratory management's commitment to comply with ISO 17025 and to continually improve the effectiveness of the management system.

SECTION 17 – PERSONNEL, TRAINING, AND DATA INTEGRITY

17.1 Overview

All personnel must demonstrate competence in the area where they have responsibility. Any person in training shall have appropriate supervision until they have demonstrated the ability to perform their job on their own. A person is considered qualified based on the appropriate education, training, experience and/or demonstrated skills.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility.

Technical staff must also have a general knowledge of laboratory operations, test methods and QA/QC procedures.

The laboratory uses personnel that are employed by or under contract to the laboratory. Contracted personnel must meet the competency standards of the laboratory and work in accordance with the laboratory's quality system.

17.1.1 Responbilities of Laboratory Director

The Laboratory Director is in charge of all laboratory activities, and is the highest level manager. The Laboratory Director is the key to a successful laboratory operation and the implementation and enforcement of the quality assurance program. Responsibilities are outlined below:

- Supervise all laboratory activities including personnel, budgeting, invoicing and data reporting.
- Implements the Quality Assurance Program within the laboratory
- Approves and recommends changes in the analytical testing and quality assurance programs.
- Ensure compliance to the applicable requirements (State and/or federal, TNI, DOD QSM, and ISO/IEC 17025).
- Maintain client relations.
- Communicates with commercial clients regarding the status of the testing programs.
- Supervises the logging in and distribution of samples throughout the laboratory.
- Coordinates the flow of work throughout the laboratory and monitors the progress through planned meetings.
- Through communication with department Supervisors, monitors the allocation of laboratory resources thereby assuring that the laboratory has the necessary resources to perform all contracted and future work.
- Oversees Technical Operation of the Laboratory.
- Maintain, updates and archives Laboratory Information System (Aspen SQL).
- Performs the duties in the absence of the QA Director.

17.1.2 Responbilities of Technical Director

Day to day supervision of technical laboratory operations is the responsibility of the Technical Directors who are full-time members of the staff and who assure reliable

data through the following activities: monitoring quality control, corroborating the analysis performed, and signing demonstrations of capability.

The Technical Directors certify that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited.

- Supervises Quality Control activities performed as part of operations in the GC, GC/MS, Metals, Wet Chemistry and Sample Prep laboratories.
- Supervises the preparation and maintenance of laboratory reports and records.
- Evaluates instrument performance and makes recommendations to the Laboratory Director.
- Reports out-of-control situations to the Laboratory Director and QA Director.
- Organizes and schedules the analytical testing program.
- Supervises the preventive maintenance program.
- Ensures quality control practices are implemented.
- Ensure compliance to the applicable standards (State and/or federal, TNI, DOD QSM, and ISO/IEC 17025).

17.1.3 Responbilities of Supervisors (Deputies) – Supervisors direct the flow of work to Analysts on a daily basis. They provide first line support of the quality assurance program. Responsibilities include:

- Review and approve all analytical data generated in their departments.
- Ensure quality control practices are implemented.
- Supervise the preventive maintenance program.
- Organize and schedule the analytical testing program.
- Ensure compliance to the applicable standards (State and/or federal, TNI, DOD QSM, and ISO/IEC 17025).

17.1.4 Responbilities of Quality Manager

The Quality Manager has the authority and responsibility for ensuring that the quality system is implemented and followed. The Quality Manager and Deputy QA Manager have direct access to the Laboratory Director and is independent of operations where the Quality Manager has oversight. The Quality Manager:

- is the focal point for the quality system and has oversight of quality control data.
- evaluates data objectively and performs assessments without managerial influence.
- arranges for, or conducts, internal audits annually;
- notifies laboratory management of deficiencies (or opportunities for continuous improvement) and monitors corrective actions.
- keeps the *Quality Assurance Manual* current.
- signs the demonstrations of capability.
- is knowledgeable in the 2009 TNI quality system and has documented training and/or experience in QA/QC procedures
- has a general knowledge of analytical procedures for which data review is performed.
- Ensure compliance to the applicable requirements (State and federal, TNI, DOD QSM, and ISO/IEC 17025).

17.2 Data Integrity and Ethics

Data integrity and ethics procedures in the laboratory include annual ethics training, signed, and dated integrity documentation for all laboratory employees, periodic monitoring of data integrity, and documented data integrity procedures.

Technical managers uphold the spirit and intent by supporting integrity procedures, by enforcing data integrity procedures, and by signing and dating the data integrity procedure training forms.

Data integrity procedures and evidence of inappropriate actions are reviewed annually or through regularly scheduled internal audits.

The mechanism for confidential reporting of ethics and data integrity issues is (1) unrestricted access to senior management, (2) an assurance that personnel will not be treated unfairly for reporting instances of ethics and data integrity breaches, and (3) anonymous reporting (please refer to SOP 1017 for detail on how to report data through the generic userid/password internet based e-mail account).

Employees are required to understand, through training and review of quality systems documents, that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious consequences such as immediate termination, or civil/criminal prosecution.

Any potential data integrity issue is handled confidentially until a follow-up evaluation, full investigation, or other appropriate actions have been completed and the issues clarified. Inappropriate activities are documented, including disciplinary actions, corrective actions, and notifications of clients, if applicable.

Any determination for detailed investigation of data integrity issues must be communicated to senior management. Allegations are investigated and remain confidential to the extent necessary.

Documentation for all investigations that result in findings of inappropriate activity includes any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

17.3 Data Integrity and Ethics Training

Data integrity and ethics training is provided for all employees initially upon hire and annually thereafter.

Attendance at an initial ethics training (part of new employee orientation) and the annual refresher training is recorded with a signature attendance sheet and a form of documentation that demonstrates all staff has participated and understand their obligations related to data integrity.

When contracted technical or support personnel are used, management is responsible for ensuring that they are trained to the laboratory's quality system and data integrity procedures, competent to perform the assigned tasks, and appropriately supervised.

Key topics covered during data integrity training include:

- the organizational mission and its relationship to the need for honesty and full disclosure in all analytical reporting;
- how and when to report data integrity issues;
- record keeping;
- discussion regarding all data integrity procedures;
- data integrity training documentation;
- data integrity procedure documentation;
- improper data manipulations;
- adjustments of instrument time clocks;
- inappropriate changes in concentrations of standards;
- the importance of proper written narration 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 deficient;
- examples of improper practices;
- examples of improper chromatographic manipulations;
- consequences for data integrity infractions.
- how to gain access to the anonymous reporting e-mail account.

17.4 General Training

All personnel are appropriately trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained.

New staff members are given introductory training and orientation upon arrival. The initial training for a new task contains the following steps:

- All documentation involved (SOPs) with a new and unfamiliar task is read and understood by the trainee.
- Training is under the direct supervision of a qualified senior analyst.
- The trainee demonstrates competency in the new task before they can operate independently. The competency for a test method is accomplished by a demonstration of capability as indicated in Section 19.

Ongoing training will consist of the following:

- The analyst attests, through signature that they have read, understood, and agreed to perform the latest version of the *Quality Assurance Manual* and any method SOP's that the analyst performs.
- Annually, the analyst shows continued proficiency in each method they perform.
- Other training as determined by management.
- Proof of acceptable on-going training is documented by the annual demonstrations of capability for each analyst and each method.

SECTION 18 – ACCOMMODATIONS & ENVIRONMENTAL CONDITIONS

Laboratory facilities are designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement. Large capacity generators have been installed which allow the laboratory to continue functioning

during catastrophic events. These generators automatically turn on during a loss of power, maintaining vital laboratory functions.

The laboratory workspaces are adequate for their use, and appropriately clean to support environmental testing.

Laboratory space is arranged to minimize cross-contamination between incompatible areas of the laboratory. The Volatile Organics laboratory is located in a separate building to avoid contamination of VO samples from solvents used in the Organic prep lab (Methylene chloride, Acetone).

SECTION 19 – TEST METHODS AND METHOD VALIDATION

19.1 Demonstration of Capability (DOC)

A DEMONSTRATION OF CAPABILITY (DOC) is a procedure to establish the ability of the analyst to generate data of acceptable accuracy and precision.

The DOC is documented on the form in Appendix 2, and these completed forms are kept in the training files for each analyst.

A DOC is performed for each analyte whenever the method, analysts, analytes, or instrument type is changed. The Technical Director certifies that personnel are trained and authorized to perform all tests for which we are accredited by signing the DOC form.

The process for DOC is as follows:

a) A quality control sample is obtained from an outside source. If not available, the QC is prepared using stock standards that are prepared independently from those used in instrument calibration.
b) At least four aliquots are prepared and analyzed according to the test method either concurrently or over a period of days.
c) Using all of the results, the mean recovery is calculated in the appropriate reporting units and the standard deviations of the population sample (in the same units) for each parameter of interest. When it is not possible to determine mean and standard deviations, such as for presence/absence and logarithmic values, the performance is assessed against established and documented criteria.
d) The information is compared to the corresponding acceptance criteria for precision and accuracy in laboratory-generated acceptance criteria (if there are not method established mandatory criteria). If all parameters meet the acceptance criteria, the analyst may begin analysis of actual samples.
e) If any one of the parameters does not meet the acceptance criteria, the performance is unacceptable for that parameter.
f) When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to 1) or 2) below.

    1. Locate and correct the source of the problem and repeat the test for all parameters of interest.
    2. Beginning with b) above, repeat the test for all parameters that failed

to meet criteria. Repeated failure, however, confirms a general problem with the measurement system. If this occurs, the source of the problem must be located and corrected and the test repeated for all compounds of interest beginning with c).

19.2 On-Going (or Continued) DOC

After the demonstration of capability is completed, on-going proficiency is maintained and demonstrated annually through the analysis of either single-blind samples, performing another DOC, or use of four consecutive laboratory control samples compared to pre-determined acceptance limits for precision and accuracy. This is documented in the training file of each analyst.

19.3 Test Methods and Method Validation

The laboratory uses methods that are appropriate to meet the client's requirements and are within the scope of the laboratory's capabilities. This includes sampling, handling, transport, storage, preparation and analysis of environmental data.

Standard Operating Procedures (SOPs), reference methods and manuals are available to laboratory personnel. Any deviations from published methods are documented in the laboratory SOPs. SOPs are submitted to client for review upon request.

19.3.1 Method Detection Limit (MDL) / Limit of Detection (LOD)

The Method Detection Limit is determined annually and is an estimate of the minimum amount of a substance that an analytical process can reliably detect. MDLs are determined using the procedure set forth in 40 CFR, Part 136, Appendix B. An MDL is analyte-and matrix specific and is laboratory-dependent. The MDL is verified using a QC sample spiked at 2-3 times the MDL for single analyte tests and 1-2 times the MDL for multiple analyte tests.

IDLs (Instrument Detection Limits) are calculated to determine an instruments sensitivity independent of sample preparation. IDLs are generally performed for Metals.

19.3.2 Reporting Limit (RL) / Limit of Quantitation (LOQ)

The REPORTING LIMIT (RL) is determined by the lowest concentration standard in the initial calibration. For most gravimetric methods the Reporting Limit is defined as a value 3 to 5 times the MDL. The RL will always be greater than the MDL.

19.3.3 Precision and Accuracy

Precision and accuracy are performed using replicate analyses and are compared to the criteria established by the method or the laboratory. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms.

19.4 Estimation of Uncertainty

The laboratory estimates uncertainty using the standard deviation calculated from routine quality control samples.

19.5 Laboratory-Developed or Non-Standard Method Validation

Where applicable, the laboratory validates non-standard methods, laboratory-designed/developed methods, standard methods used outside their published scope, and amplifications and modifications of standard methods to confirm that the methods are fit for the intended use.

19.6 Control of Data

The laboratory assures that computers and software are protected, maintained, and secure through measures such as documentation, locked access, and control of the laboratory environment. In the event that changes are made to the lims system that may adversely effect client data, the client will be informed of the change prior to installation.

Quality control results are reviewed by the analyst and by authorized personnel (such as the supervisor or peer). Transcription and calculation errors are minimized through data review and through periodic review of data reduction processes. The laboratory procedure to insure that reported data are free from transcription and calculation errors and that all quality control measures are reviewed and evaluated before data are reported is found in SOP1007. The results are evaluated for consistency, trend, or feasibility before data are released to the client.

Manual integrations and any analytical notes are reviewed for integrity and justification prior to the release of data. The laboratory procedure to address manual calculations, including manual integrations is found SOP5008.

SECTION 20 – EQUIPMENT

20.1 General Equipment Requirements

All equipment is calibrated or checked before being placed into use to ensure that it meets laboratory specifications and the relevant standard specifications. Equipment that has been subject to overloading, mishandling, given suspect results, or been shown to be defective or outside specifications is taken out of service, isolated to prevent its use, or clearly labeled as being out of service until it has been shown to function properly.

Each piece of equipment and the software used for testing and significant to the results is uniquely identified and records of equipment and software are maintained. (Appendix 3)

20.2 Support Equipment

All support equipment is maintained in proper working order and records are kept of all repair and maintenance activities. Support equipment such as balances and pipettors are calibrated each day prior to use, to ensure they are operating within the expected range for the application for which the equipment is to be used.

Mechanical volumetric dispensing equipment (except Class A glassware) is checked for accuracy quarterly.

20.2.1 Support Equipment Calibration

Calibration requirements for analytical support equipment are found in SOPs 1000, and 1001. For analytical instrumentation, the calibration requirements are found in the method specific SOP.

20.3 Analytical Equipment

20.3.1 Maintenance for Analytical Equipment

Maintenance of analytical instruments and other equipment may include regularly scheduled preventive maintenance or maintenance on an as-needed basis due to instrument malfunction and is documented in Instrument Maintenance Logs, which become part of the laboratory's permanent records.

Table 20.3-1 Analytical Equipment Maintenance

Instrument	Procedure	Frequency
Mercury Analyzer	Peristaltic pump tubing – replace Check tubing for wear Inspect tubing Clean absorption cell	Daily Daily Daily As needed
ICP	Peristaltic pump tubing Check liquid argon supply Check fluid level in waste container/drain Check torch / clean Nebulizer – inspect / clean Nebulizer entrance – clean/ inspect o-rings – replace Optics – clean Autosampler – sample probe tubing - inspect	Weekly/as needed Daily Daily Weekly/ as needed Weekly/ as needed Weekly/ as needed As needed Annually/ as needed (Service Engineer) Daily
ICPMS	Replace peristaltic pump tubing Nebulizer – inspect / clean Torch – inspect / clean o-rings – replace Clean Optics Autosampler alignment – check Sampling Cone – inspect / clean Skimmer Cone – inspect / clean Extraction Lens – inspect / clean Ion lens – clean Vacuum Pump – check / replace oil Water recirculator – check / drain, refill Spray chamber – inspect / clean	Daily Weekly/ as needed Weekly / as needed As needed Annually / As needed Daily / As needed Weekly/ as needed Weekly/ as needed Weekly/ as needed Quarterly / as needed Weekly / Quarterly, as needed Weekly / Quarterly, as needed Weekly/ as needed
GC/MS	Carrier Gas – check Column – replace Pump oil-level check	Daily As needed Monthly

Table 20.3-1 Analytical Equipment Maintenance		
Instrument	**Procedure**	**Frequency**
	Pump oil changing Analyzer bake-out Source cleaning Ferrules/ fittings – replace Injection Port Liners – replace Filaments – replace Replace glass wool/injection port liner	Annually (Service Engineer) As needed As needed As needed As needed As needed Daily
Gas Chromatograph	Carrier gas – check Carrier gas traps – replace Septum replacement Injectin port iners Check system for gas leaks Bake injector/column Change/replace column(s)	Daily Biannually/ as needed As needed As needed As needed Daily As needed
Electron Capture Detector (ECD)	Detector wipe test (Ni-63) Detector cleaning	Semi-annually As needed
Flame Ionization Detector (FID)	Detector cleaning	As needed
Purge and Trap Systems	Replace Teflon ferrules Replace trap	As needed As needed
Balances	Class 1 weight calibration Clean pan and check if level Field service	Daily, when used Daily At least annually
Conductivity Meter	Probe – clean Linearity – check	As needed Annually
UV / Visible Spectrophotometer	Lamp – replace / align Wavelength check Response check Clean light paths	As needed Semi-annually Annually Weekly / as needed
TOX	Change cell electrolyte – replace with DI water when done	Daily
Ion Chromatograph	Flush column Regenerate eluent	As needed Daily
Flow Injection	Replace tubing	As needed
Sulfur/TOC Analyzer	Replace Anhydrone	Daily
TOC Analyzer	Replace Hydrogen Scrubber Replace Septum Replace catalyst	As needed As needed As needed
Deionized/Distilled Water	Check conductivity Check deionizer light Monitor for VOA's System cleaning Replace cartridge & large mixed bed resins	Daily Daily Daily As required As required
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Drained Belts checked Lubricated	Weekly Monthly Semi-annually
pH/Specific Ion Meter	Calibration Clean electrode	Daily – see SOP 2015+2016 As required
BOD Incubator	Temperature monitoring Clean electrode Replace Electrolyte Solution	Daily Daily Weekly/ as needed
Centrifuge	Check brushes and bearings	As needed

20.3.2 Initial Instrument Calibration

Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here or in the laboratory SOPs.

If the method does not specify the number of calibration standards to use, the minimum number is five not including blanks or a zero standard. Quantitation is always determined from the initial calibration unless the test method or applicable regulations require quantitation from the continuing calibration. Any samples that are analyzed after an unacceptable initial calibration are re-analyzed or the data are reported with qualifiers.

All initial instrument calibrations are verified with a standard obtained from a second source standard when commercially available. If a second source is not available, a standard prepared from a separate lot is used as long as the manufacturer can demonstrate the lot was prepared independently from other lots purchased.

Initial instrument calibration includes calculations, integrations, acceptance criteria, and associated statistics referenced in the SOP. Sufficient raw data records are collected to allow reconstruction of the initial calibration. These include, at a minimum, calibration date, test method, instrument ID, analysis date, analyte names, analysts initials, concentration and response, calibration curve or response factor, or unique equation or coefficient used. Acceptance criteria are listed in the individual SOPs.

Corrective actions are performed when the initial calibration results are outside acceptance criteria. Calibration points are not dropped from the middle of the curve. Results that are less than the lower calibration standard are considered to have increased uncertainty, and are reported with a qualifier code ("J").

Results that are greater than the highest calibration standard are either diluted to within the calibration range, or considered to be an estimate; and are reported with a qualifier code ("E") and explained in the case narrative.

20.3.3 Continuing Instrument Calibration

Continuing instrument calibration verification is performed at the beginning and end of each analytical batch, except for instances when an internal standard is used (GC/MS analyses). For those methods employing internal standards, only one verification is performed at the beginning of the analytical batch.

Continuing instrument calibration verification is performed when the time period for calibration or the most recent calibration verification has expired as specified in the laboratory method SOPs. Calibration is verified for each compound, element, or other discrete chemical species.

The calculations and associated statistics for continuing instrument calibration are included or referenced in the laboratory method SOPs. Sufficient raw data records are retained to allow reconstruction of the continuing instrument calibration

verification. Continuing instrument calibration verification records connect the continuing verification date to the initial instrument calibration.

20.3.4 Unacceptable Continuing Instrument Calibration Verifications

If routine corrective action for continuing instrument calibration verification fails to produce a second consecutive (immediate) calibration verification within acceptance criteria, then a new calibration is performed or acceptable performance is demonstrated after corrective action with two consecutive calibration verifications.

SECTION 21 – MEASUREMENT TRACEABILITY

Traceability of measurements is assured using a system of documentation, calibration and analysis of reference standards.

Clients can verify that required uncertainty is achieved by reviewing the internal quality control data, if requested.

21.1 Reference Standards/Materials

Reference Standards/Materials, where commercially available, are traceable to certified reference materials. Commercially prepared standards are purchased from vendors, with an accompanying Certificate of Analysis that documents the standard purity. Internal reference materials, such as working standards or intermediate stock solutions, are verified by comparison with a standard from a second source.

All Certificates of Analysis must be retained and readily available for use and inspection. These records are maintained in the applicable departments.

Reagent quality is verified during routine blank analyses.

21.2 Transport and Storage of Reference Standards and Materials

Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials.

Reference standards and materials are stored according to manufacturer's recommendations and separately from working standards or samples.

21.3 Labeling of Reference Standards, Reagents, and Materials

Records of all standards, reagents, reference materials, and media include:

1. the manufacturer/vendor name
2. the manufacturer's Certificate of Analysis or purity (if supplied)
3. the date of receipt
4. reference to the method of preparation
5. date of preparation

6. an expiration date after which the material shall not be used (unless its reliability is verified by the laboratory).
7. preparer's initials (if prepared)

All containers of standards, reagents, or materials, whether original or prepared, are labeled with an expiration date. The manufacture's expiration date will be used for all chemicals, however, if one is received without a expiration date the chemical will be given an expiration date of one year from the date of receipt.

All containers of prepared standards and reference materials have a preparation date and unique identifier. This laboratory uses "V" followed by sequential numbers.

Standard preparation records are documented in Veriprog and indicate traceability to purchased stocks or neat compounds, reference to the method of preparation, date of preparation, expiration date, and preparer's initials.

Prepared reagents are demonstrated to meet the requirements of the test method through Blank analysis.

SECTION 22 – SAMPLE MANAGEMENT

22.1 Sample Receipt

Procedure
When samples are received at the laboratory, their condition is documented, they are given unique identifiers, and they are logged into the sample tracking system (Aspen).

22.2 Sample Acceptance

Upon receipt, the Sample Custodian, in accordance with SOP 7002,:

- records the sample temperature
- examines all samples for breakage and/or leakage upon receipt
- verifies the samples and their identification against the Chain of Custody (COC)
- checks the pH of preserved samples to ensure preservation is adequate
- verifies date and time of collection

The following preservation checks are performed and documented upon receipt:

Thermal preservation:

a) For samples that require preservation at 4°C, the acceptable range is "from just above freezing to 6°C".
b) Samples that are delivered to the lab the same day as they are collected are likely not to have reached a fully chilled temperature. This is acceptable if there is evidence that chilling has begun.
c) The temperature and if ice is present is recorded on the 'Condition Upon Receipt' form.

pH checks:

d) The pH of samples requiring acid/base preservation is checked and documented on the 'Preservation Document'.

Any anomalies pertaining to the samples are documented on the 'Condition Upon Receipt' and reported to Project Management. Project Management will, in turn, contact the client as required. Anomolies include:

- sample temperature received outside specification
- samples received broken or leaking
- samples received outside of hold time
- sample received in inappropriate containers
- COC does not match samples received
- COC is not properly completed
- Breakage of any custody seal
- Headspace in Volatiles
- Insufficient sample volume received
- Illegible information on COC

Although the laboratory has a few drinking water certifications, the laboratory does not analyze drinking water samples for compliance purposes. If samples arrive at the laboratory that require PA-DEP SDWA or NJDEP BSDW compliance, they will be rejected or subcontracted to an accredited laboratory for analysis.

Hampton-Clarke, Inc. (WBE/DBE/SBE)
175 Route 46 West and 2 Madison Road, Fairfield, New Jersey 07004
Ph: 800-426-9992 | 973-244-9770 Fax: 973-244-9787 | 973-439-1458
Service Center: 137-D Gaither Drive, Mount Laurel, New Jersey 08054
Ph (Service Center): 856-780-6057 Fax: 856-780-6056
A Women-Owned, Disadvantaged, Small Business Enterprise
NELAC/NJ #07071 | PA #68-00463 | NY #11408 | CT #PH-0671 | KY #90124 | DE HSCA Approved

Hampton-Clarke WBE/DBE/SBE 800-426-9992

CHAIN OF CUSTODY RECORD

Project# (Lab Use Only)

Page _____ of _____

3) Reporting Requirements (Please Circle)

Turnaround	Report Type	Electronic Deliv.
When Available:	Data Summary	Hazsite/CSV
1 Business Day (100%) *	Results + QC (Waste)	EnviroData
2 Business Days (75%) *	NJ Reduced	Excel - NJ Regulatory
3 Business Days (50%) *	NY Reduced	Excel - NY Regulatory
4 Business Days (35%) *	PA Reduced	Excel - PA Regulatory
5 Business Days (25%)	Full / Category B	EQuIS *(specify below)*:
10 Business Days (Stand.)	Category A	4-File/EZ/NYS/Reg. 2 or 5
Other: _____	Electronic (PDF)	Other: _____

* Expedited TAT Not Always Available. Please Check with Lab.

Customer Information

1a) Customer: _____
Address: _____
1b) Email/Cell/Fax/Ph: _____
1c) Send Invoice to: _____
1d) Send Report to: _____

Project Information

2a) Project: _____
2b) Project Mgr: _____
2c) Project Location (City/State): _____
2d) Quote/PO # (If Applicable): _____

FOR LAB USE ONLY ↓

Batch #

===> *Check If Contingent* ===>

Matrix Codes
DW - Drinking Water S - Soil A - Air
GW - Ground Water SL - Sludge
WW - Waste Water OL - Oil
OT - Other (please specify under item 9, Comments)

7) Analysis *(specify methods & parameter lists)*

<=== *Check If Contingent* <===

Lab Sample #	4) Customer Sample ID	5) Matrix	6) Sample Date	6) Sample Time	Sample Type: Composite (C)	Sample Type: Grab (G)	8) # of Bottles: None	MeOH	En Core	NaOH	HCl	H2SO4	HNO3	Other:	9) Comments

10) Relinquished by:	Accepted by:	Date	Time

Comments, Notes, Special Requirements, HAZARDS

Indicate if low-level methods required to meet current groundwater standards (SPLP for soil):
- ☐ BN or BNA (8270D SIM)
- ☐ VOC (8260C SIM or 8011)
- ☐ SPLP (BN, BNA, Metals)

Check if applicable:
- ☐ Project-Specific Reporting Limits
- ☐ High Contaminant Concentrations
- ☐ NJ LSRP Project (also check boxes above/right)

For NJ LSRP projects, indicate which standards need to be met:
- ☐ NJDEP GWQS
- ☐ NJDEP SRS
- ☐ NJDEP SPLP
- ☐ Other (specify):

Cooler Temperature

Additional Notes

11) Sampler (print name): Date:

Please note NUMBERED items. If not completed your analytical work may be delayed.
A fee of $5/sample will be assessed for storage should sample not be activated for any analysis.

HC-V

Analysis/Methods/Holding Times

Hampton Clarke/Veritech

175 Route 46 West, Fairfield NJ 07004

Analysis	Method (water)	Method (soil)	Holding Time (water)	Holding Time (soil)	Container	Preservative * (water)	Preservative * (soil)
Inorganic Analysis							
Acidity	SM2310B-11	SM2310B-11	14 days	N/A	G	none	4 C
Alkalinity	310.2, SM2320B-11	SM2320B-11	14 days	N/A	G	none	4 C
Ammonia	SM4500NH3 B+E11	SM4500NH3 B+E11	28 days	28 days	P	H2SO4<2	4 C
BOD / CBOD	SM5210B-11	SM5210B-11	48 hours	N/A	P	none	N/A
Bromide	300.0	9056 / A	28 days	N/A	P	none	4 C
Chloride	300.0	9056 / A	28 days	N/A	P	none	4 C
COD	Hach8000	Hach8000	28 days	N/A	P	H2SO4<2	N/A
Cyanide, Total	SM4500CN E-11	9010C / 9012B	14 days	14 days	G	dark/NaOH>12	4 C
Cyanide, Amenable	SM4500CN G-11	9010C / 9012B	14 days	14 days	P	dark/NaOH>12	4 C
Cyanide-Total	335.4	9012B	14 days	14 days	G	dark/NaOH>12	4 C
Cyanide, Available	1677	9012B	14 days	14 days	G	dark/NaOH>12	4 C
Fluoride	300.0	9056 / A	28 days	N/A	P	none	4 C
Hardness, as Total	200.7	N/A	6 months	N/A	G	HNO3<2	N/A
pH	SM4500-H B-11	9045D	15 min	asap	P	none	4 C
Hexavalent Chromium	SM3500CrB-11	3060A/7196A	24 hours	30/7 (a)	P	none	4 C
Nitrate	300.0	9056 / A	48 hours	N/A	P	none	4 C
Nitrite	300.0	9056 / A	48 hours	N/A	P	none	4 C
Oil & Grease	1664A / B	1664A / B 9071B	28 days	28 days	G	HCl<2	4 C
Ortho-Phosphate	300.0	9056 / A	48 hours	6 months	P	none	4 C
Phenol, Total	420.1	9065	28 days	6 months	G	H2SO4<2	4 C
Phosphorus, Total	SM4500-P B5-11+E-11 / F-11	SM4500-P B5-11+E-11 / F-11	28 days	N/A	P	H2SO4<2	N/A
Salinity	SM2520B	SM2520B	28 days	N/A	P	none	N/A
Solids, Settable	SM2540F-11	N/A	48 hours	N/A	P	none	N/A
Solids, Total	SM2540B-11	SM 2540G	7 days	7 days	P	none	4 C
Solids, Total Dissolved	SM2540C-11	N/A	7 days	N/A	P	none	N/A
Solids, Total Volatile	160.4	SM 2540G	7 days	7 days	P	none	4 C
Solids, Total Suspended	SM2540D-11	N/A	7 days	N/A	P	none	N/A
Specific Conductance	SM2510B-11	9050A	28 days	N/A	P	none	4 C
Sulfate	300.0	9056 / A	28 days	28 days	P	none	4 C
Sulfide, Total	SM4500-S E	9030B/9034	7 days	7 days	P	ZnAc+NaOH>9	4 C
Metals (except Mercury)	200.7, 6010B / C	6010B / C	6 months	6 months	P	HNO3<2	4 C
Metals (except Mercury)	200.8, 6020 / A	6020 / A	6 months	6 months	P	HNO3<2	4 C
Mercury	245.1, 7470A	7471A / B	28 days	28 days	P	HNO3<2	4 C
TOC	SM5310B-11	9060A	28 days	28 days	G	H2SO4	4 C
TOC	N/A	Lloyd Kahn	N/A	14 days	G	H2SO4	4 C

Analysis	Method (water)	Method (soil)	Holding Time (water)	Holding Time (soil)	Container	Preservative * (water)	Preservative * (soil)
Inorganic Analytes - continued							
Tot Organic Halide, EOX	9020	9023	28 days	28 days	G	H2SO4	4 C
Turbidity	180.1	N/A	48 hours	N/A	G	none	N/A
Analyze Immediate Parameters							
Temperature	SM2550 B	N/A	immediate	N/A	field probe	none	N/A
Dissolved Oxygen	SM4500-O G-11	N/A	immediate	N/A	field probe	none	N/A
pH	SM4500-H B-11	N/A	immediate	N/A	field probe	none	N/A
Chlorine Residual	SM4500-Cl G-11	N/A	immediate	N/A	P	none	N/A
Organic Analysis							
Volatile Organics (water)	624, 8260B/C	N/A	14 days (2)	N/A	GTLS	HCl<2	n/a
Volatile Organics (soil)	N/A	8260B /C	N/A	48hr/14dys	(4)	N/A	(5)
Volatile Organics (potable)	524.2	N/A	14 days (8)	N/A	GTLS	HCl<2	N/A
Semi-Volatile Organics	625, 8270C/D	8270C / D	7/40 (1)	14/40 (6)	GTLC	none	4 C
Pesticides	608, 8081A/B	8081A / B	7/40 (1) (9)	14/40 (6)	GTLC	none	4 C
PCB's	608, 8082/ A	8082 / A	7/40 (1)	14/40 (6)	GTLC	none	4 C
Herbicides	8151A	8151A	7/40 (1)	14/40 (6)	GTLC	none	4 C
DRO / TPH	8015B/C/D	8015B/C/D	7/40 (1)	14/40 (1)(6)	G	HCl<2	4 C
TPH	OQAQAM025	OQAQAM025	14/40 (2)(6)	14/40 (6)	G	HCl<2	4 C
GRO	8026B/C	8260B/C	14 days (2)	14 days	G	HCl<2	4 C
EDB / DBCP	8011	8011	14 days	N/A	GTLS	HCl<2	4 C
Alcohols	8015B/C/D	8015B/C/D	14 days (2)	14 days	G	HCl<2	4 C
Waste Characterization							
TCLP VOA	8260B/C	1311/8260B/C	14 days (7)	14 days (7)	G	none	4 C
TCLP Semi-Voa	8270C/D	1311/8270C/D	14 days (7)	14 days (7)	G	none	4 C
TCLP Pesticides	8081A/B	1311/8081A/B	14 days (7)	14 days (7)	G	none	4 C
TCLP Herbicides	8151A	1311/8151A	14 days (7)	14 days (7)	G	none	4 C
TCLP Metals	6010B/C	1311/6010B/C	6 months (7)	6 months (7)	G	none	4 C
TCLP Mercury	7470A	1311/7471A/B	28 days(7)	28 days (7)	G	none	4 C
Ignitability/Flashpoint	1010A	1030	N/A	N/A	G/P	none	4 C
Corrosivity by pH	9045D	9045D	15 min	asap	G/P	none	4 C
Paint Filter	N/A	9095B	N/A	N/A	G/P	none	4 C
Reactive Cyanide	7.3.3.2	7.3.3.2	N/A	asap	G	none	4 C
Reactive Sulfide	7.3.3.2	7.3.3.2	N/A	asap	P	none	4 C
Microbiology							
Fecal Coliform (WW)	SM9222D	N/A	6 hours	N/A	sterile P	sodium thiosulfate	N/A
Total Coliform (WW)	SM9222B	N/A	6 hours	N/A	sterile P	sodium thiosulfate	N/A
Heterotropic (WW)	SM9215B	N/A	8 hours	N/A	sterile P	sodium thiosulfate	N/A
Total Coliform (DW)	SM9221D	N/A	30 hours	N/A	sterile P	sodium thiosulfate	N/A
Total Coli/E.Coli (DW)	SM8922B/G	N/A	6 hours	N/A	sterile P	sodium thiosulfate	N/A

Definitions:

G - Glass
P - Polyethylene
GTLC - Glass with Teflon lined cap
GTLS - Glass with Teflon lined septum

(a) Hex Cr soil - 30 days extraction / 7 days analysis

(1) - 7 days extraction/40 days analysis
(2) - 7 days if not preserved with HCl
(3) - 14 days preserved or methanol/48hr Encore
(4) – Encore or Terracore
(5) - frozen < 7 degrees C or prepped in Methanol
(6) - 14 days extraction/40 days analysis
(7) - Days for TCLP extraction, then follow method
(8) - 24 hours if not preserved
(9) - if pH is not bet. 5 and 9, 72hr hold unless pH is adjusted.

*** all samples are to be maintained at 4 degrees Celsius**

Information is subject to change based on federal and state method updates and regulations.

22.3 Sample Identification

Samples are assigned unique identifications when they are logged into the LIMS. Each set of samples received is identified by a batch which is seven characters long consisting of two alphabetical letter followed by five numerical digits (i.e. AC00001). The sample then contains a hyphenate number to distinguish each sample (AC00001-001). Each container received for each sample are further identified by an additional hyphenation (i.e. AC00001-001-001).

The following information is documented in Apsen:

a) Client and project name
b) Date and time of sampling
c) Date and time of receipt at lab
d) Unique laboratory identification number
e) Field identification number
f) Initials of recorder
g) Analyses requested
h) Matrix
i) Type of deliverable
j) Turn around time

22.4 Sample Storage

Samples are held secure, as required. Samples are stored apart from standards, reagents, food or potentially contaminating sources, and such that cross-contamination is minimized. All portions of samples, including extracts, digestates, leachates, or any product of the sample is maintained according to the required conditions.

Handling and storage of sample received for Volatile Organic analysis are detailed in SOP 7002.

22.5 Sample Disposal

Samples are disposed of according to State and local regulations. Procedures for the disposal of samples, digestates, leachates, and extracts are documented in SOP 7003.

22.6 Sample Transport

Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. This includes moving bottles within the laboratory.

In the event the laboratory needs to ship samples (i.e. for subcontracting), following the procedure outlined in SOP 7007, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6 degrees C during transit. A Chain of Custody is prepared the Sample Custodian or Project Manager.

22.7 Sampling Records

Sampling plans are based, whenever it is reasonable or requested by the client, on appropriate statistical sampling methods. Relevant sampling data are recorded, including the sampling procedure used, 2) the identification of the sampler, 3) environmental conditions (if relevant), and 4) the sampling location.

Sub-sampling from a container within the laboratory is necessary to ensure the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample within the container and the homogeneity of the sample need to be considered when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative sub-sample or aliquot of the sample for analysis. See SOPs 7006 (Procedure for Compositing Samples), 7010 (Procedure for Mixing Soil Samples) and 7011 – Procedure for Crushing Samples.

SECTION 23 – QUALITY OF TEST RESULTS

23.1 Essential Quality Control Procedures

All essential quality control elements are collected and assessed on a continuing basis. The qualities of test results are recorded on QC control charts so that trends are detectable, and where practicable, are statistically evaluated.

For test methods that do not provide acceptance criteria or where no regulatory criteria exist, acceptance criteria are developed. Control limits are developed using the mean, plus or minus 3 standard deviations (using a minimum of 20 data points); or static limits such as +/- 25 percent. These limits can be found in the test method SOPs.

To monitor the validity of environmental tests performed, review includes any one or combination of the techniques below:

a) use of certified reference materials or cultures and/or internal quality control using secondary reference materials;
b) participation in proficiency testing programs;
c) replicate testing using the same or different methods;
d) retesting of retained samples; and/or

Written procedures to monitor quality controls including acceptance criteria are located in the test method SOPs, except where noted, and include such procedures as:

a) use of laboratory control samples and blanks to serve as positive and negative controls for chemistry methods;
b) use of laboratory control samples to monitor test variability of laboratory results;
c) use of calibrations, continuing calibrations, certified reference materials and/or PT samples to monitor accuracy of the test method;
d) measures to monitor test method capability, such as limit of detection (MDL) , limit of quantitation (RL), and/or range of test applicability, such as linearity;
e) use of regression analysis, internal/external standards, or statistical analysis to reduce raw data to final results;
f) use of reagents and standards of appropriate quality;
g) use of sterility checks for equipment, media and dilution water for microbiology; and
h) use of positive and negative culture controls for microbiology.

23.2 Internal Quality Control Practices

Analytical data generated with QC samples that fall within prescribed acceptance limits indicate the test method is IN CONTROL (conforming). QC samples that fall outside QC limits indicate the test method is OUT OF CONTROL (non-conforming) and that corrective action is required or that the data are qualified.

All QC measures are assessed and evaluated on an on-going basis, so that trends are detected.

The following general controls are used:

Positive and Negative Controls such as:

a) Blanks (negative)
b) Laboratory control sample (positive)

Selectivity is assured through:

a) absolute and relative retention times in chromatographic analyses;
b) two-column confirmation when using non-specific detectors;
c) use of acceptance criteria for mass-spectral tuning (found in test method SOPs);
d) use of the correct method according to its scope assessed during method validation; and

Consistency, Variability, Repeatability, and Accuracy are assured through:

a) proper installation and operation of instruments according to manufacturer's recommendations or according to the processes used during method validation;
b) monitoring and controlling environmental conditions (temperature, access, proximity to potential contaminants);
c) selection and use of reagents and standards of appropriate quality; and
d) cleaning glassware appropriate to the level required by the analysis. Cleaning procedures not provided in test method SOPs are provided in a separate SOP. For microbiology, glassware care includes use of borosilicate glassware, use of detergents designed for laboratory use, testing each day for alkaline or acid residue with bromothymol blue, and conduct of the Inhibitory Residue test when the detergent is changed.
e) following SOPs and documenting any deviation, assessing for impact, and treating data appropriately;
f) testing to define the variability and/or repeatability of the laboratory results, such as replicates;
g) use of measures to assure the accuracy of the test method, including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, or other measures;

Acceptance or rejection criteria are created according to laboratory policy where no method or regulatory criteria exist. Acceptance criteria define the boundary for the appropriate response from laboratory personnel, such as corrective action, reporting with qualifiers, reanalysis, review, and others.

Test Method Capability is assured through:

a) establishment of the limit of detection (MDL) where appropriate;
b) establishment of the limit of quantitation or reporting level (RL)
c) establishment of the range of applicability such as linearity;

Data reduction is assured to be accurate by:

a) selection of appropriate formulae to reduce raw data to final results such as regression;
b) periodic review of data reduction processes to assure applicability;

The following tables summarize the key elements of the quality control system for the laboratory.

Table 23.2-1 Essential Quality Control Requirements (Negative Controls)	
Method Blank (MB)	Is used to assess preparation and analysis for possible contamination during the preparation and processing steps. The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples. The method blank is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc)
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are reagent water that may be analyzed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content
Trip Blanks	are required to be submitted by the client with each shipment of samples requiring aqueous and solid VOC analyses. A trip blank is prepared by the laboratory by filling a clean container with deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks	are used for specific projects by the field samplers. A field blank is prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken.
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOC samples in the laboratory

Table 23.2-2 Essential Quality Control Requirements (Positive Controls)	
Matrix Spike	Is a sample fortified with a known amount of the test analyte(s) and is used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used. At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.
Surrogates	Measure method performance to sample matrix (organics only) and are added to all samples, standards, and blanks, for all organic chromatography methods. The recovery of the surrogate is compared to the laboratory generated limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
Duplicates	For a measure of analytical precision, with each matrix-specific batch of samples processed, a sample duplicate (DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure. Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
Internal Standards	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements. Internal standards are used in all organic and ICPMS methods as required by the analytical method. Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

23.3 Method Blanks

Contaminated blanks are identified according to the acceptance limits in the test method SOPs. Samples associated with a contaminated blank are evaluated as to the appropriate corrective action for the samples (e.g. reprocessing and reanalyzing or data qualifying codes).

When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem. Data that are unaffected by the blank contamination (non-detects or other analytes) are reported unqualified.

Sample data that are suspect due to the presence of a contaminated blank are reanalyzed or qualified.

23.4 Laboratory Control Samples

LABORATORY CONTROL SAMPLES (LCS) are prepared from analyte free water, and spiked with verified and known amounts of analytes for the purpose of establishing precision or bias measurements.

The results of laboratory control samples (LCS) are calculated in percent recovery or other appropriate statistical technique that allows comparison to established acceptance criteria.

The individual LCS is compared to the acceptance criteria as published in the mandated test method, or where there are no established criteria, the laboratory established limits.

23.5 Matrix Spikes and Matrix Spike Duplicates

The MS/MSD results are used to help assess the effect of the sample matrix on method performance.

The laboratory procedure for MS/MSD includes spiking appropriate analytes at appropriate concentrations, calculating percent recoveries and relative percent difference (RPD), and evaluating and reporting the results.

Where there are no established criteria, the laboratory uses the mean plus or minus three standard deviations or static limits such as +/- 25 percent as the control limits for MS/MSD. A minimum of 20 data points is used to establish limits.

For MS/MSD results outside established criteria the corrective action is to evaluate the LCS for comparison and note in the narrative that there may be matrix interference present.

23.6 Surrogate Spikes

Surrogates are added to all samples (in test methods where surrogate use is appropriate) prior to sample preparation or extraction. Surrogate recovery results are compared to the acceptance criteria. Where there are no established criteria, the laboratory uses the mean plus or minus three standard deviations as surrogate control limits. A minimum of 20 data points are used to establish limits.

For surrogate results outside established criteria, data are evaluated to determine the impact. Corrective actions include re-extracting, reanalyzing and qualifying data as appropriate.

23.7 Proficiency Test Samples

The laboratory participates in proficiency test (PT) samples twice per year. The laboratory institutes corrective action procedures for all failed PT samples. The results of the investigation and subequent corrective actions are sent to the laboratory's primary acrediation body and any agency (A2LA) that requires submittal of the proficiency results and corrective actions. All information will be provided within 30 days of receipt of the results.

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

Proficiency Testing (PT) samples are treated as typical samples in the normal production process where possible, including the same preparation, calibration, quality control and acceptance criteria, sequence of analytical steps, number of replicates, and sample log-in.

23.8 Data Management and Data Review

The laboratory reviews all data generated in the laboratory for compliance with method, laboratory and, where appropriate, client requirements. Initially, the analyst reviews data for acceptability of quality control measures and accuracy of the final result(s).

After the initial review, a second reviewer, usually the department supervisor, reviews all manual transcriptions and (manual) calculations and spot checks all electronic transfers of data. Final results are compared to raw data either directly or through several reviewed steps.

A third level of review is performed within the Reporting/QA department. Results entered in the LIMS are compared to raw data. Analyses reported are checked against the COC. Results are checked for compliance with method, laboratory and client requirements. Spot check calculations are performed.

Further information regarding the aceptance and rejection of samples, data review, importation of data, manual entry of data, changing data and document control can be found in the following SOPS:

- 1005 – Quality Assurance Training Procedure.
- 1007 - Final Report Assembly and Data Review.
- 1011 – Final Report Assembly and Data Review.
- 1021 - Procedure for Manual Entry of Data.
- 1022 – Procedure for Making Changes to Electronic Data.
- 1023 – Document Control
- 1024 – Importing Results into Aspen.
- 5008 – Manual Integrations.

The QA Director and/or designee review atleast 10% of all analytical reports. They are responsible for responding to clients who have questions or concerns regarding the final report.

SECTION 24 – REPORTING OF RESULTS

The result of each test carried out is reported accurately, clearly, unambiguously, and complies with all specific instructions contained in the test method.

Data are reported without qualification if they are greater than the lowest calibration standard and lower than the highest calibration standard. If a client requires data results to be reported where the concentration is below the lowest calibration standard, the data is appropriately flagged ("J") to alert the data user of the uncertainty associated with that value. A result below the MDL is never reported.

24.1 Test Reports

The report format has been designed to accommodate each type of test performed and to minimize the potential for misunderstanding or misuse.

Each test report generated contains the following information (unless not required by the client):

a) a title, such as Test Report or Test Results;

b) the name and address of the laboratory, the location of the laboratory if different from the address, and the phone number and name of a contact person;

c) unique identification of the test report, such as a serial number, on each page and a pagination system that ensures that each page is recognized as part of the test report and a clear identification of the end of the report, such as 3 of 10;

d) the name and address of the client if applicable;

e) the identification of the test method used;

f) an unambiguous identification of the sample(s), including the client identification code;

g) the date of sample receipt when it is critical to the validity and application of the results, date and time of sample collection, dates the tests were performed, the time of sample preparation and analysis if the required holding time for either activity is less than or equal to 72 hours;

h) the test results with failures identified, units of measurement, an indication of whether results are calculated on a dry weight or wet weight basis.

i) the name, function, and signature or an equivalent electronic identification of the person authorizing the test report, and the date of issue;

j) a statement to the effect that the results relate only to the samples;

k) at the laboratory's discretion, a statement that the report shall not be reproduced except in full without written approval of the laboratory;

l) certification that the results are in compliance with the 2009 TNI Standards if accredited to be in compliance or provide reasons and/or justification if they do not comply.

24.2 Supplemental Test Report Information

When necessary for interpretation of the results or when requested by the client, test reports include the following additional information:

a) deviations from, additions to, or exclusions from the test method, information on specific test conditions, such as environmental conditions, and any non-standard conditions that may have affected the quality of the results, and any information on the use and definitions of data qualifiers;

b) a statement of compliance/non-compliance when requirements of the quality systems are not met, including identification of test results that did not meet 2009 TNI sample acceptance requirements, such as holding time, preservation, etc.;

c) where applicable and when requested by the client, a statement on the estimated uncertainty of the measurement;

d) where appropriate and needed, opinions and interpretations

a. When opinions and interpretations are included, the basis upon which the opinions and interpretations are documented. Opinions and interpretations are clearly marked as such in the test report.

e) additional information which may be required by specific methods or client;

f) qualification of results with values outside the working range.

24.3 Environmental Testing Obtained from Subcontractors

Test results obtained from test performed by subcontractors are clearly identified in the test report case summary by subcontractor name.

The test results from subcontractors are reported in writing or electronically. A copy of the subcontractors report is included in the final report.

24.4 Electronic Transmission of Results

All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of this *Quality Assurance Manual* and associated procedures to protect the confidentiality and proprietary rights of the client.

24.5 Amendments to Test Reports

Amendments to a test report after it has been issued are made only in the form of another document or data transfer. All supplemental reports meet all the requirements for the initial report and the requirements of this *Quality Assurance Manual*.

Amended test reports are titled, "Revised" or an equivalent form of wording to assure they can be differentiated from the original test reports.

SECTION 25 – APPENDICES

Appendix 1

Hampton-Clarke, Inc. maintains accreditations and certifications with the following State entities:

Organization	Certificate/Lab ID #
New Jersey DEP	07071, 03046
New York DOH	11408
Pennsylvania DEP	68-00463
Connecticut DPH	PH-0671
Kentucky	90124

Appendix 2 – Demonstration of Capability Certificate

Date:
Analyst Name:

Matrix:
A) Drinking Water **B)** Waste Water
C) Solid hazardous waste

Method Number:
SOP Number: , Rev #
Measured Parameter:

We, the undersigned, CERTIFY that:

1. The Analyst identified above, using the cited test method(s), which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, have met the Demonstration of Capability.
2. The method(s) was performed by the Analyst(s) identified on this certification.
3. A copy of the method (s) and the laboratory-specific SOPs are available for all personnel on-site.
4. The data associated with the demonstration capability are true, accurate, complete and self-explanatory.
5. All raw data (including a copy of this certification form) necessary to reconstruct and validate these analyses have retained at the facility, and that the associated information is well-organized and available for review by authorized assessors.

Department Supervisor	Signature	Date
Quality Assurance Officer	Signature	Date
Analyst	Signature	

Appendix 3 – Ethics and Data Integrity Agreement

Hampton-Clarke
WBE/DBE/SBE 800-426-9992

ETHICS AND DATA INTEGRITY AGREEMENT

Hampton-Clarke, Inc. is an honest company. At no point in time is fraudulent data ever acceptable. If mistakes occur, the consequences can be dealt with using honest action. As a scientist, you are expected to approach data generation with a similar attitude.

I. I,_____, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at Hampton-Clarke, Inc.

II. I agree that in performance of my duties at Hampton-Clarke, Inc.:

a. I shall not intentionally report data values that are not the actual values obtained,
b. I shall not intentionally report the dates and times of data analyses that are not the actual dates and times of data analyses, and
c. I shall not intentionally represent another individual's work as my own.

III. I agree to inform Hampton-Clarke, Inc. of any accidental reporting of non-authentic data by myself in a timely manner.

IV. I agree to inform Hampton-Clarke, Inc. of any accidental or intentional reporting of non-authentic data by other employees in a timely manner.

_____
Signature

_____
Date

Appendix 4 - Equipment List

Metals Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
METALS PE4 ICP	Perkin Elmer ICP Perkin Elmer auto sampler Peristaltic Pump PolyScience Chiller Lenovo Computer Monitor	OPTIMA 8300 Serial # 078S1410156 S10 Autosampler Serial # 102S15010517 N0772026 Serial # 2F1522101 SN VNA025CW	Metals Instrumentation Lab
PE2 ICP	Perkin Elmer ICP Perkin Elmer auto sampler PolyScience Chiller Hyvision Monitor Dell CPU	4300 DV OPTIMA Serial # 077N1030901 AS93PLUS Serial # 1370 N0772026 Serial # 107900322 MV-177 Serial # SZMSBK778HE11596 Dimension ES20 Serial # 8QBOCC1	Metals Instrumentation Lab
ICP-OES PE3	Perkin Elmer PolyScience Chiller Dell Studio CPU Fuji Plus Monitor HP LaserJet Printer 4250	7300DV Optima Serial #077C0061602 PE # N0776999 C3FK3L1 FPS11P60824 Serial # CNRXL81808	Metals Instrumentation Lab
CV1 Mercury Analyzer	Perkin Elmer Perkin Elmer auto sampler Acer Monitor Dell Optiplex 380 CPU	FIMS 100 Serial #1107 AS91 Serial # 3408 Serial # 9991171421 Serial # 3MLLNN1	Metals Instrumentation Lab
CV2 Mercury Analyzer	Perkin Elmer Perkin Elmer auto sampler Verisonic G70fmb Monitor Dell Inspiron 5150 CPU	FIMS 100 Serial # 101SZ010404 AS90 Serial # 904S2010205 VCDTS23104-2M 899GC11	Metals Instrumentation Lab
ICPMS2 (HP7500)	Agilent Cetac Auto sampler Edwards 18 Peristaltic Pump Coolflow CFT-75 Chiller eMachines Monitor Dell CPU HP 4250 Printer	G3152a Serial #JP93200208 ASX-500Model 510 Serial #100133ASX Serial # 027437998 Serial # 495222139 Serial#ETE090800184 50FDEB4200 Serial # 2CY2511 G96978	Metals Instrumentation Lab
ICPMS3 (HP7700)	Agilent Tech Agilent ASX-500 Auto Sampler HP Compaq Monitor HP CPU Edwards 18 Vacuum Pump HP P3015 Printer Agilent Chiller	JP10240435 US061074A520 LA225WG Serial # 3CQ020CJHT Serial # 20A02302R3 Serial # 109431913 Serial # VNBC9DX2W5 G3292A Serial # 3L1130467	Metals Instrumentation Lab
Printer	HP4050TN	G84167	Metals Instrumentation

Metals Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
			Lab
Data Processing Units	Dell Dimension ES2P CPU Aces Monitor	FKQLZC1 ETL460C288813DDAF 7404A	Metals Instrumentation Lab
Data Processing Units	Dell Inspiron CPU Dell Monitor	S30-04K198 CN-OWH319-72872-GAS-3ETM	Metals Instrumentation Lab
Multi Magnestir	Lab Line	1278 Serial # 5147	Metals Digestion Lab
Analytical Balance 007	Mettler	AE100-S H29479	Metals Digestion Lab
Top Loader Scale B-026	OHAUS	SCOUTPROSP402 Serial#7131060152	Metals Digestion Lab
pH meter #3	Orion	420 A Serial # 31599	Metals Digestion Lab
Block Digester 1	Hampton-Clarke	M100	Metals Digestion Lab
Block Digester 2	Hampton-Clarke	M100	Metals Digestion Lab
Block Digester 6	Hampton-Clarke	M100	Metals Digestion Lab
Block Digester 9	SCP Science-DIGI-MS	MSA1015230126	Metals Digestion Lab
Block Digester 7	Hampton-Clarke	M50 Serial #34	Metals Digestion Lab
Hot Block 5	Environmental Express, Inc.	Model SC154 S/N 9234CECW4070	Metals Digestion Lab
Hot Block 4	Environmental Express, Inc.	Model SC154 S/N 8140CECW3438	Metals Digestion Lab
Hot Block Water Bath 8	Hampton-Clarke	M-100	Metals Digestion Lab

Wet Chemistry Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
WET CHEMISTRY			
Easy-Dist Universal Distillation System	Westco	Serial # 1049	Wet Chemistry Lab
Block Digester	AIM	Serial # 450	Wet Chemistry Lab
UV/Visible Spectrophotometer	Shimadzu	UV-1201 Serial # 60232J	Wet Chemistry Lab
UV/Visible Spectrophotometer	Perkin Elmer Lambda 20	Serial # 101N8060923	Wet Chemistry Lab
Flow Injection System	OI Analytical FS3100-CN Module FS3100-UV Module FS3100-Pump FS3100-autosampler Scepter X-56 Komodo7 CPU Dell E520 Dimension Monitor	322689 Serial # 333831433 Serial #705833638 ISM938C Serial # 16236-00014 ASX-130 Serial # 110605A130 Serial # 419X5G034H3957 Serial # 47WYQC1	Wet Chemistry Lab
Ion Chromatograph	Dionex Dell Pentium CPU	DX120 Serial # 98071005 Serial # 030545566	Wet Chemistry Lab
Ion Chromatograph	Dionex	ICS-1600 Serial#11121452	Wet Chemistry Lab
TOX Analyzer	Analytikjena	Multi 2500X Serial # NI-072/L	Wet Chemistry Lab
Sulfur/TOC Analyzer	LECO Dell OPTIplex 746 CPU	S632 Serial #3102 Model 686-457 Serial # 3084	Wet Chemistry Lab
TOC Analyzer	Shimadzu TOC 5050A Dell Pentium Optiplex 745 CPU	Serial # 36301690 H7DPDC1	Wet Chemistry Lab
TOC	Analytikjena	Multi N/C 2100 Serial#N5-295/J	Wet Chemistry Lab
pH Meter	ThermoScientific	B16004	Wet Chemistry Lab
pH Meter	ThermoScientific	B25641	Wet Chemistry Lab
Salinity/Conductivity/ Temperature Meter	YSI Incorporated	Model 30/10 FT Serial # 96B46343	Wet Chemistry Lab
Flashpoint	Koehler	K-162 Serial # 2047	Wet Chemistry Lab
Flashpoint	Koehler	K16200 Serial#R07002952-B	
Radiant Heat Oven	Baxter DK-43	Imperial II Serial #208002	Wet Chemistry Lab
COD Reactor	Hach COMPANY	DRB 200 Serial # 10030C0061	Wet Chemistry Lab
BOD Incubator	Equatherm	FV19F5WVFB Serial#WB92702691	Wet Chemistry Lab
DO Meter	Orion	850A + Serial # 087001	Wet Chemistry Lab
Turbidmeter	HF Scientific	Micro 100 Serial # 200702184	Wet Chemistry Lab
Centrifuge	Fisher	228 Derial#330	Wet Chemistry Lab
Sonicator	Branson	1510R-MT Serial # RKA010018665D	Wet Chemistry Lab
Isotemp Oven #6	Shel Lab	CE3F Serial#10034411	Wet Chemistry Lab
Oven #5	Fisher Scientific	637G Serial # 1579060786274	Wet Chemistry Lab
Gravity Conv. Oven	Precision	Serial # 24AX-2	Wet Chemistry Lab
Analytical Balance #008	Mettler	AE-100 Serial # 36120052	Wet Chemistry Lab
Top Loading Balance	Ohaus Scout Pro	SP202 Serial #	Wet Chemistry Lab

Wet Chemistry Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
(BAL-031)		B424688032	
Analytical Balance (BAL-030)	Mettler	Model # AE 100 Serial # 30502229	Wet Chemistry Lab
Top Loading Balance (BAL-028)	Ohaus Scout Pro	SP202 Serial # 7131421047	Wet Chemistry Lab
Top Loading Balance (BAL-023)	Ohaus Scout Pro	SP202 Serial#7125411578	Wet Chemistry Lab
% Solids Computer	Dell Dimension E520	87V25C1	Wet Chemistry Lab
Stirplate IKA	IKA	Model: Color Squid	Wet Chemistry Lab
Stirplate IKA	IKA	Model: Color Squid	Wet Chemistry Lab
Furnace	Thermo Scientific	FB1415M Serial # 1257090216669	Wet Chemistry Lab
Refrigerator #27	Frigidare	WA04001143	Wet Chemistry Lab
TOC, Sulfur	Analytikjena	HT09/13/021	Wet Chemistry Lab
UV/Visible Spectrophotometer	Hach	DR3900 serial#1484240	Wet Chemistry Lab
UV/Visible Spectrophotometer	Hach	DR3900 serial#1412612	Wet Chemistry Lab
Microdist	Lachat	Serial#111200002137	Wet Chemistry Lab
Microdist	Lachat	Serial#120800002157	Wet Chemistry Lab
Microdist	Lachat	Serial#110100002099	Wet Chemistry Lab
ISE	Thermo Scientific	Orion Star A214 Serial#X03759	Wet Chemistry Lab
Discrete Analyzer	Seal	AQ2 serial#090817	Wet Chemistry Lab

Semi-Volatile Organic Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
GCMS5	Agilent Technologies	GC (6890N) Serial # US10438026 MS (5973) Serial # US94240120 Tray (2614A) Serial # US12511945 Auto Sampler (G2613A) Serial # US01713197	Organic Instrumentation Lab
GCMS7	Agilent Technologies	GC (6890A) Serial # US00030680 MS (5973) Serial # US40610193 Controller (G1512A) Serial # 3523A2047 Tray (18596C) Serial # 3512A38408 Auto Sampler (18593B) Serial # 312OA27228	Organic Instrumentation Lab
GCMS9	Agilent Technologies	GC (6890) Serial # CN10652091 MS (5975B) Serial # US65115206 Tray (G2614A) Serial # CN72244136 Auto Sampler (G2913A) Serial # CN52826350	Organic Instrumentation Lab
GCMS10	Agilent Technologies	GC (6890N) Serial # US00021320 MS (5975C) Serial # US71216353 Controller (G1512A) Serial # 3608A04454 Tray (18596B) Serial # 3238A23101 Auto Sampler (18593B) Serial # 3502A41391	Organic Instrumentation Lab
GCMS 12	Agilent Technologies	GC (7890A)(G3440A) Serial # CN10481010 MS (5975C) Serial # US10477403 Tray (G4514A) Serial # CN10440033 AutoSampler (G4513A) Serial # CN10460246	

Semi-Volatile Organic Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
GC1	Hewlett Packard	GC (5890) Serial # 2643A10991 Controller (18594B) Serial # 3350A34246 Tray (18596B) Serial # 3306A31271 Auto Sampler (18593B) Serial # 3231A31703	Organic Instrumentation Lab
GC2	Hewlett Packard	GC (5890E) Series II Plus Serial # 3336A56148 Controller (G1512A) Serial # CN00002726 Tray (18596B) Serial # 3018A21193 Auto Sampler (18593B) Serial # 3440A37131	Organic Instrumentation Lab
GC3	Hewlett Packard	GC (5890E) Series II Plus Serial # 3336A51420 Controller (G1512A) Serial # CN00002613 Tray (18596B) Serial # 3146A27034 Auto Sampler (18593B) Serial # 3414A38429	Organic Instrumentation Lab
GC4	Hewlett Packard	GC (5890A) Series II Serial # 3235A46464 Controller (18594B) Serial # 3113A26379 Tray (18596B) Serial #3315A31802 Auto Sampler (18593B) Serial # 3120605608	Organic Instrumentation Lab
GC5	Agilent	GC (5890) Series Serial # US00034887 Tray (G2614A) Serial # CN22320925 AutoSampler (G2613A) Serial # US11318379	Organic Instrumentation Lab
GC6	Hewlett Packard	GC (5890) Series II Plus Serial # 3336A58785 Controller (18594B) Serial # 3018A2205B Tray (18596B) Serial # 3106A24394	Organic Instrumentation Lab

Semi-Volatile Organic Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
		Auto Sampler (18593B) Serial # 3439A40267	
GC7	Hewlett Packard	GC (5890) Serial # 2643A11266 Controller (18594B) Serial # 3113A25752 Tray (18596B) Serial # 3349A33991 Auto Sampler (18593B) Serial # 3013A22490	Organic Instrumentation Lab
GC8	Agilent	GC (6890) Serial # US00042241 Tray (G2614A) Serial # US01507992 AutoSampler (G2613A) Serial # US01513059	Organic Instrumentation Lab
GC9	Agilent	GC (6890) (G1530A) Serial # US00020563 Controller (G1512A) Serial # 3643A6680 Tray (18596B) Serial # 3231A29342 AutoSampler (18593B) Serial # 3549A45009	Organic Instrumentation Lab
GC10	Agilent	GC (6890N) (G1530A) Serial # US10508010 Tray (G2613A) Serial # CN50431973 AutoSampler Front (G2613A) Serial # US23021205 Back (G2913A) Serial # CN50623459	Organic Instrumentation Lab
GC11	Hewlett Packard	GC (5890) Series II Serial # 3223A42806	Organic Instrumentation Lab
GC12	Hewlett Packard	GC (5890) Series Serial # US00002611 Controller (G1512A) Serial # 00000516 Tray (18596C) Serial # 3547A40753 AutoSampler (18593B) Serial # 3215A30429	Organic Instrumentation Lab

Organic Extraction Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
High Pressure Extractor (ASE)	Dionex	ASE 200 Serial # 01080423	Organic Extraction Lab
Herb Shaker	Burrell	Model 75	Organic Extraction Lab
Herb Shaker	Burrell	Model 75	Organic Extraction Lab
ASE Extractor 1	Dionex	ASE200 Serial # 97040450	Organic Extraction Lab
ASE Extractor 2	Dionex	ASE200 Serial # 1080423	
ASE Extractor 3	Dionex	ASE200 Serial # 07040204	
ASE Extractor 4	Dionex	ASE200 Serial # 97070811	
High Pressure ASE Extractor	Dionex	ASE200 # Serial # 07040204	Organic Extraction Lab
GPC	Waters	2487 717 1515 2488	Organic Extraction Lab
GPC Detector	Waters	Model 2487 Serial # H03487-670M	Organic Extraction Lab
GPC Auto sampler	Waters	Model 717 Serial # H0371P-327M	Organic Extraction Lab
GPC HPLC Pump	Waters	Model 1515 Serial # F0315P-744M	Organic Extraction Lab
GPC Fraction Collector	Waters	Model WFC#III Serial # D03WFC091M	Organic Extraction Lab
Fractionator	Agela	SPE-01	Organic Extraction Lab
Centrifuge	Drucker	Serial # E92-282	Organic Extraction Lab
Centrifuge	Fisher	Model # 228 Serial # 838	Organic Extraction Lab
Centrifuge	Grafco	Serial # 160110-91	Organic Extraction Lab
Nitrogen Evaporator – N-EVAP 112	Organomation	Model #8125 Serial # 52471	Organic Extraction Lab
Nitrogen Evaporator – N-EVAP	Organomation	Model # 111 Serial # L2306	Organic Extraction Lab
ZHE TCLP Extractor Tumbler #19	Associated Design and MFG Co.	Model 3740-12-BRE Serial # 1069	Organic Extraction Lab
ZHE TCLP Extractor Tumbler #8	Associated Design and MFG Co.	Model 3740-12-BRE Serial # 1234	Organic Extraction Lab
ZHE TCLP Extractor Tumbler #10	Associated Design and MFG Co.	Model 3740-12-BRE Serial # 1023	Organic Extraction Lab
Turbo Vap Evaporator	Zymark	Serial # TV9432N4195	Organic Extraction Lab
Turbo Vap II	Biotage	Serial #TV1038N16110	Organic Extraction Lab
Turbo Vap II	Biotage	Serial # TV1038N1611	Organic Extraction Lab
Furnace	Thermolyne	30400 Serial#1262070457163	Organic Extraction Lab
Furnace	Thermolyne	F30428C Serial # 0152421401100622	Organic Extraction Lab
Furnace	Thermolyne	F30428C Serial # 152426501100621	Organic Extraction Lab
Furnace	Thermolyne	30400 Serial#1059000532278	Organic Extraction Lab
Sonic Disruptor	Tekmar	TM-600 Serial # 12164	Organic Extraction Lab
Sonic Disruptor	Sonic Materials	VC250B Serial # 7446	Organic Extraction Lab
Sonic Disruptor	Heat Systems	Serial # G9139	Organic Extraction Lab
Sonic Disruptor	Sonic Materials	Serial #18588	Organic Extraction Lab
Sonic Disruptor	Sonic Materials	Serial # 18518F	Organic Extraction Lab
Sonic Disruptor	Sonic Materials	Serial # 8047	Organic Extraction Lab
Shakers	Ederback	6010 s/n069816	Organic Extraction Lab
Shakers	Ederback	6010	Organic Extraction Lab
Shakers	Ederback	6010	Organic Extraction Lab
Shakers	Ederback	6010	Organic Extraction Lab

Organic Extraction Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
Shakers	Ederback	6010	Organic Extraction Lab
Shakers	Ederback	6010	Organic Extraction Lab
Water Bath	Thelco	Serial # 12-Y-5	Organic Extraction Lab
Water Bath	Precision Scientific	Serial # 11-U-10	Organic Extraction Lab
Water Bath	Precision Scientific	Serial # 13-AF--3	Organic Extraction Lab
Water Bath	Precision Scientific	Serial # 13-2-11	Organic Extraction Lab
Water Bath	Thelco	Serial # 13-AE-6	Organic Extraction Lab
Water Bath	Thelco	Serial # 10-X-7	Organic Extraction Lab
Top Loading Balance (BAL-019)	Ohaus	Scout Pro SP 202 Serial # 7126470360	Organic Extraction Lab
Top Loading Balance (BAL-022)	Ohaus	Model # AdvProAV+12 Serial # 1225301233	Organic Extraction Lab
Refrigerator	Magic Chef	#17	Organic Extraction Lab
Refrigerator	Magic Chef	#18	Organic Extraction Lab
Refrigerator	Frigidaire	#19	Organic Extraction Lab
Refrigerator	Magic Chef	#23	Organic Extraction Lab
PC	IBM XP Professional Series	Serial # KBFLMV5	Organic Extraction Lab
Monitor	IBM 6639-U3N	Serial # 23FF107	Organic Extraction Lab
Refrigerator	Power Scientific	Model# ST70GD Serial# B122915	Organic Extraction Lab
Refrigerator	Power Scientific	Model# ST70GD Serial# B122917	Volatile Lab
Refrigerator	Magic Chef	#15	Organic Extraction Lab
Refrigerator	Americana	#16	Organic Extraction Lab
Extractor	Gerhard Soxtherm	1/846513007	Organic Extraction Lab
Extractor	Gerhard Soxtherm	1/846513008	Organic Extraction Lab
Extractor	Gerhard Soxtherm	1/846513009	Organic Extraction Lab
Extractor	Gerhard Soxtherm	1/846513010	Organic Extraction Lab
Chiller-sample circulator		0120318201131114	Organic Extraction Lab
Controller		0120318301131116	Organic Extraction Lab
Centrifuge	Grafco	151214259	Organic Extraction Lab
Sonic Disruptor	Sonic Materials	16388F	Organic Extraction Lab
Sonic Disruptor	Tekmar	15590E	Organic Extraction Lab
Sonic Disruptor	Sonic Mterials	8588	Organic Extraction Lab
Sonic Disruptor	Sonic Mterials	6282	Organic Extraction Lab
Refrigerator	Magic Chief	MCBR445B1	Organic Extraction Lab
Water Bath	Presicion Scientyfic	13-AF-5	Organic Extraction Lab
ZHE TCLP Extractor #12	Asso. Design and MFG. Co.	Mod:3740-20-BRE-TM s/n:10112280	Organic Extraction Lab
Heavy Duty LE Rotator	Environmental Express	Mod:LE1002 s/n: 659512604	Organic Extraction Lab
Nitrogen Evaporator	Organomation	Mod 8125 s/n 38336	Organic Extraction Lab
Nitrogen Evaporator	Organomation	Mod 8125 s/n 52479	Organic Extraction Lab
Nitrogen Evaporator	Organomation	Mod 8125 s/n 59023	Organic Extraction Lab
Nitrogen Evaporator	Organomation	Mod 8125 s/n 59295	Organic Extraction Lab
Centrifuge	Thermo Electric Corp.	Mod GP8R s/n 31220128	Organic Extraction Lab
Top Loading Balnce	Ohaus	s/n B527136681	Organic Extraction Lab
Top Loading Balnce #27	Ohaus		Organic Extraction Lab
Circulation Bath #1	Thermo Fisher	s/n 0120318201131114	Organic Extraction Lab
Circulation Bath #2	Thermo Fisher	s/n 0120318301131116	Organic Extraction Lab
Circulation Bath #3	Thermo Fisher	s/n 0141389701150414	Organic Extraction Lab
Circulation Bath #4	Thermo Fisher	s/n 0141389601150414	Organic Extraction Lab
Soxtherm Extractor #1	Gerhardt Co.	s/n 1/8465130008	Organic Extraction Lab
Soxtherm Extractor #2	Gerhardt Co.	s/n 1/8465130007	Organic Extraction Lab
Soxtherm Extractor #3	Gerhardt Co.	s/n 1/8465130010	Organic Extraction Lab
Soxtherm Extractor #4	Gerhardt Co.	s/n 1/8465130009	Organic Extraction Lab
Soxtherm Extractor #5	Gerhardt Co.	s/n 1/8465150007	Organic Extraction Lab
Soxtherm Extractor #6	Gerhardt Co.	s/n 1/8465150009	Organic Extraction Lab
Soxtherm Extractor #7	Gerhardt Co.	s/n 1/8465150005	Organic Extraction Lab
Soxtherm Extractor #8	Gerhardt Co.	s/n 1/8465150006	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 60064	Organic Extraction Lab

Organic Extraction Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
Solvent Evaporation System	Organomation	s/n 60078	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 60071	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 60056	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 60828	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 58392	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 60829	Organic Extraction Lab
Solvent Evaporation System	Organomation	s/n 60674	Organic Extraction Lab
Recirculation chiller	PolyScience	s/n 3H 15B0809	Organic Extraction Lab
Recirculation chiller	PolyScience	s/n 3H15B0808	Organic Extraction Lab
Recirculation chiller	PolyScience	s/n 4H1621303	Organic Extraction Lab
Recirculation chiller	PolyScience	s/n 4H1621304	Organic Extraction Lab
Recirculation chiller	PolyScience	s/n 1D1331412	Organic Extraction Lab

Volatile Organic Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
GCMS1	Hewlett Packard Hewlett Packard Tekmar Purge and Trap Env. Sci. Tech, Inc	GC (5890) Serial # 2950A28158 MS (5970) Serial # 2905A11689 Encon EV Serial#EV707110415 Arcon Auto Sampler Serial # 11805995	Volatile Organics Lab
GCMS2	Hewlett Packard Hewlett Packard Tekmar Purge and Trap OI	GC (5890) Serial # 3310A47409 MS (5970) Serial # 3114A13083 LSC-2000 Serial # 92133004 Auto sampler 4552 Serial # 13280	Volatile Organics Lab
GCMS3	Hewlett Packard Hewlett Packard Tekmar Purge and Trap Env. Sci. Tech, Inc	GC (5890) Serial # 2938A25182 MS (5970) Serial # 2716A10420 LSC-2000 Serial # 89055008 Arcon Auto sampler Serial # 12932	Volatile Organics Lab
GCMS6	Hewlett Packard Hewlett Packard Tekmar Purge and Trap	GC (5890) Serial # 3029A29774 MS (5970) Serial # 2923A12295 LSC-2000 Serial # 91287003	Volatile Organics Lab
GCMS8	Hewlett Packard Hewlett Packard Tekmar Purge and Trap Env. Sci. Tech Inc.	GC (5890) Serial # 3121A35567 MS (5970) Serial # 3004A12685 LSC-2000 Serial # 90121002 Arcon Auto sampler Serial # 12932	Volatile Organics Lab

Volatile Organic Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
GCMS11	Agilent	GC (7890A) Serial # CN10221081	Volatile Organics Lab
	Agilent	MS (5975C) Serial # US10203420	
	Varior	Serial# 012056/Archor	
	Entech Dynamic Diluter	4600A Serial # 1281	
	Entech Canister Cleaner	3100A Serial # 01427	
	Entech Preconcentrator	7100A Serial # 1607	
	Entech Canister Auto Sampler	7016CA Serial # 1311	
	Corbett Industries, Inc. Oven	Serial # B33-02690	
ORG-SYS-35	Dell Dimension E520 CPU	KDS Rad-5X Serial # 66V25C1	
ORG-SYS-40	Dell Monitor	B3FK3L1 Model # E197FP	
	Purge Trap, East Analytical	Encon EV EB524110413	
GC13	Hawlett Packard	5890E serial#3336A56038	Volatile Organics Lab
	Tekmar Purge and Trap	LSC 2000 Serial#88217050	
	Est Archon	Autosampler serial#12113	
Freezer # 18	GE	Model#FUF20SUDRWW Serial # VM179179	Volatile Organics Lab
Freezer # 19	Kenmore	Model # 253.28062801 Serial # WB82557622	Volatile Organics Lab
Refrigerator # 21	Kenmore	Model # 253.60722001 Serial # WA80500518	Volatile Organics Lab
Refrigerator # 22	Kenmore	Model # 253.60722001 Serial # WA80500603	Volatile Organics Lab
Refrigerator VOA	Ranco	# 3	Sample Receiving
Junior Orbit Shaker	Lab Line	Model # 3520 Serial # 0180	Volatile Organics Lab
Top Loading Balance (BAL-013)	Ohaus Scout Pro	Model # SP202 Serial # 7125411998	Volatile Organics Lab
ORG-SYS-06	Dell	E520 Serial # G7VZ5C1	Volatile Organics Lab
Monitor	Acer	Model # AL1511W	Volatile Organics Lab
ORG-SYS-27	Dell	E520 Serial # 1ZBK6D1	Volatile Organics Lab
Monitor	Dell	Model # L51B	Volatile Organics Lab
ORG-SYS-24	Dell	E520 Serial # FYBK6D1	Volatile Organics Lab
Monitor	Dell	Model # S199WFP	Volatile Organics Lab
ORG-SYS-23	Dell	E520 Serial # 4ZBK6D1	Volatile Organics Lab

Monitor	Dell	Model # E197FP	Volatile Organics Lab
ORG-SYS-26	Dell	Inspiron 530 Serial # 2TRTQG1	Volatile Organics Lab
Monitor	Dell	Model # S199WFP	Volatile Organics Lab
ORG-SYS-25	Dell	Inspiron 530 Serial # FZZ41G1	Volatile Organics Lab
Monitor	I-INC	Model # HSG1015	Volatile Organics Lab
ORG-SYS-02	Systemax	Venture Serial # 106194642	Volatile Organics Lab
Monitor	Dell	Model # E197FP	Volatile Organics Lab
ORG-SYS-01	Systemax	Venture Serial # 106194644	Volatile Organics Lab
Monitor	Dell	Model # E197FP	Volatile Organics Lab
Laser Jet Printer	HP	5SI Serial # USDJ065951	Volatile Organics Lab

Sample Receiving Laboratory Equipment			
Instrument Type	**Manufacturer**	**Model/Serial#**	**Location**
SAMPLE RECEIVING			
Top Loading Balance #014	Ohaus	Scout Pro SP202 Serial # 7126032397	Sample Receiving
Top Loading Balance #024	Ohaus	Scout Pro SP202 Serial # 7131350314	Sample Receiving
Top Loading Balance #025	Ohaus	Scout Pro SP2001 Serial # 7131421580	Sample Receiving

Appendix 5 – Definitions:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accreditation Body: The Territorial, State, or Federal Agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (NELAC)

Accuracy: 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 which are due to sampling and analytical operations; a data quality indicator.

Analysis Date: The calendar date of analysis associated with the analytical result reported for an accreditation or experimental field of. (NELAC)

Analyst: 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. (NELAC)

Analytical Uncertainty: A subset of Measurement Uncertianty that includes all laboratory activities performed as part of the analysis. (NELAC)

Assessment: The evaluation process used to measure or establish the performane, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (NELAC)

Audit: 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. (NELAC)

Batch: Environmental samples which 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 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. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and /or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Bias: The systematic or persistent distortion of a measurement process, which causes errors on one direction (i.e., the expected sample measurement is different from the sample's true value). (NELAC)

Blank: A sample that has 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.

Blind QC Sample: A 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.

Calibration: To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method: A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard: A substance or reference material used to calibrate an instrument.

Certified Reference Material (CRM): A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30–2.2)

Chain of Custody: An unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples. (NELAC) [5.12.4]

Clean Air Act: The enabling legislation in 42 U>S>C> 7401 et seq., Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and enforce them. (NELAC)

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: 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 (NELAC)

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.)

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (that they meet specified acceptance criteria). (NELAC)

Data Reduction: The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

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 if performed.

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Federal Water Pollution Control Act (Clean Water Act, CWA): The enabling legislation under 33 U.S.C. 1251 et seq., Public Law 92-50086 Stat 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for noncompliance. (NELAC)

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken

Field of Testing: NELAC's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required to submit to only that portion of the accreditation process not previously addressed (see NELAC, section 1.9ff). (NELAC)

Holding Time: The maximum times that samples may be held prior to analyses and still be considered valid or not compromised.

Internal Standard: A known amount of standard added to a test portion of a sample and carried through the entire measurement process as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (NELAC)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, method spike blank (MBS) 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, taken through all preparation and analysis steps. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total volatile solids, pH, color, odor, Temperature or dissolved oxygen. The results of these samples shall be used to determine batch acceptance. (NELAC)

Laboratory Duplicate: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit.

Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent. (Analytical Chemistry, 55, p.2217, December 1983, modified) See also Method Detection Limit.

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used: Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix. Includes surface water, groundwater, effluents, and TCLP or other extracts. Drinking Water: any aqueous sample that has been designated as a potable or potential potable water source. Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake. Solids: includes soils, sediments,

sludges, and other matrices. Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined. Air: 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. (NELAC)

Matrix Spike (spiked sample or fortified sample): Prepared by adding a known mass of target analyte to a specified amount of matrix sample. Matrix spikes are used to determine the effect of the matrix on a method's recovery efficiency. Matrix spikes shall be performed at a frequency of one in 20 samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in a matrix spike may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the spike.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A second replicate matrix spike is prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. Matrix spike duplicates or laboratory duplicates shall be analyzed at a minimum of 1 in 20 samples per matrix type per sample extraction or preparation method. The laboratory shall document their procedure to select the use of an appropriate type of duplicate. The selected sample(s) shall be rotated among client samples so that various matrix problems may be noted and/or addressed. Poor performance in the duplicates may indicate a problem with the sample composition and shall be reported to the client whose sample was used for the duplicate.

Method Blank: 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. (NELAC)

Method Detection Limit: The minimum concentration of a substance (an analyte) 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. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

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. (NELAC)

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC) [2.1]

Proficiency Testing Program: 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. (NELAC)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (NELAC)

Quality Assurance:
An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

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: The overall system of technical activities which purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Control Sample: An uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality Manual: 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. (NELAC)

Quality System: 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 QA and QC.

Range: The difference between the minimum and the maximum of a set of values.

Raw Data: 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. (NELAC)

Reference Material: Material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (NELAC)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (NELAC)

Replicate Analyses: The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limit (RL): The laboratory nominal Quantitation Limit (QL) determined by the lowest calibration standard in the initial calibration. Any value reported below the Reporting Limit but above the MDL shall be flagged as an estimate ("J"). No value below the MDL shall be reported.

Resource Conservation and Recovery Act (RCRA): The enabling legislation under 42 USC 321 et seq. (1976), that gives EPA the authority to control hazardous waste from the "cradle-to-grave", including its generation, transportation, treatment, storage, and disposal. (NELAC)

Safe Drinking Water Act (SDWA): The enabling legislation, 42 USC 300f et seq. (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample Duplicate: Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature of the data.

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Standard Operating Procedures (SOPs): A written document which details the method of an operation, analysis, or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

Surrogate: 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. Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery.

Systems Audit: A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Traceability: The ability to trace the history, application, or location of an entity by means of record identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants 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. A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system.

Uncertainty: The estimated amount or percentage by which an observed or calculated value may differ from the true value. This may be due to any of the many parameters that influence a measurement.

Acronyms

A list of acronyms used in this document and their definitions are:

°C	–	degrees Celsius
cal	–	calibration
CCV	–	Continuing calibration verification
COC	–	Chain of custody
DO	–	Dissolved oxygen
DOC	–	Demonstration of Capability
EPA	–	Environmental Protection Agency
GC/MS	–	gas chromatography/mass spectrometry
ICPMS	–	inductively coupled plasma-mass spectrometry
ICV	–	Initial calibration verification
LCS	–	Laboratory control sample
MDL	–	method detection limit
mg/Kg	–	milligrams per kilogram
mg/L	–	milligrams per liter
MS	–	matrix spike
MSD	–	matrix spike duplicate
NELAC	–	National Environmental Laboratory Accreditation Conference
NELAP	–	National Environmental Laboratory Accreditation Program
NIST	–	National Institute of Standards and Technology
PT	–	Proficiency Test(ing)
PTOB	–	Proficiency Testing Oversight Body
QA	–	Quality Assurance
QC	–	Quality Control
RL	–	Reporting level
RPD	–	Relative percent difference
RSD	–	Relative standard deviation
SOPs	–	Standard operating procedures
spk	–	spike
std	–	standard
TNI	-	The NELAC institute
ug/L	–	micrograms per liter
UV	–	Ultraviolet
VOC	–	Volatile organic compound
WET	–	Whole effluent toxicity

DOCUMENT REVISION LOG

DOCUMENT: **QA MANUAL**

DATE	Rev. No	Initials	SECTION	REVISION
9/1/10	14	JR	(all)	Complete re-write of QAM.
6/22/11	15	JR		Updated Organizational chart
				Section 17.1.2.3, 20.2, 22.2, 23.2, Tcl 23.4, Tbl 20.3-1 – deleted references to microbiological analyses
			App 4	Updated equipment list
8/29/12	16	DHFL	Several	Update Org Chart, Forms and fix grammar and punctuation issues.
11/06/13	17	RC	Section 4	Added TNI 2009 reference
			Section 4.1	Updated organizational chart
			Section 6.1	Clarified that notification of changes to controlled documents are sent via e-mail
			Section 6.3	Added location of SOPs- w:drive
			Section 15	Clarified that scanned electronic copies are maintained
			Section 16.1	Added timeframe to notify clients when problems are uncovered during internal audits
			Section 17.1.2	Updated to current practice- only one Technical Director
			Section 17.1.4	Added TNI 2009 reference
			Section 17.2	Clarified how anonymous reporting is accomplished – generic internet based e-mail account
			Section 17.3	Added to list how to gain access to the generic e-mail account
			Section 22	Added updated chain of custody
			Section 22	Updated Analysis/Method/Holding Time table
			Section 24.1	Added TNI 2009 reference
			Section 24.2	Added TNI 2009 reference
			Appendix 1	Updated to current certifications
			Appendix 5	Added definitions to match TNI 2009
02/10/15	18	EJ	Cover page	Changed the names of responsible parties
			Appendix 4	Updated equipment list
			Section 4.1	Updated organization chart
09/16/15	19	RC	Section 4.1	Updated organization chart
			Section 18	Added generators to accomodations
			Section 19.6	Added statement that clients will be notified of change in lims
			Section 22	Added updated chain of custody
06/16/16	20	RC/EJ	Section 4	Added reference to DOD and ISO 17025
			Section 4.2	Updated Heading
			Section 5.1	Added DOD and ISO 17025 to quality statement
			Section 16.4	Added refernce to Executive Team
			Section 17.1.1	Updated Title and added compliance to DOD and 17025
			Section 17.1.2	Updated Title and added compliance to DOD and 17025
			Section 17.1.3	Updated Title
			Section 17.1.4	Updated Title and added compliance to DOD and 17025
			Section 23.7	Added reference to completting CA for proficiencies
			Section 23.8	Updated Title and added QA/Deputy responsibility to review reports
08/18/16	21	RC/EJ	Section 16.4	Updated System Audits and Management Reviews
			Section 23.7	Clarified completion of CA and submital to A2LA
09/25/17	22	RC	Section 22.2	Clarifed that DW compliance samples are not analyzed at lab

QUALITY ASSURANCE MANUAL

CHEMTECH

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Date

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8/01/2017
Date

INTRODUCTION

The Chemtech Quality Program, outlined in this document, has been prepared to meet the requirements of ISO/IEC DIS 17025 and National Environmental Laboratory Accreditation Program (NELAP). The program establishes all Quality Assurance (QA) policies and Quality Control (QC) procedures to follow in order to ensure and document the quality of the analytical data produced by the Laboratory. The Quality Program is reviewed periodically and revisions are implemented as required.

Chemtech Standard Operating Procedures (SOPs) provide explicit instructions on the implementation of each element of the plan and assure that compliance with the requirements of the plan is achieved. All employees are required to adhere to the requirements of the SOP's in performing their specific job functions. SOP's are reviewed periodically and revisions are implemented as required when change occurs.

The goal of the Quality Program is to consistently produce accurate, defensible analytical data through the implementation of sound and useful Quality Assurance/Quality Control management practices. The plan will ensure that Chemtech, its employees and client expectations are achieved.

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1. QUALITY POLICY

1.1 CHEMTECH MISSION

Chemtech will be recognized as a dynamic, professional organization, which provides high quality analytical services to the environmental market.

It will consistently meet client expectations while providing a challenging work environment for its employees and acceptable profit margins for its shareholders.

1.2 POLICY STATEMENT

Chemtech is committed to the production of analytical data meeting specific defined quality standards and to continue improvements in all areas of our operation. As a result of having a focus on environmental analyses, an emphasis is placed on timelines of work, meeting data quality objectives, and the legal defensibility of the data. Each operation maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality. Chemtech has policies and procedures to avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment or operational integrity. Under the guidance of this quality assurance manual, a level of quality, which is acceptable on a national and international scale, is upheld in all Chemtech laboratory operations. Chemtech management is committed to be compliant with 2009 TNI Standard and NELAP policies. Chemtech will comply with the requirements in Department of Defense Quality Systems Manual for Environmental laboratories, Version 5.0 for all DOD work.

Our corporate goal for all segments of Chemtech operations is to have uniform products and service quality standards, while encouraging local variation to meet state regulations and customer specifics needs. The process of achieving this goal entails continuous evaluation and action. Chemtech management requires documentation of existing practices and improvement action plans at every stage in the analytical measurement process. Documentation is fundamental to the demonstration and management of quality practices in environmental analytical laboratories.

Chemtech management is committed to continually improve the quality system. The importance of meeting customer requirements, operating in accordance with statutory and regulatory requirements, and operating in accordance with Chemtech's documented ethics policy is communicated to all personnel and stressed at all levels of work.

A spirit of innovation is an essential element to the success of Chemtech in solving the complicated analytical problems encountered with environmental samples. This spirit, combined with the discipline and detail oriented attention required to provide the level of service expected by our customers, is what makes Chemtech stands out among others in this field. This same spirit is what drives continuous quality improvement and is the keystone to the Chemtech quality program.

1.3 ANNUAL REVIEWS AND PLANNING

As part of 2009 TNI Standard requirement, the QA/QC Director produces an annual report to the Management to discuss deficiencies, corrective actions and planning for the upcoming year. All corrective actions in the laboratory are documented and updated in the Corrective Action Report Database. These Corrective Action Reports are also graphed. The QA/QC Director submits this report to the Management in the second half of the year and the management performs annual review and planning based on this report. The issues discussed in the report are New Certifications, New Instrumentation, Performance Evaluation, Assessment, Quality Assurance Programs, Change in Volume and type of work, Customer Feedback and Goals for the next year.

2. ORGANIZATION AND MANAGEMENT

2.1 ORGANIZATIONAL ENTITY

Chemtech, located in Mountainside, New Jersey, is a privately held independent analytical laboratory established in 1967. Chemtech is incorporated in the State of New York and registered to do business in the State of New Jersey. Our Directors, many of who are also major shareholders are acutely aware of the dynamics of our industry, the changing technology, and need for capital investment. Capital for investment in technology and expansion is mainly derived from operating profits and our shareholders. We have been successful in acquiring the necessary equipment, software and automation necessary to be a leader in the analytical community.

2.2 MANAGEMENT RESPONSIBILITIES

Objective: The laboratory has an established chain of command as detailed in the Organizational Chart. The responsibilities of the management staff are linked to the President of Chemtech who establishes the strategy and direction for all company activities.

President: Primarily responsible for all operations and business activities. Develops and implements strategies, initiatives and direction for the company. Delegates authority to Laboratory Directors, all Managers, and Quality Assurance/Quality Control Director to conduct day-to-day operations and execute quality assurance duties.

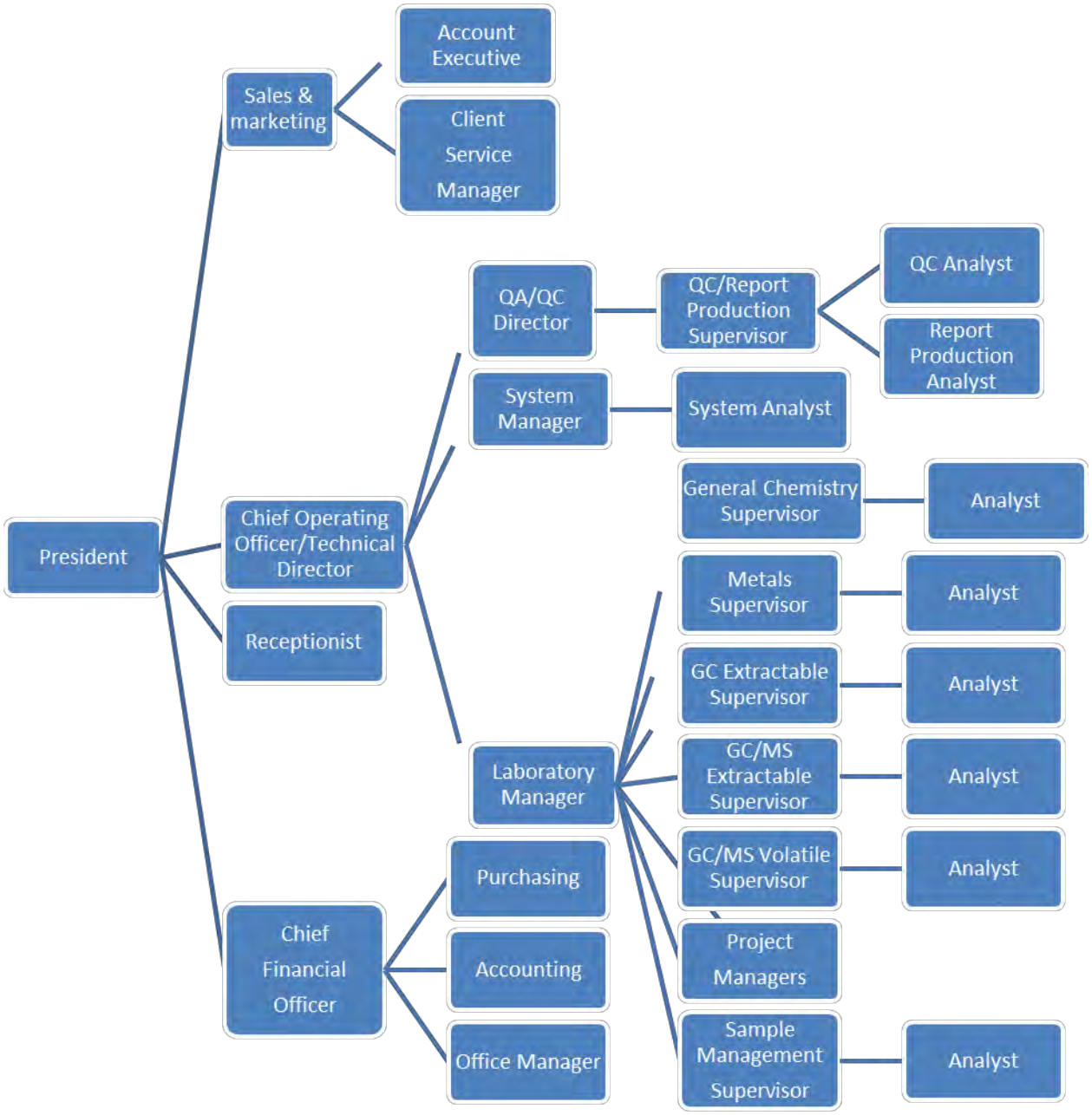
Chief Operating Officer/Technical Director: Facilitates uniformity and focus in all aspects of the company's technical affairs; including, Quality Assurance, Information Systems, and Organic and Inorganic technical direction. Strives to align the strategies, initiative and direction of technical affairs with the strategic direction of the company. Reports to the President.

Quality Assurance/Quality Control (QA/QC) Director: Implements, supervises, and facilitates responsibility for all QA activities established by the Quality Program. Reports to the Chief Operating Officer/Technical Director.

Laboratory Manager: Plans, directs, and controls the day-to-day company's operational performance expectations. Reports to the Chief Operating Officer/Technical Director.

Department Manager: Supervise, plans, directs, and controls the day-to-day responsibility of a specific laboratory department. Report to Laboratory Manager.

Department Supervisors: Supervise day-to-day responsibility of a specific laboratory department. Report to Department Manager.


President
Sales & marketing
Account Executive
Client Service Manager
Chief Operating Officer/Technical Director
QA/QC Director
QC/Report Production Supervisor
QC Analyst
Report Production Analyst
System Manager
System Analyst
General Chemistry Supervisor
Analyst
Metals Supervisor
Analyst
GC Extractable Supervisor
Analyst
GC/MS Extractable Supervisor
Analyst
GC/MS Volatile Supervisor
Analyst
Project Managers
Sample Management Supervisor
Analyst
Laboratory Manager
Receptionist
Chief Financial Officer
Purchasing
Accounting
Office Manager

3. RELATIONSHIP BETWEEN MANAGEMENT, TECHNICAL OPERATIONS, SUPPORT SERVICES, AND QUALITY SYSTEM

Objective: The members of the management team have defined responsibility for the Quality Program. The development and implementation of the Quality Program is the responsibility of Quality Assurance/Quality Control Director. The implementation and operation of the Program is the responsibility of the operations management.

President: Responsible for all quality activities including the overall responsibility of implementing the Program. Authorizes the QA/QC Director to design, implement, and coordinate the Program.

Chief Operating Officer/Technical Director: Responsible for executing and coordinating the Program in all laboratory departments. Responsible to certify and document that personnel have the appropriate education and/or technical background to perform the tests for which the laboratory is accredited to perform. Responsible for the development and implementation of corrective actions, including the authority to delegate Quality Program implementation responsibilities. Is the primary alternate in the absence of the QA/QC Director or Laboratory Manager.

Quality Assurance/Quality Control Director: Responsible for the establishment, execution, support, training, monitoring of the Quality Program & document control. Identifies all product, process, or operational defects through statistical monitoring and audits including implementation of corrective action. Audits corrective actions for compliance with the Program. Is the primary alternate in the absence of the Technical Director for QA/QC related issues.

Laboratory Manager: Responsible for coordinating and monitoring the requirements of the Quality Program in the laboratory. Assures that subordinates follow the requirements of the Quality Program. Implement corrective actions as necessary to address quality deficiencies. Is the primary alternate in the absence of Technical Director for technical issues, and the primary alternate in the absence of Department Managers or Department Supervisors.

Department Managers: Responsible for implementing the requirements of the Quality Program in their departments. To assure all subordinates and analysts follow the requirements of the Quality Program. Implement corrective actions as necessary to address quality deficiencies.

Department Supervisors: Responsible for implementing the requirements of the Quality Program within their department. To assure all analysts follow the requirements of Quality Program. Implement corrective actions as necessary to address quality deficiencies.

Analysts: Responsible for applying the requirements of the Quality Program to the analyses they perform. To evaluate QC data and initiate corrective action for quality control deficiencies within their control. Implement corrective actions as directed by superiors.

Support Services: Sample Management, MIS, Client Services and the Account Executives are responsible for applying the applicable requirements of the Quality Program to their specific tasks.

4. JOB DESCRIPTION OF KEY PERSONNEL

Objective: Job descriptions of key positions are defined to communicate a clear understanding of the duties and responsibilities including reporting relationships.

President: Responsible for all business activities including the strategic direction, mission and expectations of the company. Builds a strong, cohesive management team that is constantly focused on improving the operating, technical and financial performance of the company.

Chief Operating Officer/Technical Director: Coordinates the operational activities and the technical direction of the laboratory. Responsible to certify and document that personnel have the appropriate education and/or technical background to perform the tests for which the laboratory is accredited to perform. Develops the strategy to evaluate new methods, technology and objectives. Provides assistance and leadership to management teams to implement new innovated technologies. Reports to the President.

Quality Assurance/Quality Control Director: Establishes and audits the company quality program. Provides technical assistance to ensure that the procedure and data quality is technically sound, legally defensible and consistently meets the objectives of the QA Manual. Reports to the Technical Director.

System Manager: Provides the operational support for all information systems. Develops and implements MIS software to meet the strategic and technical goal of the company. Reports to the Technical Director.

Client Service Manager: Responsible for the planning, directing and control of the Sample Management Department and the Project Management staff. Supervises the sample log in operation and coordinates the project management activities. Communicates client expectations to the laboratory regarding analytical and reporting requirements. Reports to the President.

Laboratory Manager: Provides the technical, operational and administrative leadership through planning, allocation and management of personnel and equipment resources. Maintains a clearly qualified model of laboratory capacity. Uses this model as a basis for controlling the flow of work into and through the laboratory. Reports to the Technical Director.

Department Manager: Directs, plans and controls the operations of the department. Supervises daily production to ensure compliance with the requirements of the Quality Program and client expectations. Reports to the Laboratory Manager.

Department Supervisor: Provides supervision and directions for the group. Implements the daily analysis schedule. Ensures that the group and the analytical data are in compliance with the Quality Program. Reports to the Department Manager.

5. APPROVED SIGNATORIES

Objective: For traceability of data and related documents procedures are required which detail the authorization of signature approvals of data and information within Chemtech. A log of signatures and initials of all the analytical staff is maintained in the QA/QC office for cross-reference check.

5.1 SIGNATURE AUTHORITY

President: Authorizes contracts and binding agreements.

Chief Operating Officer/Technical Director: Approves the QA policy and SOP's and approves final reports in the absence of QC supervisor and QA/QC Director.

Quality Assurance/Quality Control Director: Approves SOP's, and the QA Plan. Approves final reports in the absence of QC supervisor.

5.2 SIGNATURE REQUIREMENT: All laboratory activities, commencing with sample receipt through the release of data, are approved by appropriate personnel by initialing or signing and dating the documents. A document signed or initialed by an employee, is within their limits of authority. All raw data are initialed and dated by the analyst conducting the analysis. All signatures and initials can be cross-referenced to the signatures and initial log.

5.3 SIGNATURE AND INITIAL LOG: The QA/QC office keeps a record of all signatures and initials of all technical personnel. New technical employee's signatures and initials are added to their training file. Ex-employee signatures are kept on file. The QA/QC office also keeps a common log for the record of "Signature & Initial" of all employees. This log is updated annually in the beginning of the year. This log contains signature and initial of upper management as well. If any new employees hired in between then their signature and initial are also added in this log.

6. PERSONNEL TRAINING

Objective: To ensure that all analysts are properly trained, acquire an adequate amount of experience prior to performing independent analyses and maintain technical competence. These factors are an essential part of the laboratory QA Program. Chemtech uses personnel who are employed by, or are under contract to Chemtech. Where contracted and additional technical key support personnel are used, Chemtech ensures that such personnel are supervised and competent and that they work in accordance with Chemtech's quality system.

6.1 EMPLOYEE ORIENTATION AND TRAINING: All new employees go through a training period which includes introducing new personnel to Chemtech company policies, QA/QC practices, safety and health, and ethics training in addition to training related to their job functions. The training period extends approximately 1 to 6 months, depending upon the level of experience of the individual.

6.2 PERSONNEL QUALIFICATIONS AND TRAINING: All technical employees at Chemtech fulfill the educational, work experience, and training requirements for their positions as outlined in their job description. As workload permits, Chemtech encourages cross training of personnel as appropriate.

All employees must undergo laboratory health and safety training and ethics training and must read laboratory QA Manual. A signed and dated statement from each technical employee that they have read, understood, and is using the latest version of the laboratory QA manual and SOP's is maintained in their training file.

A signed and dated statement from each employee that they have read, acknowledged and understood their personal ethical and legal responsibilities is kept in their training record.

The analysts are also required to take any QA/QC training (Introduction to Quality Assurance and specialized QC courses) provided by the QA/QC Director.

6.3 TECHNICAL SKILLS: Analysts are initially qualified by education with a minimum of a BS degree in Chemistry, Physical and/or Biological sciences, wherever required. Every new analyst is trained, regardless of education and outside experience, in the individual analytical procedures by a senior analyst. All Chemtech analyst capabilities are determined initially with Initial Demonstration of Capability studies.

When new equipment is purchased, appropriate Chemtech personnel are trained locally by the manufacturer, vendor or at the manufacturer's training course.
Any significant change to an analytical system requires that the analyst perform an initial demonstration of precision and accuracy, and recalibration of the instrument. For example, replacing a column in a gas chromatograph, cleaning the mass spectrometer ion source, etc.

6.4 **TRAINING RECORDS:** Training records for technical employees are kept in the QA office. The Technical Director certifies and document's that all technical employees have the appropriate education and/or technical background to perform the tests for which the laboratory is accredited to perform. It is the responsibility of each employee to assure that records of completed training are provided to the QA/QC Director to update his/her personnel file.
In addition to the ethics and QA manual statements, the employee record file contains: read receipts of SOP's, a Demonstration of Capability for each accredited method that he/she performs; documentation of any training courses, seminars, and/or workshops; and documentation of continued proficiency to perform each test.
Continued analyst proficiency can be achieved by one of the following: acceptable performance of blind samples for each accredited method that he/she performs; through the analysis of Laboratory Control Samples - at least four consecutive Laboratory Control Samples with acceptable levels of precision and accuracy.

6.5 **Training requirements for key positions:** Training requirements are assigned depending on the position and department the employee is in.

QA/QC Director: The QAQC Director must have ample knowledge of the laboratory procedures, have at least 5 years of laboratory experience preferably in Organics and have at least 2 years of data review procedures training.

Department Manager- A department manager must have at least 3 years of experience in the area of Supervision. Must have proper training in methodology and the skill to organize, schedule and train personnel for a successful operation of their department.

Department Supervisor: A department supervisor must have at least 2 years of experience in the area they are to supervise. Be able to write SOPs

7. ETHICS POLICY

Chemtech provides comprehensive analytical testing services for the qualitative and quantitative assessment of environmental contaminants. Our services are used to meet various regulatory permitting and reporting requirements, determine compliance for both State and Federal environmental regulations to assess potential present and future environmental liability or health risks.

Our policy is to conduct our business with honesty and integrity; to produce accurate and usable data, and provide our employees with guidelines leading to an understanding of the ethical and quality standard required by Chemtech.

All laboratory employees, from top management to entry level, must receive formal data integrity training on annual basis.

7.1 CODE OF ETHICS: Chemtech is managed in accordance with the following principals:

To produce analytical test results that are accurate and meet the requirements of our Quality program.

To operate our laboratory in a manner that protects the environment, as well as the health and safety of all our employees.

To provide employees with guidelines leading to an understanding of the ethical and quality standards required by Chemtech.

To report analytical data without any considerations or self-interests.

To provide analytical services in a confidential, truthful, and candid manner.

To abide by all Federal, State, and Local regulations that affects our business.

To have processes to ensure that its management and personnel are free from any undue internal and external commercial, financial and other pressures and influences that may adversely affect the quality of their work.

7.2 EMPLOYEE ETHICS TRAINING: Each employee receives ethics training once hired and must sign an Employee Ethics Statement. During the ethics training, an employee is made aware of the ethical and legal responsibilities including potential punishments and penalties for improper, unethical or illegal actions. The Employee Ethics Training program is updated annually (or more frequently if required). Ethics

Training is given to all employees annually. QA manager is sending Ethics Power Point Presentation along with Ethics Policy SOP P-252 to all employees. All employees are asked to go through Ethics Power Point Presentation as well as Ethics Policy SOP P-252. All employees are asked to generate a read receipt for Ethics Power Point Presentation as well as Ethics Policy SOP P-252 after the completion of Ethics training.

7.3 **CONFIDENTIAL REPORTING OF DATA INTEGRITY ISSUES:** CHEMTECH has set up a procedure for Confidential Data Reporting of Data Integrity Issues. A locked box labeled as "Comments/Suggestions" has been kept in common cafeteria. This box has been kept such a way that it does not come in the view of security camera. At any time any employee wants to report an issue related to data integrity without disclosing their identity then they can do that by leaving a comment in "Comments/Suggestions" box. This box is always locked and operated by CHEMTECH's President only.

8. FACILITIES AND RESOURCES FOR NEW ANALYTICAL PROJECTS AND IMPLEMENTING CLIENT REQUIREMENTS

Objective: To ensure that appropriate facilities and resources are available to meet the demand for new analytical projects and process to implement client requirements.

8.1 REVIEW OF NEW ANALYTICAL PROJECTS: A Project Chronicle (PC) is prepared by the Account Executive prior to a quotation preparation and/or an award, and presented to the Technical Director and his staff for review and comments. The PC outlines all the client requirements and includes copies (if available) of the clients Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and contractual provisions. The PC and associated information are scanned and stored on the network for future reference.

A "Kick Off Meeting" chaired by the Technical Director is scheduled to discuss the PC and its associated information. Project Management, the QA/QC Director, Laboratory Manager, including appropriate Department Managers/Supervisors, Sample Management and MIS staff are present to familiarize themselves with the requirements, and are asked to participate in the planning and implementation of the project. Client is notified at the time of submitting the bid if CHEMETCH cannot able to meet requested QC standards or CHEMTECH is not certified to analyze any method/parameter. If possible CHEMTECH also suggest an alternate certified method.

8.2 RESOURCE AVAILABILITY: Chemtech maintains a 30,000 square foot laboratory designed for maximum efficiency and safety. There is a redundancy of equipment to ensure ample equipment resources. The laboratory is adequately staffed by a highly skilled group of chemists with diversified experience in environmental analysis; and managed by a knowledgeable team of professionals who are committed to quality and client satisfaction.
The laboratory management maintains a clearly defined model of laboratory capacity based upon historical data. This model is the basis for controlling resources, management of personnel and equipment, including the flow of work into and through the laboratory.

8.3 NEW WORK COORDINATION: Project Management coordinates the project logistics with the client and Sample Management in addition to overseeing the analytical progress through the laboratory. Sample

Management initiates the Log-In process, which includes requirements, detailed in the PC and Quotation.

Prior to release of data to the client, the Department Managers, Supervisors, and the QC/Report Production staff review the data for completeness, accuracy, and conformance with applicable regulatory and clients requirements.

9. CLIENT CONFIDENTIALITY

Objective: To design and implement policies and procedures to protect the confidentiality and proprietary rights of our clients.

9.1 CLIENT CONFIDENTIALITY:

Information related to a Client and or a Project are entered and stored in Chemtech's LIMS SQL Server. Employees with the appropriate level of authority enter the information. Security levels within Chemtech's system define an individual's access to information levels. Information on the Server is backed up at defined intervals, and the backup information is stored offsite. Refer to P229-Computer Backup and Security SOP and P232-Data Storage SOP. Computer Security training has been given to all employees once when they are hired.

Analytical data is prepared in a report format, as required by the client. The report is copied and scanned electronically. A paginated copy of the report or the original copy is distributed as directed by the client while the scanned copy and related information is kept on site in the Document Storage Area on our LIMS Server. The employee's security authorization levels limit access to the Document Storage Area or the LIMS Server. The files are archived for a period of five years.

Electronic data stored in Chemtech's database is protected by a variety of systems including, Virtual Private Networks (VPS), firewalls, log in user names and passwords. A Gateway system is also employed to restrict access to specific users based upon their authorization level.

Reports or client information requested by a third party must be accompanied by written authorization from our Client. Client information is released when directed by a subpoena from a court with valid jurisdiction. The Client is promptly notified of the subpoena requesting their information.

Keeping the National Security Concern in consideration any information regarding CHEMTECH's Client's or Client's Report will not be released to a third party or any government agency unless there is a written authorization provided by our client or government agency.

10. CLIENT COMPLAINTS AND RESOLUTIONS

Objective: To establish a system to address and resolve client complaints regarding any laboratory activity. The process for dealing with complaints must include a procedure, documentation, corrective action, and monitoring of the implemented corrective action. Chemtech will co-operate with the client or their representatives to clarify the client's request and to monitor the laboratory's performance in relation to the work performed, provided that Chemtech ensures confidentiality to other clients.

10.1 PROCEDURE: When a client calls or e-mails an inquiry regarding a project or a report to the Project Manager (PM), the PM receiving the call (or e-mail) summarizes the client issue or requests the client to mail/fax any questions. Once a formal request is received, the PM communicates to the QA/QC Director, who prepares a Corrective Action (CA) report form, which includes the client name, laboratory project numbers(s), and summary of issues. The CA report form is assigned a three digit tracking number, by the QA/QC Director. The CA report form is submitted to the Technical Director, who assigns the CA report form to the affected department supervisor to review, comment and correct the issue within 24 hours. All technical and data reporting inquiries are submitted to the QA/QC Director for review. Once the response comes back from the laboratory, the QC Supervisor and QA/QC Director reviews it, and if satisfactory, the CA report form is filed in the QA/QC office. The client is sent the corrected information.

10.2 DOCUMENTATION: Client's complaints are documented using CA report form, which originates from the QA/QC Director's office. The original communication (phone log, e-mail, or fax) is kept in the PM office while closed CA report form is filed in the QC office. The CA report contains the date and name of the person receiving the complaint, a description of the complaint, source of the complaint, the resolution, and any written material accompanying the complaint. The CA database is updated by QA/QC office to which only QA/QC Director has access. A database is maintained where client inquiries are logged-in including date, client name, project number, department in question, and a summary of the inquiry and CA taken.

10.3 CORRECTIVE ACTION: The CA report is entered in a database to monitor systematic defects. The appropriate department supervisor must deal with the complaint by responding to the inquiry. The response must address the issue(s) and provide an explanation and resolution. The response may involve reprocessing of data and issuing a revised data report. The QA/QC Director reviews the CA for a persistent defect in case the

respective SOP needs modifications. Refer to P210-Corrective Action Report SOP.

10.4 **QA/QC AUDITING:** The CA is entered in a database to monitor systematic defects. The QA/QC Director investigates complaints and promptly audits all areas of activity to assure that the CA implemented has resolved the defect. If the defect persists, the QA/QC Director, and Department Manager and Supervisor develop and implement an effective process. When the defect is resolved, monitoring is incorporated as a part of the annual system audit. For detailed information on client inquiries refer to the SOP for handling client inquiries. At any time when CHEMTECH finds out that there was an issue with client's data which may have affected the validity of results, then first CHEMTECH will evaluate and confirm the defect. Once it is confirmed, CHEMTECH make necessary correction with data and notify associated client within 7 days.

10.5 **CLIENT FEEDBACK SURVEY:** CHEMTECH is sending Log in Summary, Fax Data, Hard copy data, Electronic Data Deliverables & invoices to client via email. In that email, CHEMTECH has included a link using which client survey can be generated. CHEMTECH is also taking survey on website at **www.chemtech.net.** CHEMTECH president is responsible for handling client survey data. CHEMTECH president is notifying sales staff, project managers, laboratory manager, QA/QC director, QC Supervisor and laboratory supervisors about the negative and positive feedbacks. Negative feedbacks from clients are used to improve the affected area of CHEMTECH. Positive feedbacks are used for getting new business from other clients.

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11. SAMPLE MANAGEMENT PROCESS

Objective: To establish a system to process client requests for analytical services and samples upon arrival at the laboratory. Refer to P204-Chain of Custody SOP and P250-Log in SOP for detailed information for sample receipt, containers and all other related information.

11.1 CONTAINER ORDER REQUEST: Project Managers prepare a Container Order Request from the information detailed on the Project Chronicle (PC) and provide a copy to Sample Management in order to initiate a sampling event.

11.2 SAMPLE CONTAINER PREPARATION AND SHIPMENT: All bottle orders prepared from the Container Order Requests are prepared with bottles that are certified pre-cleaned by the manufacturer according to US EPA specifications. Reagent grade preservatives are added to the bottles at the laboratory. All preservative solutions are checked to assure that they are free of contamination. Chemtech utilizes laboratory reagent water for trip and field blanks.

Bottle orders are prepared by sample management department. The bottles are then relinquished from Sample Management to the appropriate courier. When the bottles arrive at the client destination, the courier will then relinquish custody of the bottles to the client or the client designee.

Samples arrive at the laboratory via Chemtech couriers, common carrier, or client delivery. All shipments and deliveries of samples are received through the shipping & receiving door located in the rear of the facility. All deliveries enter in the same location and go directly to the sample room. The SOP's for Chain of Custody (CoC) P204 Chain of Custody SOP and Sample Acceptance and Receipt P250-Log-in Procedure SOP are followed.

Sample Management personnel sign for all shipments received and notify the Sample Custodian immediately. The samples are then relinquished to the Sample Custodian.

A sample or sample container is considered to be in custody if: it is in the persons' actual possession; it is in the person's view after being in their physical possession; it was in their possession and then locked in a refrigerator or sealed in a cooler; it is in a designated secure area.

11.3 SAMPLE ACCEPTANCE

Upon receipt of sample coolers at the laboratory, coolers are examined for damaged or broken custody seals. Records of the condition of the custody seals and coolers are recorded on the Project Track Ticket Detail. If seals and coolers are intact, the sample acceptance procedure is continued. If they are not intact, the appropriate Laboratory Project Manager (PM) is notified. The PM will seek guidance from the client whether to proceed with the analysis of the samples or discard or send back the samples. The PM will communicate information given by the Client to Sample Management via Project Track Ticket Detail.

11.4 SAMPLE RECEIPT

Once the samples have been accepted, the sample receipt process begins. Sample Management will issue the Project ID, which will be documented on the CoC and on the respective cooler. Sample Management will then give a yellow copy of the CoC to the Project Manager. The Project Manager will generate Login-Guidance based on the CoC review. The Sample Custodian will line up the samples according to the CoC and begin comparing the information documented on the CoC to the samples received. Any deviation noted from the CoC or non-conformance is recorded on the Project Track Ticket Detail and communicated to the appropriate Laboratory Project Manager.

11.5 SAMPLE CUSTODIAN RESPONSIBILITIES

The Sample Custodian must take a cooler temperature soon after sample receipt and record it on the Laboratory Chronicle and the Field CoC. This will verify that the samples were transported and received at the required temperature.

The Sample Custodian must ensure that samples are received in good condition and ensure that samples listed on the CoC are all present. The Sample Custodian must compare the sample identification on the CoC to the labels on the bottles, and make sure that the information on the CoC exactly matches the bottle labels. Verification that enough volume has been received for the sample tests requested and absence of headspace for volatile analysis must be noted.

The Sample Custodian must ensure that all samples are properly preserved. Appropriate preservation of samples is determined by checking the pH of the samples. Sample Management Staff are issued a reference table that lists the tests methods utilized and their appropriate preservation techniques. The pH of the samples is checked, and any discrepancies are recorded on the Laboratory Chronicle and communicated to the client.

The Sample Custodian must sign the CoC and other documentation received with the samples. Documentation of custody is initiated when the field sampler is collecting the samples. Custody documentation includes all information that provides a clear record of the sample identification, time of collection, and collection chronology. This record is kept on Chemtech or Client CoC Forms.

The Sample Custodian must place the samples in storage or relinquish to the appropriate laboratory analyst after labeling the samples with the unique laboratory number, as will be automatically assigned by the software when samples are logged in the LIMS. Refer to P250-Log-in Procedure SOP.

11.6 SAMPLE MANAGEMENT STAFF RESPONSIBILITIES

Sample Management staff must review the Field CoC submitted by the Sample Custodian once login is created based on Login Guidance from the PM. Sample Management staff must compare the Login Guidance to the Field CoC and ensure that all information on the Login Guidance follows the CoC. If not, contact the appropriate PM for further guidance. The PM should resolve all discrepancies between the Login Guidance and the CoC prior to signing off the project. Once the discrepancies are resolved the PM will issue a Record of Communication to document the client's instructions.

Upon receipt of the yellow copy of the CoC, the Project Manager will create a Login Guidance. Sample Management will proceed to login the samples based on the Login Guidance. Create a folder with the original Field CoC, the sample and delivery tickets, any third party delivery documentation, and the login report.

If samples are received for short hold-time analysis (hold times less than 72 hours) after 5:30pm, then samples are relinquished to the laboratory without login. Samples relinquished by the sample management personnel and received by the analytical department analyst are documented on a copy of the CoC.

11.7 SUBCONTRACTED ANALYSIS

Projects sometimes contain analyses that Chemtech does not perform. In order to give a high level of service to our clients, Chemtech will subcontract these analyses to other laboratories. All subcontracted laboratories must meet vigorous standards set forth by QA/QC Department as well as standards established for the environmental laboratory industry. A documented procedure is followed to qualify laboratories for subcontracting and a list in maintained in our QA/QC

Department. Procedures have also been established to assure that CoC is maintained and the subcontract laboratory achieves all client objectives.

Note: For DoD work: Subcontracting laboratories must have an established and documented laboratory quality system that complies with DoD QSM requirements, must be approved by the specific DoD component, must be able to generate acceptable results from PT sample analysis, must receive project-specific approval from DoD client before any samples are analyzed, and must identify those samples requiring special reports (e.g. MCL exceedance).

A subcontracted laboratory must provide our QA/QC Department the following information in order to be used as a subcontractor: a valid state certification for the required tests, Quality Assurance Plan, PT Studies for the required tests, and copies of the SOP's for the required tests.

The subcontracting procedure is a documented procedure that is initiated by an Account Executive. The Account Executive is responsible for ensuring that the subcontracted laboratory meets all client specifications. When a client issues a Scope of Work, the Account Executive thoroughly reviews the document. If subcontracting is required, the Account Executive will consult the established subcontracting list that is issued by the QA/QC Department. If a particular analysis is not conducted by one of these approved laboratories, the Account Executive must then request that QA/QC Director locates and approves a laboratory for the requested analysis.

Once a subcontract laboratory is found, the Account Executive must contact the laboratory to communicate the client's requirements and request a quotation from the laboratory. The Account Executive then creates a Project Chronicle that documents the client requirements, the subcontract laboratory to be used, and attaches a quote to this document. The Project Chronicle is an electronic document available to all appropriate personnel. This procedure is followed prior to the receipt of samples from the client.

When the client calls to order the bottles for the project, the PM initiates a Container Order Request from the information documented on the Project Chronicle. The Container Order Request includes the information for the subcontract laboratory as well as any special bottle instructions for the subcontracted tests, and is given to Sample Management. Sample Management then creates the bottle order and sends it to the client.

Upon receipt of the samples, the Sample Custodian will give a copy of the CoC to the Client Service Manager. The Client Service Manager will then create a subcontract chain of custody and procure a Purchase Order from Accounting. This documentation is given to Sample Management to send to the subcontract laboratory along with the samples. A copy of this documentation is retained and placed in the login folder and double-checked by the appropriate Project Manager.

All subcontracted samples are logged into the LIMS System to allow for sample tracking and data reporting. A PM will track the samples to ensure that client deadlines and specifications are met. Once the data packages arrive from the subcontract laboratory, the PM will check the report for completeness. If the data package is deficient, the PM will immediately notify the subcontract laboratory to remediate the deficiencies. The report is then passed to the QA/QC Department. All data that is subcontracted is clearly designated.

11.8 SAMPLE STORAGE

Chemtech maintains a 40-foot walk-in refrigerator that contains a multitude of shelves. Sample Management staff maintains the storage chart manually that indicates the locations in the refrigerator that are either used or empty. While assigning sample storage location, sample custodian looks for available shelves by checking the sample storage chart, and then crosses off that shelf location on the chart to indicate that the shelf is now occupied. All samples, with the exception of volatiles, are kept in this refrigerator. The refrigerator temperature is monitored constantly and recorded once a day. The refrigerator temperature is also monitored using a data logger over the weekend. All shelves in the walk-in refrigerator are identified with a code. The Sample Custodian assigns samples to a refrigerator shelve and gives the shelve location to Sample Management to login with the sample information. This documented procedure allows the samples to be found very easily.

The volatile refrigerators are located in the Volatile Department and kept secure. All Volatile refrigerators are also monitored for temperature. The temperature is recorded every day on a log page. Samples for Volatile Organic analysis are stored separately from other samples. Samples suspected of containing high levels of Volatile Organic Compounds are further isolated from other Volatile Organic samples.

Back-up refrigerators are available should any mechanical problem present itself. All samples are securely moved to the backup refrigerators if necessary.

Only the Sample Custodians are permitted access to sample storage. Analysts create a sample request electronically and send the request to the Sample Custodians. Once received, the Sample Custodians fill out the appropriate paperwork and issue the samples to the Analysts.

Periodically throughout the day, the Sample Custodians will pick up samples from the laboratory and sign them back into storage. Analysts will submit a signed work list to the Sample Custodian along with the samples when they finished with the samples. All samples must be back in refrigeration at the end of a shift and the chain of custody is required to be kept at all times.

12. ANALYTICAL CAPABILITIES

Analytical Fraction	Soil/Solid Matrix Methods	Aqueous Matrix Methods
Volatile Organics by GC/MS	SW 5030B/5030C/8260B/C SW 5035/8260B/C SOM01.2, SOM02.3	SW 5030B/5030C/SW 8260B/C SW5035/SW 8260B/C EPA 524.2 EPA 624 SOM01.2, SOM02.3
Volatile Organics by GC	SW 8015B/8015C/8015D	SW 8015B/8015C/8015D
Semi volatiles by GC/MS	SW 3510C/SW 8270C SW 3520C/SW 8270C SW 3541/SW 8270C/D SW 3580A/SW 8270C/8270D SOM01.2, SOM02.3	EPA 625 SW 3510C/SW 8270C/8270D SW 3520C/SW 8270C/8270D SW 3541/SW 8270C/D SW 3580A/SW 8270C/8270D SOM01.2, SOM02.3
Semi volatiles by GC	SW 8015B/8015C/8015D	SW 8015B/8015C/8015D
Explosives by HPLC	SW 8330/8330A	SW 8330/8330A
Pesticides &/ or PCBs	SW 3510C/SW 8081A&/or 8082 SW 3520C/SW 8081A&/or 8082 SW 3541/SW 8081A/8081B&/or 8082/8082A SW 3580A/SW 8081A/8081B&/or 8082/8082A SOM01.2, SOM02.3	SW 3510C/SW 8081A/8081B&/or 8082/8082A SW 3520C/SW 8081A/8081B&/or 8082/8082A SW 3541/SW 8081A/B &/or 8082/8082A SW 3580A/SW 8081A/8081B&/or 8082/8082A EPA 608 SOM01.2, SOM02.3
Chlorinated Herbicides	SW 8151A	SW 8151A
Volatile Organics by GC/MS	Air Matrix Method: TO-15	
Metals	SW 6010B/6010C SW 6020/6020A SW 7471A/7471B SW 3050B ILM05.4 ISM01.2, ISM01.3, ISM02.3	EPA 200.7 EPA 245.1 SW 6010B/6010C SW 6020/6020A SW 7470A SW 3005A SW 3010A ISM01.2, ISM01.3, ISM02.3
Wet Chemistry		
Acidity	------	ASTM D1067-92
Acidity	------	SM 2310 B-11
Alkalinity	------	SM 2320 B-11

Analytical Fraction	Soil/Solid Matrix Methods	Aqueous Matrix Methods
Alkalinity, Bicarbonate	------	SM 2320 B-11
Ammonia	------	SM 4500-NH3 B plus G-11
Anions: Bromate Bromide Chloride Fluoride Nitrate Nitrite Orthophosphate Sulfate Chlorate Chlorite	SW 9056	EPA 300.0
Biochemical Oxygen Demand (BOD5)	------	SM 5210B-11
Bromide	------	EPA 300.0
Carbonaceous BOD (cBOD)	------	SM 5210B-11
Cation-Exchange Capacity	SW 9080 SW 9081	------
Chemical Oxygen Demand (COD)	------	SM 5220D-11
Chloride	SW 9056	EPA 300.0 SM 4500-Cl C-11
Color	------	SM 2120B-11
Conductivity	SW 9050A	EPA 120.1 SM 2510 B-11
Corrosivity	SW 9045C/9045D	SW 9040B/9040C
Corrosivity Toward Steel	SW 1110	SW 1110A
Cyanide	SW 9010C SW 9012B SW 9014	SM 4500-CN C-11 & E-11 SW 9010C SW 9012B SW 9014
Cyanide-Amenable	SW 9010C	SM 4500-CN C-11,G-11
Dissolved Oxygen	-----	SM 4500-O G-11 SM 4500-O C-11
Extractions	SW 3610/3610B SW 3620C SW 3630/3630C SW 3640A SW 3660/3660B SW 3665	SW 3610/3610B SW 3620C SW 3630/3630C SW 3640A SW3660/3660B SW 3665

Analytical Fraction	Soil/Solid Matrix Methods	Aqueous Matrix Methods
Flashpoint	SW 1030	SW 1010A
Foaming Agents	-----	SM 5540 C-11
Fluoride	SW 9056	EPA 300.0
Hardness, Calcium	------	EPA 200.7 SW 6010B/6010C SW 6020/6020A
Hardness, Total	------	EPA 200.7 SM 2340C SW 6010B/6010C SW 6020/6020A
Hexavalent Chromium	SW 3060A/SW 7196A	SM 3500-Cr D-11
Ignitability	SW 1030	SW 1010A
Methylene Blue Active Substances (MBAS) Surfactants	------	SM 5540 C-11
Nitrate	SW 9056	EPA 300.0
Nitrate/Nitrite	------	EPA 300.0
Nitrite	SW 9056	EPA 300.0 SM 4500 NO2 B-11
Odor	------	SM 2150 B-11
Oil & Grease	SW 9071B	EPA 1664A
Orthophosphate	SW 9056	EPA 300.0 SM 4500-P,E-11
Paint Filter Test	------	SW 9095
pH	SW 9040B SW 9045C/9045D	SM 18 4500-H B-11 SW 9040B/9040C SW 9041A
Phenolics	SW 9065	EPA 420.1
Phosphorus, Ortho	SW 9056	EPA 300.0 EPA 365.3 SM 4500 P-E-11
Phosphorus, Total	EPA 365.3	------
Residual Chlorine	-----	SM 4500-Cl G-11
Settleable Solids	------	SM 2540 F-11
Silica	----------	EPA 200.7
SPLP Extraction	SW 1312	SW 1312
Sulfate	SW9038 SW9056	EPA 300.0 SW 9056, SW 9038 SM 426C 15th Ed

Analytical Fraction	Soil/Solid Matrix Methods	Aqueous Matrix Methods
Sulfide	SW 9030B SW 9031 SW 9034	SW 9030B SW 9031 SW 9034 SM 4500 S E 18th Ed
Sulfide, Acid Soluble & Insoluble	SW 9030B	SW 9030B SW 9031
TCLP Leaching Procedure	SW 1311	SW 1311
Temperature	SW 2550B	SM 2550B-11
Total Dissolved Solids (TDS)	------	SM 2540 C-11
Total Kjeldahl Nitrogen (TKN)	------	SM 4500-N Org B or C & SM 4500-NH3 B plus G-11
Total Organic Carbon (TOC)	SW 9060 Lloyd Kahn	SW 9060 SM 5310 B-11
Total Solids (TS)	------	SM 2540 B-11
Total Suspended Solids (TSS)	------	SM 2540 D-11
Total Volatile Solids (TVS)	------	EPA 160.4
Turbidity	------	EPA 180.1 SM 2130 B-11
Volatile Suspended Solids (VSS)	------	EPA 160.4

13. MAJOR EQUIPMENT

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC/MS SEMI VOA Lab							
GC	BNA-M	Agilent 7890B G3442B	CN14443036	December 2014	December 2014	BNA Lab	New
MSD	BNA-M	Agilent 5977 G7039A	US1446M402	December 2014	December 2014	BNA Lab	New
Auto Sampler	BNA-M	Agilent G4514A	CN14380099	December 2014	December 2014	BNA Lab	New
Injector Tower	BNA-M	Agilent G4513A	CN14410227	December 2014	December 2014	BNA Lab	New
Controller	BNA-M	Agilent G4514A	CN14380099	December 2014	December 2014	BNA Lab	New
Computer	BNA-M	HP	2UA4380G5N	December 2014	December 2014	BNA Lab	New
GC	BNA-B	Hewlett Packard 5890	2750A18411	July 1994	July 2001	BNA Lab	Used
MSD	BNA-B	Hewlett Packard 5971 Series	3188A03673	July 1994	July 2001	BNA Lab	Used
Auto Sampler	BNA-B	Hewlett Packard 18596B	3021A21493	July 1994	July 2001	BNA Lab	Used
Injector Tower	BNA-B	Hewlett Packard 7673 A	2704A04914	July 1994	July 2001	BNA Lab	Used
Controller	BNA-B	Hewlett Packard 7673 A 18594B	320A28097	July 1994	July 2001	BNA Lab	Used
Computer	BNA-B	Minta	93001897	July 1994	July 2001	BNA Lab	Used
GC	BNA-E	Hewlett Packard 6890 Series	4500030441	Dec 2002	Jan 2003	BNA Lab	New
MSD	BNA-E	Hewlett Packard 5973	4591422501	Dec 2002	Jan 2003	BNA Lab	New
Auto Sampler	BNA-E	Agilent 7683 Series	4514413296	Dec 2002	Jan 2003	BNA Lab	New
Injector Tower	BNA-E	Agilent 7683 Series	CN13922355	Dec 2002	Jan 2003	BNA Lab	New
Computer	BNA-E	Hewlett Packard Vectra VL 420 DT	4522100267	Dec 2002	Jan 2003	BNA Lab	New
GC	BNA-F	Hewlett Packard 6890 Series	CN10525020	Oct. 2006	Oct. 2006	BNA Lab	New
MSD	BNA-F	Hewlett Packard 5975	4552430204	Oct. 2006	Oct. 2006	BNA Lab	New
Auto Sampler	BNA-F	Agilent 7683 Series	CN52033154	Oct. 2006	Oct. 2006	BNA Lab	New
Injector Tower	BNA-F	Agilent 7683 Series	CN52025140	Oct. 2006	Oct. 2006	BNA Lab	New
Computer	BNA-F	Hewlett Packard Vectra VL 420 DT	------	Oct. 2006	Oct. 2006	BNA Lab	New
GC	BNA-G	Hewlett Packard 6890 Series	US00029768	July 2011	July 2011	BNA Lab	New
MSD	BNA-G	Hewlett Packard 5973	US92522714	July 2011	July 2011	BNA Lab	New
Auto Sampler	BNA-G	18596C	3506A38037	July 2011	July 2011	BNA Lab	New
Injector Tower	BNA-G	HP 6890 Series	3600A45484	July 2011	July 2011	BNA Lab	New
Controller	BNA_G	G1512 A	US72001994	July 2011	July 2011		
Computer	BNA-G	Dell Windows XP	GVC4B71	July 2011	July 2011	BNA Lab	New
Refrigerator	BNA-Ref-1	Roper	ED2933135	May 1999	July 2001	BNA Lab	Used
Refrigerator	BNA-Ref-2	White Westinghouse	------	June 2006	June 2006	BNA Lab	New

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC SEMI VOA Lab							
Refrigerator	BNA-Ref-3	Frigidaire	WA81100949	1999	Mar. 2008	BNA Lab	Used
HPLC	HPLC-B	Hewlett Packard Series 1100 DAD	JP73007001/ US72101011/ US72101340	May 1999	July 2001	Pest Lab	Used
Auto sampler	HPLC-B	Hewlett Packard 1313 AS	US72102636	May 1999	July 2001	Pest Lab	Used
Computer	HPLC-B	HP Vectra XA	US73465640	May 1999	July 2001	Pest Lab	Used
HPLC	HPLC-L	Hewlett Packard Series 1100 DAD	US64402121 US72101011 JP73007001	Oct. 2006	Oct. 2006	Pest Lab	Used
Auto sampler	HPLC-L	Hewlett Packard 1313 AS	Us80603781	Oct. 2006	Oct. 2006	Pest Lab	Used
Computer	HPLC-L	HP Vectra XA	------	Oct. 2006	Oct. 2006	Pest Lab	Used
HPLC	HPLC-N	Hewlett Packard Series 1100 DAD	------	------	2013	Pest Lab	Used
Degasser	HPLC-N	G1322A	JP73010099	------	2013	Pest Lab	Used
QuatPump	HPLC-N	G1310A	US72101878	------	2013	Pest Lab	Used
Auto Sampler	HPLC-N	G1313A ALS	DE33224630	------	2013	Pest Lab	Used
Column Compartment	HPLC-N	G1316A	DE11610394	------	2013	Pest Lab	Used
Detector	HPLC-N	G1314A Variable Wavelength UV Detector	JP43825742	------	2013	Pest Lab	Used
ECD	ECD-Q	Agilent 7890B G3440B	CN14493092	December 2014	December 2014	Pest Lab	New
Auto Sampler	ECD-Q	Agilent 4514A	CN13060033	December 2014	December 2014	Pest Lab	New
Inject Tower	ECD-Q	Agilent 4513A	CN1441091	December 2014	December 2014	Pest Lab	New
Controller	ECD-Q	Agilent 4514A	CN13060033	December 2014	December 2014	Pest Lab	New
Computer	ECD-Q	HP	2UA4380G89	December 2014	December 2014	Pest Lab	New
ECD	ECD-R	Agilent 7890B G3440B	CN14493093	December 2014	December 2014	Pest Lab	New
Auto Sampler	ECD-R	Agilent 4514A	CN11480026	December 2014	December 2014	Pest Lab	New
Inject Tower	ECD-R	Agilent 4513A	CN14410180	December 2014	December 2014	Pest Lab	New
Controller	ECD-R	Agilent 4514A	CN11480026	December 2014	December 2014	Pest Lab	New
Computer	ECD-R	HP	2UA4380G1C	December 2014	December 2014	Pest Lab	New
ECD	ECD-D	Agilent Technologies 6890N	CN10521041	June 2005	June 2005	Pest Lab	New
Auto Sampler	ECD-D	Agilent 7683	CN52033127	June 2005	June 2005	Pest Lab	New
Inject Tower	ECD-D	Agilent 7683B	CN51825037	June 2005	June 2005	Pest Lab	New
Computer	ECD-D	Dell	CN-0G1494-70821-359-25-KF	June 2005	June 2005	Pest Lab	New
ECD	ECD-E	Hewlett Packard 5890 Series II	2541A06937	May 1999	July 2001	Pest Lab	Used

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC SEMI VOA Lab							
Auto Sampler	ECD-E	HP 7673A	3120A26762	May 1999	July 2001	Pest Lab	Used
Inject Tower	ECD-E	HP 7673	2718A08998	May 1999	July 2001	Pest Lab	Used
Controller	ECD-E	HP 7673A	2906A13936	May 1999	July 2001	Pest Lab	Used
FID	FID-E	Agilent Tech 6890N	CN10410002	June 2005	June 2005	Pest Lab	New
Auto Sampler	FID-E	Agilent 7683	CN41128296	June 2005	June 2005	Pest Lab	New
Inject Tower	FID-E	Agilent Tech	CN41235695	June 2005	June 2005	Pest Lab	New
Computer	FID-E	Dell	J2YZZ31	June 2005	June 2005	Pest Lab	New
GC	ECD_L	HP 6890N	US10217093	------	2004	GC Lab	------
ECD	ECD_L	ECD1	U44268	------	2004	GC Lab	------
ECD	ECD_L	ECD2	U44267	------	2004	GC Lab	------
Injector	ECD_L	HP 7683	CN32631493	------	2004	GC Lab	------
Auto Sampler	ECD_L	----------	CN53536388	------	2004	GC Lab	------
GC	ECD_O	HP 6890N	US10417011	------	2004	GC Lab	------
ECD	ECD_O	ECD1	U6937	------	2004	GC Lab	------
ECD	ECD_O	ECD2	U6936	------	2004	GC Lab	------
Injector	ECD_O	HP 7683	CN41536014	------	2004	GC Lab	------
Auto Sampler	ECD_O	----------	CN41528555	------	2004	GC Lab	------
GC	ECD_P	HP 6890N	US10329046	------	2004	GC Lab	------
ECD	ECD_P	ECD1	U5759	------	2004	GC Lab	------
ECD	ECD_P	ECD2	U5760	------	2004	GC Lab	------
Injector	ECD_P	HP 7683	CN21224536	------	2004	GC Lab	------
Auto Sampler	ECD_P	----------	CN32224158	------	2004	GC Lab	------

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC SEMI VOA Lab							
FID	FID-A&B	Hewlett Packard	3033A32320	Oct. 2007	Oct. 2007	Pest Lab	Used
Auto Sampler	FID-A&B	ALS2016 Tekmar	92231005	June 2008	July 2008	Pest Lab	Used
Computer	FID-A&B	Ultra	----------	Oct. 2007	Oct. 2007	Pest Lab	Used
Controller	FID-A&B	LCS 2000 Tekmar	93257007	June 2008	June 2008	Pest Lab	Used
FID	FID-C&D	Agilent Tech 6890N	CN10805006	Oct. 2007	Oct. 2007	Pest Lab	New
Auto Sampler	FID-C&D	Agilent Tech	CN80347096	Oct. 2007	Oct. 2007	Pest Lab	New
Tower 1	FID-C	Agilent Tech	CN80346457	Oct. 2007	Oct. 2007	Pest Lab	New
Tower 2	FID-D	Agilent Tech	CN80346490	Oct. 2007	Oct. 2007	Pest Lab	New
Computer	FID-C&D	Dell	CN-0G3022-42940-3AT-029T	Oct. 2007	Oct. 2007	Pest Lab	New
Refrigerator	GC ext-Ref 2	Hot Point	LA21203733	May 1999	May 2015	Pest Lab	Used
Refrigerator	GC ext-Ref 3	GE	ST734619	Feb. 2009	Feb. 2009	Pest Lab	New
Refrigerator	GC ext-Ref 1	Gibson	PN182574-76	April 2016	April 2016	Pest Lab	Used
Refrigerator	GC ext-Ref 5	Frigidaire	WA92101209	June 2009	June 2009	Pest Lab	New
Instrument	**Lab ID**	**Manufacturer Description**	**Serial Number**	**Year Purchased**	**Date placed in service at this location**	**Current Location**	**Condition Received (used, new, recondition)**
GC/GC MS VOA Lab							
MSD	MSVOA-D	Hewlett Packard 5972	3341A00913	August 2013	August 2013	VOA Lab	Refurbished
GC	MSVOA-D	Hewlett Packard 5890 Series II	3033A31948	May 1999	July 2001	VOA Lab	Used
Auto Sampler	MSVOA-D	ENCON Evolution EST	CENTS 309071013	August 2013	August 2013	VOA Lab	New
Concentrator	MSVOA-D	ENCON Evolution EST	CENTS 309071013	August 2013	August 2013	VOA Lab	New
Computer	MSVOA-D	DELL Dimension 3000	1318635-0008	August 2013	August 2013	VOA Lab	Used

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC/GC MS VOA Lab							
MSD	MSVOA-F	Hewlett Packard 5971 Series	3118A02237	May 1999	July 2001	VOA Lab	Used
GC	MSVOA-F	Hewlett Packard 5890 Series II	3108A34429	May 1999	July 2001	VOA Lab	Used
Concentrator	MSVOA-F	OI 4660 Eclipse	338466642P	July 2001	July 2001	VOA Lab	Recondition
Auto Sampler	MSVOA-F	OI4552	14293	July 2001	July 2001	VOA Lab	Recondition
Computer	MSVOA-F	Dell Dimension 2350	93007037	May 1999	July 2001	VOA Lab	Used
MSD	MSVOA-U	Agilent 5977A	US1446L416	December 2014	December 2014	VOA Lab	New
GC	MSVOA-U	Agilent 7890B	CN14443026	December 2014	December 2014	VOA Lab	New
Auto Sampler	MSVOA-U	Atomx Tekmar	US14262011	December 2014	December 2014	VOA Lab	New
Computer	MSVOA-U	HP	Z230	December 2014	December 2014	VOA Lab	New
MSD	MSVOA-H	Hewlett Packard 5971 Series	3188A03008	May 1999	July 2001	VOA Lab	Used
GC	MSVOA-H	Hewlett Packard 5890	2750A17849	May 1999	July 2001	VOA Lab	Used
Concentrator	MSVOA-H	OI Eclipse 4660	A401466023P	2004	Feb 2004	VOA Lab	Used
Auto Sampler	MSVOA-H	EST Archon	12971	May 1999	July 2001	VOA Lab	Used
Computer	MSVOA-H	MINTA ACER 32X	83007353	May 1999	July 2001	VOA Lab	Used
MSD	MSVOA-I	Hewlett Packard 5972 Series	3188A03673	June 1992	July 2001	VOA Lab	Used
GC	MSVOA-I	Hewlett Packard 5890 Series II	3235A45496	June 1992	July 2001	VOA Lab	Used
Concentrator	MSVOA-I	OI 4660 Eclipse	338466643P	2003	March 2003	VOA Lab	New
Auto Sampler	MSVOA-I	OI Archon 5100A	12225	2003	March 2003	VOA Lab	Used
Computer	MSVOA-I	Dell	A4054664199	June 1992	July 2001	VOA Lab	Used
MSD	MSVOA-K	Hewlett Packard 5971A Series	3188A03008	December 2002	Jan 2003	VOA Lab	New
GC	MSVOA-K	Hewlett Packard 5890 Series II	3235A45495	December 2002	Jan 2003	VOA Lab	New

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC/GC MS VOA Lab							
P&T 2	MSVOA-K	OI Analytical 4560	N249460496	December 2002	Jan 2003	VOA Lab	New
Auto Sampler	MSVOA-K	OI Analytical 4552	13843	December 2002	Jan 2003	VOA Lab	New
Computer	MSVOA-K	EXPERT Group	_____	December 2002	Jan 2003	VOA Lab	New
MSD	MSVOA-L	Agilent 5975	US52430266	2004	March 2004	VOA Lab	New
GC	MSVOA-L	Agilent 6890N	CN10524059	2004	March 2004	VOA Lab	New
Concentrator	MSVOA-L	Entech 7100A	1224	2004	March 2004	VOA Lab	New
Auto Sampler	MSVOA-L	Entech 7016CA	----------	2004	March 2004	VOA Lab	New
Computer	MSVOA-L	Dell XP	----------	2004	March 2004	VOA Lab	New
MSD	MSVOA-M	Agilent 5971	3118A02663	2004	March 2004	VOA Lab	New
GC	MSVOA-M	Agilent 5890	2429A02327	2004	March 2004	VOA Lab	New
Concentrator	MSVOA-M	Entech 7100A	1129	2004	March 2004	VOA Lab	New
Auto Sampler	MSVOA-M	Entech 7500/7016CA	----------	2004	March 2004	VOA Lab	New
Computer	MSVOA-M	Dell XP	----------	2004	March 2004	VOA Lab	New
GC	MSVOA_R	HP 6890N	CN10414059	------	2004	VOA Lab	------
MS	MSVOA_R	HP 5973	US40620571	------	2004	VOA Lab	------
Auto Sampler	MSVOA_R	OI4552	13576	------	2004	VOA Lab	------
Concentrator	MSVOA_R	Tekmar 3100 P&T	95195004	------	2004	VOA Lab	------
Computer	MSVOA_R	Dell Dimension 8300	55274-OEM-0011903-00102	------	2010	VOA Lab	------
GC	MSVOA_T	HP 6890N	US10244019	------	2004	VOA Lab	------
MS	MSVOA_T	HP 5973	US21864274	------	2004	VOA Lab	------
Auto Sampler	MSVOA_T	OI 4552	13694	------	2004	VOA Lab	------
Concentrator	MSVOA_T	OI 4660	A405466417P	------	2004	VOA Lab	------

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
GC/GC MS VOA Lab							
Computer	MSVOA_T	Dell Dimension 8300	55274-OEM-0011903-00102	------	2010	VOA Lab	------
GC	MSVOA_N	HP 7890	CN12061053	May 2012	May 2012	VOA Lab	------
MS	MSVOA_N	HP 5975C	US11483919	May 2012	May 2012	VOA Lab	------
Auto Sampler	MSVOA_N	Tekmar	US12017004	May 2012	May 2012	VOA Lab	------
Concentrator	MSVOA_N	Tekmar	US12017004	May 2012	May 2012	VOA Lab	------
Computer	MSVOA_N	HP Compaq	------	May 2012	May 2012	VOA Lab	------
GC	MSVOA_V	HP 7890B	CN16333185	Oct 2016	Oct 2016	VOA Lab	New
MS	MSVOA_V	HP 5977B	US1635M037	Oct 2016	Oct 2016	VOA Lab	New
Auto Sampler	MSVOA_V	ATOMX	US16173008	Oct 2016	Oct 2016	VOA Lab	New
Concentrator	MSVOA_V	ATOMX	US16173008	Oct 2016	Oct 2016	VOA Lab	New
Computer	MSVOA_V	HP Z240	2UA6331LKZ	Oct 2016	Oct 2016	VOA Lab	New
Refrigerator	VOA-Ref-1	Frigidaire	WB50332890	June 2005	June 2005	VOA Lab	New
Refrigerator	VOA-Ref-2	Frigidaire	WB50332901	June 2005	June 2005	VOA Lab	New
Refrigerator	VOA-Ref-3	Sanyo	911246533	May 1999	July 2001	VOA Lab	Used
Refrigerator	VOA-Ref-4	Glenco	JJ-371503	May 1999	July 2001	VOA Lab	Used
Refrigerator	VOA-Ref-5	Beverage Air KR48-IAS	7054308	May 1999	July 2001	VOA Lab	Used
Refrigerator	VOA-Ref-6	True Refrigerator T-72	682166	May 1999	July 2001	VOA Lab	Used
Oven	VOA-Oven 1	Fisher Scientific 230F	2876	May 1999	July 2001	VOA Lab	Used
Scale	VOA SC-1	Mettler PE 300	E28222	May 1999	July 2001	VOA Lab	Used
Instrument	**Lab ID**	**Manufacturer Description**	**Serial Number**	**Year Purchased**	**Date placed in service at this location**	**Current Location**	**Condition Received (used, new, recondition)**
Metals Lab							
ICAP	P-4	Thermo Scientific ICAP series 6000	20070701	Mar. 2007	Mar. 2007	Metals Lab	New
Autosampler	P-4	Thermo Scientific CETAC ASX-520	121363A520	Mar. 2007	Mar. 2007	Metals Lab	New
Circulator	P-4	Thermo Scientific Neslab Merlin M33	110134043	Mar. 2007	Mar. 2007	Metals Lab	New

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
Metals Lab							
Computer	P-4	Dell	----------	Mar. 2007	Mar. 2007	Metals Lab	New
ICAP	P-5	Thermo Scientific ICAP series 6000	20081906	June 2008	June 2008	Metals Lab	New
Autosampler	P-5	Thermo Scientific CETAC ASX-520	1018173A520	June 2008	June 2008	Metals Lab	New
Circulator	P-5	Thermo Scientific Neslab Thermoflex 900	0110220301120829	June 2008	June 2008	Metals Lab	New
Computer	P-5	Dell	----------	June 2008	June 2008	Metals Lab	New
ICP MS	P-6	Thermo Elemental	X0315	Dec 2003	Feb 2004	Metals Lab	New
Auto Sampler	P-6	ASX-510 Autosampler	120308ASX	Dec 2003	Feb 2004	Metals Lab	New
Circulator	P-6	Thermo Neslab (Water Circulator)	109223014	Dec 2003	Feb 2004	Metals Lab	New
Computer	P-6	IBM	KLAT783	Nov 2013	Nov 2013	Metals Lab	New
ICP MS	P-7	Agilent Technologies	JP14410463	December 2014	December 2014	Metals Lab	New
Auto Sampler	P-7	Agilent Technologies ASX-500	US1014101A520	December 2014	December 2014	Metals Lab	New
Heat Exchanger	P-7	Agilent Technologies	3F1491167	December 2014	December 2014	Metals Lab	New
Computer	P-7	HP	2UA4380G2Y	December 2014	December 2014	Metals Lab	New
ICP MS	P-8	Agilent Technologies	JP17141814	February 2017	May 2017	Metals Lab	New
Auto Sampler	P-8	Agilent Technologies SPS-4	AU16401968	February 2017	May 2017	Metals Lab	New
Heat Exchanger	P-8	Agilent Technologies	6H1720664	February 2017	May 2017	Metals Lab	New
Computer	P-8	HP	2UA6373LST	February 2017	May 2017	Metals Lab	New
Mercury Analyzer	CV-1	Leeman Labs HYDRA II AA Automated Mercury Analyzer	64244	June 2011	Dec 2011	Metals Lab	New

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
Metals Lab							
Computer	CV-1	Dell	----------	June 2011	Dec 2011	Metals Lab	New
Mercury Analyzer	CV-2	Leeman Labs Hydra AA Automated Mercury Analyzer	62598	June 2002	June 2002	Metals Lab	New
Computer	CV-2	Dell	CJ85K11	June 2002	June 2002	Metals Lab	New
Oven	M Oven-1	Lab-Line Model 3512	0700-0078	May 1999	July 2001	Metals Digestion Lab	Used
Scale	M SC-1	Adventurer Pro	8027100143	June 2006	June 2006	Metals Digestion Lab	New
Instrument	**Lab ID**	**Manufacturer Description**	**Serial Number**	**Year Purchased**	**Date placed in service at this location**	**Current Location**	**Condition Received (used, new, recondition)**
General Chemistry Lab							
Scale	M SC-2	Adam Highland HCB 1002	AE75803678	September 2013	September 2013	Metals Digestion Lab	New
Scale	M SC-3	Adam Highland HCB 1002	AE75803679	September 2013	September 2013	Metals Digestion Lab	New
Digestion Block	Dig Block # 1	Environmental Express	6083 CECW2808	May 2010	May 2010	Metals Digestion Lab	New
Digestion Block	Dig Block # 2	Environmental Express	8297 CECW43568	August 2012	August 2012	Metals Digestion Lab	New
Digestion Block	Dig Block # 3	Environmental Express	8379 CECW3685	September 2012	September 2012	Metals Digestion Lab	New
Digestion Block	Hg Dig Block # 1	Environmental Express	8211 CECW3498	July 2013	July 2013	Metals Digestion Lab	New
Digestion Block	Hg Dig Block # 2	Environmental Express	8211 CECW3500	June 2012	June 2012	Metals Digestion Lab	New
Digestion Block	Hg Dig Block # 3	Environmental Express	615CECD814	April 2001	April 2001	Metals Digestion Lab	New
on Chromatograph	IC-1	Metrohm 761 Compact Ion Chromatograph	17610020/09119	June 2002	June 2002	General Chemistry Lab	New

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
General Chemistry Lab							
Sample Processor	IC-1	Metrohm 766	62041430	June 2002	June 2002	General Chemistry Lab	New
Computer	IC-1	Micron	13186350008	June 2002	June 2002	General Chemistry Lab	New
Ion Chromatograph	IC-2	Metrohm 838Compact Ion Chromatograph	-----	June 2005	June 2005	General Chemistry Lab	New
Sample Processor	IC-2	IC838 Advanced Sample Processor	1830002400412 9	June 2005	June 2005	General Chemistry Lab	New
Interface	IC-2	Interface 830	1830002004179	June 2005	June 2005	General Chemistry Lab	New
Detector	IC-2	Detector 819	1819001003166	June 2005	June 2005	General Chemistry Lab	New
Pump	IC-2	Metrohm Pump 818	1818011004182	June 2005	June 2005	General Chemistry Lab	New
Separation Center	IC-2	Metrohm 820	1820023004135	June 2005	June 2005	General Chemistry Lab	New
Liquid Handling Unit	IC-2	Metrohm 833	183001004142	June 2005	June 2005	General Chemistry Lab	New
Incubator	Incubator-3	Forma-Scientific Model 3918 Incubator	60147-89	May 1999	July 2001	General Chemistry Lab	Used
Scale	WC SC-1	Mettler AE 200	J39330	May 1999	July 2001	General Chemistry Lab	Used
Scale	WC SC-2	Mettler AE200	J39333	May 1999	July 2001	General Chemistry Lab	Used
Scale	WC SC-3	Sartorius TE2145	22250964	------	2006	General Chemistry Lab	------
COD Digestion Block	COD Block # 1	HACH Hot Plate 16500-10	880711134	May 1999	July 2001	General Chemistry Lab	Used
COD Digestion Block	COD Block # 2	COD Reactor HACH	971100016836	------	2004	General Chemistry Lab	------
Stirrer Hot Plate	WC S-1	Torrey Pine Scientific	50000055	Nov 2014	Nov 2014	General Chemistry Lab	New

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
General Chemistry Lab							
Stirrer Hot Plate	WC S-2	Torrey Pine Scientific	50000056	Nov 2014	Nov 2014	General Chemistry Lab	New
Tumbler	T-1	Env. Express	------	June 1997	July 2001	General Chemistry Lab	New
Tumbler	T-2	Env. Express	------	June 1997	July 2001	General Chemistry Lab	New
Zero Headspace Extractor	ZHE-1	ZHE	3745-ZHE	June 1997	July 2001	General Chemistry Lab	New
Zero Headspace Extractor	ZHE-2	ZHE	3740-12-BRE	May 1999	July 2001	General Chemistry Lab	Used
pH Meter	WC pH meter-1	Thermo Orion 350	014070	July 2004	July 2004	General Chemistry Lab	New
pH Probe	WC pH Probe-1	Thermo Orion 9106 BNWP	R01	February 2004	February 2004	General Chemistry Lab	New
Konelab	Konelab	Konelab	P4719011	Dec 2002	Jan 2003	General Chemistry Lab	new
Computer	Konelab	Dell	2000-256036	Dec 2002	Jan 2003	General Chemistry Lab	new
Refrigerator	WC-Ref-1	Frigidaire	LA23205322	May 1999	July 2001	General Chemistry Lab	used
Refrigerator	WC-Ref-2	GE	WR844752	June 2013	June 2013	General Chemistry Lab	used
Cabiner Dessicator	1WCD	Boekel	----------	------	2004	General Chemistry Lab	------
Cabiner Dessicator	2WCD	Boekel	----------	------	2004	General Chemistry Lab	------
Oven	WC-Oven 2	VWR 1305U	01202393	Dec 1997	July 2001	General Chemistry Lab	Used
Oven	WC- Oven 3	VWR 1305U	01203788	May 1999	July 2001	General Chemistry Lab	Used
Spectrophotometer	Spectrophotometer-1	Hach DR/2010 Spectrophotometer	971100006417	May 1999	July 2001	General Chemistry Lab	used
Turbidimeter	WC-Turbidimeter-1	HACH 2100N	09090C025745	------	2004	General Chemistry Lab	------

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
General Chemistry Lab							
Conductance Meter	WC Conductance Meter-1	YSI Model 35 Conductance Meter	K8002530	May 1999	July 2001	General Chemistry Lab	used
Muffle Furnace	Muffle Furnace	Paragon Q11	418333	May 1999	July 2001	General Chemistry Lab	used
Midi Cyanide	MC-1	Andrews Glass (Cyanide Distillation)	ABX0409	May 1999	July 2001	General Chemistry Lab	used
Midi Cyanide	MC-2	Andrews Glass (Cyanide Distillation)	S06771	2002	2002	General Chemistry Lab	New
TOC Analyzer	TOC	Tekmar Appolo 9000	US03227003	Aug 2003	Aug 2003	General Chemistry Lab	new
TOC Boat Sampler	TOC	Rosemount Dohrmann-183	9311029	Aug 2003	Aug 2003	General Chemistry Lab	new
Auto-Titrator	Titrator	Titroline Alpha	441912	March 2004	March 2004	General Chemistry Lab	new
Auto-Titrator Sampler	Titrator	TW Alpha 16 Sample Changer	00472248	March 2004	March 2004	General Chemistry Lab	new
Digestor	Digestor	Westco Easy Digest 40/20	1102	March 2003	March 2003	General Chemistry Lab	new
Ignitability/ Flash Point Instrument	IGN-1	Koehler closed cup (Penske substitute)	R61091858	March 2004	April 2004	General Chemistry Lab	new
Dissolved Oxygen meter	DO Meter	YSI 5000 Dissolved Oxygen Meter	98C0951AB	May 1999	July 2001	General Chemistry Lab	Used
BOD Probe	BOD Probe H-1	DO Probe, YSI Model S010	13M100172	------	2004	General Chemistry Lab	------
Grain Size Seive Shaker	MDGEO-1	RO-TAP RX-29	21049	------	2004	General Chemistry Lab	------
Autoclave	MDA1	All American Pressure Steam Sterilizer 25X	0011555	------	2004	General Chemistry Lab	------
Puck-Mill Grinder	MDMI#1	Labtechnics LM1-P	9202634	------	2008	Sample Management	------
Hot Plate	EX HP-1	Corning PC-35	----------	May 1999	July 2001	General Chemistry Lab	Used

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
Sample Management							
Refrigerator	SM Ref-2	White Westinghouse (Ice Packs)	BA93101799	May 1999	July 2001	Sample Management	used
Walk in Refrigerator	SM-Walk in-1	Bally (10' X 38')	----------	May 1999	July 2001	Sample Management	used
Temperature Gun	Temperature Gun	Mannix Model # IRT4	----------	2005	2005	Sample Management	New
PID	PID # 3	RAE Systems	592-918947	May 2017	May 2017	Sample Management	New
PID	PID # 4	RAE Systems	592-920032	May 2017	May 2017	Sample Management	New
Instrument	**Lab ID**	**Manufacturer Description**	**Serial Number**	**Year Purchased**	**Date placed in service at this location**	**Current Location**	**Condition Received (used, new, recondition)**
Extractions Lab							
N-EVAP	N-EVAP	Organomation Nitrogen Evaporation System	----------	May 1999	July 2001	Extractions Lab	used
Water Bath	EX-WB-1	Boekel	----------	May 1999	July 2001	Extractions Lab	used
Water Bath	EX-WB-2	Boekel	----------	May 1999	July 2001	Extractions Lab	used
Water Bath	EX-WB-3	Boekel	----------	May 1999	July 2001	Extractions Lab	used
Water Bath	EX-WB-4	Boekel	----------	May 1999	July 2001	Extractions Lab	used
Water Bath	EXT Water Bath#2	Boekel	----------	July 2012	July 2012	Extractions Lab	------
Water Bath	EXT Water Bath#3	Boekel	----------	July 2012	July 2012	Extractions Lab	------
GPC	GPC-1	Accuprep JZ Scientific	03B-1060-3.0	2003	March 2003	Extractions Lab	used
S-Evaporator	Evaporator-1	Organomation Analytical Evaporator	10688	May 1999	July 2001	Extractions lab	used
Oven	EX Oven-2	Fisher 117G	----------	May 1999	July 2001	Extractions Lab	Used
ASE	ASE-1	Dionex Accelerated Extraction	03010456	March 2003	October 2003	Extractions Lab	new
ASE	ASE-2	Dionex Accelerated Extraction	03060034	March 2003	October 2003	Extractions Lab	new
ASE	ASE-3	Dionex Accelerated Extraction	03060032	March 2003	October 2003	Extractions Lab	new
Ultrasonic Bath	Sonicator Bath	Bransonic Ultrasonic Cleaner 8510	RPA020497187 E	March 2004	March 2004	Extractions Lab	new

Instrument	Lab ID	Manufacturer Description	Serial Number	Year Purchased	Date placed in service at this location	Current Location	Condition Received (used, new, recondition)
Extraction Lab							
Turbovap II	Turbovap	Zymark	TV9751N7885	**1997**	**July 2001**	Extractions Lab	**New**
Refrigerator	EX Ref-1	Gibson	LA23601205	May 1999	July 2001	Extractions Lab	used
Touch Vortexer	Vortex	Glas-Col	263248	May 1999	July 2001	Extractions Lab	Used
Centrifuge	Centrifuge	Damon/IEC Division	AE0921	**1984**	**July 2001**	Extractions Lab	**New**
Scale	EX-SC-1	Mettler PM 4600	975690	May 1999	July 2001	Extractions Lab	used
Scale	EX SC-2	Ohaus GA110	1348	2000	July 2001	Extractions Lab	Used
Scale	EX SC-3	Sartorius A 200S	36100008	2000	July 2001	Extractions Lab	Used
Soxtherm	SOX-1	Soxtherm	4032298	Feb 2004	March 2004	Extractions Lab	New
Soxtherm	SOX-2	Soxtherm	4040032	Feb 2004	March 2004	Extractions Lab	New
Soxtherm	SOX-3	Soxtherm	4031744	Feb 2004	March 2004	Extractions Lab	New
Soxtherm	SOX-4	Soxtherm	4031743	Feb 2004	March 2004	Extractions Lab	New
SPE DEX Extractor	SPE-1	Horizon 4790 series	04-0509	2004	2004	Extractions Lab	New
SPE DEX Extractor	SPE-2	Horizon 4790 series	04-0510	2004	2004	Extractions Lab	New
SPE DEX Extractor	SPE-3	Horizon 4790 series	04-0507	2004	2004	Extractions Lab	New
SPE DEX Extractor	SPE-4	Horizon 4790 series	04-0508	2004	2004	Extractions Lab	New
ROT-X-TRACT-LC	LL-Extractor-1	Organomation Liquid-Liquid extractor	----------	Nov 2005	Nov 2005	Extractions Lab	New
ROT-X-TRACT-LC	LL-Extractor-2	Organomation Liquid-Liquid extractor	60079	2016	January 2016	Extractions Lab	New
SPE DEX Controller	SPE Controller	Horizon	04-0433	**2004**	**2004**	Extractions Lab	**New**
Shaker	Shaker-1	Shaker	11302197	--------	**December 2013**	Extractions Lab	**Used**
GPC	GPC-2	Accuprep J2 Scientific	PLH 1548-1.1	**July 2015**	**July 2015**	Extraction Lab	**New**
Lab Oven	EXT Oven-1	Quincy Lab	30 GC Oven	---------	**June 2015**	Extraction Lab	**Used**

14. DOCUMENT CONTROL

Objective: To establish a system in order to have all information related to the production of analytical data controlled, protected, and stored to ensure its integrity and traceability. The system must ensure that only most recent version of required documentation is used by the appropriate personnel in the laboratory. Insure that invalid or obsolete documents are promptly removed from all points of issue or use, or otherwise assured against unintended use. All internal regulatory documents including the QA manual, SOP's, software, and equipment user's manuals are subject to document control. Obsolete documents retained for either legal or knowledge preservation purposes will be marked with the date that the document became obsolete.

Quality Assurance Manual: The QA Manual outlines how Chemtech plans, implements, and assesses the effectiveness of QA/QC control actions in the functioning of its analytical services.

Standard Operating Procedures (SOP's): An SOP is a written document, which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed, and which is accepted as the method for performing certain routine or repetitive task. SOP's are an integral part of consistent quality laboratory work.

14.1 DOCUMENT OVERSIGHT: The QA/QC Director is responsible for the document control system and maintains a current list of controlled documents, their location, and revision number. The QA/QC Director and Technical Director approve all newly released operating procedures and any revision to controlled documents. QC Supervisor is keeping track of all laboratory log books, temperature logs, hood logs and refrigerator logs.

14.2 DISTRIBUTION OF CONTROLLED DOCUMENTS: Controlled documents are signed by QA/QC Director and Technical Director. Copies of documents not signed or assigned a control number are considered uncontrolled documents. All departments supervisor can access the electronic copy of the updated document control of the QA Manual, SOP's, and any other related documents from the server. With the document, the supervisor receives a distribution document log that is signed and returned to the QA Office to be filed in a binder. This distribution log has the name of the document the printed name of the person receiving it, the signature and date of distribution.

Electronic copy of current applicable SOP (analytical, administrative, and or procedural) and QA Manual are saved on server. The original

document of each outdated SOP or QA manual is retained in the QA/QC office as well as on the server.

14.3 **DOCUMENT REVISIONS:** All laboratory documents under document control are reviewed at least annually and revised as appropriate. Document revisions may be requested due to a change in procedure; an added procedure; internal review of the laboratory procedures, personnel, facility, equipment, policy and/or procedures; implementation of new contracts/regulations.

For work performed under the USEPA SOW for Organic analysis Multi-Media, Multi-Concentration SOM01.X and SOW for Inorganic Superfund Methods Multi-Media Multi-Concentration Methods ISM01.X, the QAP must be revised when the following circumstances occur:

- USEPA modifies the technical requirements of the SOW or contract.
- USEPA notifies Chemtech of deficiencies in the QAP.
- USEPA notifies Chemtech of deficiencies resulting from USEPA's review of the laboratory performance.
- Chemtech's organization, personnel, facility, equipment, policy or procedures change.
- Chemtech identifies deficiencies resulting from the internal review of the organization, personnel, facility, equipment, policy or procedure changes.

The QAP will be revised within 14 days of when the circumstances listed above result in a discrepancy. The changes are highlighted and a copy is sent to USEPA Regional CLP PO and QATS.

A request to change a document is initiated on a "Corrective Action Report". The Technical Director and QA/QC Director review the requested change. The QA/QC Director is responsible for updating the appropriate document once a change has been approved.

Whenever corrections are required to a controlled document pending the re-issue of the document, a corrective action report will be generated. The corrected data will be entered manually by hand on the hard copy of the document, with initial and date, and the reason for the change. The changes will be approved by all persons originally approving the document. The corrected copy will be replaced in electronic copy, as applicable. A revised document will be re-issued as soon as practicable. Altered or new text in the SOP or QAM will be highlighted.

Any changes in electronically stored data are identified by storing the file as a revised version, keeping the original file intact and tracing the changes to the data to the user login ID.

These changes will be communicated to the affected personnel by replacing all copies with the revised version. Read receipts and/or training documents will be signed by the affected personnel, documenting that the affected changes are read and understood, and followed as soon as the changes are approved. The read receipts/training documents are maintained in the employee training file.

14.4 STANDARD OPERATING PROCEDURES (SOP's): Three (3) types of SOP's are used at Chemtech.

14.4.1 **Analytical SOP**: Provides stepwise instructions to an analyst on how to perform a particular analysis.

14.4.2 **Administrative SOP**: Details the process of documentation of all administrative activities.

14.4.3 **Procedural SOP**: Provides instructions and information for support activities in the laboratory.

Each SOP developed is assigned a unique document control number. SOP's are reviewed annually and updated if necessary. SOP's can be edited more frequently if systematic errors dictate a need for process change or the originating regulatory agency promulgates a new revision of the method. All SOPs are reviewed annually by associated Lab chemist & Lab supervisor. CHEMTECH's SOP Management program will highlight SOPs when their annual review date comes near. At that point of time QA manager ask Lab supervisor to review SOP with lab chemist. If there is any change require than lab chemist notify lab supervisor. Lab supervisor notifies QA manager about the change. Then QA manager update that SOP in SOP management program with a new revision number, effective date & a comment with the reason for updating SOP. Once SOP is revised by QA manager in SOP management Program, it has to be approved by lab chemist followed by lab supervisor, QA/QC Director and Technical Director. Then a read receipt for that SOP will be generated for all associated lab personnel. In case when no changes required for a SOP at the time of annual review then only date reviewed will be updated in SOP management Program. The revision number & effective date will not change for that SOP.

SOP's are maintained in electronic format on CHEMTECH LIMS network server. A list of available SOPs is enclosed as Section 27.

All SOPs are reviewed annually and changes are suggested by associated Laboratory Analyst or Laboratory Supervisor or Laboratory Manager or QC Supervisor or QA/QC Director. For any reason if SOP needs to be updated in the middle of the year then a corrective action report is

generated for that particular change. Associated Laboratory Analyst and Laboratory Supervisor are notified for this change with effective date. Laboratory Analyst and Laboratory supervisor acknowledge this change by putting their initial and date on that corrective action report which is then attached with related SOP. This corrective action report will be attached with SOP until next annual review when this change will be incorporated in SOP.

14.5 LOGBOOK CONTROL: Laboratory logbooks maintained at Chemtech are preprinted, numbered and include a title which identifies the purpose of the logbook. Some Laboratory logbooks are maintained electronically as well. Each logbook indicates the instrument name, manufacturer, model number and a Chemtech identification number. All quality control activities are recorded in the logbooks. Refer to P243-Manual Integration Policy and Electronic Logbook SOP, P254-Purchases and Supplies SOP and P255-Maintenance SOP.

All logbook entries must be completed and reviewed. For any corrections made to the logbook entries, Refer to P226-Corrections SOP.

Active logbooks are maintained in the laboratory and retired logbooks are maintained in the QA/QC office or archived on the server. Refer to P232-Data Storage SOP. Laboratory staff may keep two recent sequentially dated logbooks of the same type in order to simplify review of recently conducted analysis.

14.6 ANALYTICAL DOCUMENT MAINTENANCE AND STORAGE: Analytical data logbooks and clients reports are retained for five years unless specified otherwise. After five years, the analytical data and reports are systematically destroyed. The data is retained for ten years for clients from Massachusetts.

Projects completed in the current year are maintained in the Report Production area. All other analytical data, reports, and logbooks are kept in the Document Storage Area. The electronically scanned data are archived on LIMS Server. Levels of authorization limit access to Document Storage Area and the LIMS Server. Refer to P229-Computer Backup and Security SOP, P231-Data Archive SOP and P232-Data Storage SOP.

CHEMTECH has generated an access log for long term data storage. As this log indicates each box which will be stored at long term data storage place will have description on Box along with number on it. When this box will be placed at long tern data storage place the access log will be

updated with Box number, Box Description, Storage location, Stored by signature and date. At any time someone wants to access that box will have to update access log with Box number, Box Description, Storage location, Accessed by signature and date.

In the event of an ownership change all appropriate regulatory agencies will be notified. As a condition of the ownership change the buyer will be requested to maintain all records and reports prior to the time of legal transfer.

In the event of a bankruptcy all appropriate regulatory agencies and clients will be notified. They will be given the opportunity to retrieve their records and reports within 30 days of notification. The records and reports will be destroyed after the 30 days notification period has expired.

14.7 **PERSONNEL RECORDS:** The QA/QC office maintains personnel folders for all analytical staff members. These folders document that analysts have received instructions for their job related activities including read receipts for SOP's and the QA Manual. Personnel records also include health and safety training received and a signed ethics agreement, in addition to technical training records, demonstration of capability, and precision and accuracy for the tests.

14.8 **INTERNAL AUDITS:** The QA/QC Director conducts annual internal audits of the laboratory activities to verify that the laboratory operations continue to comply with the requirements of the quality system, the latest version of the TNI standard, DOD QSM, and all applicable state and federal program requirements. The internal audit program addresses all elements of the quality system, including the environmental testing activities. Internal Audits are planned activity. The QA/QC Director follows a schedule for Internal Audit. The QA/QC Director can make changes in schedule depending on the work situation and availability of Laboratory personnel. General Chemistry Laboratory Internal Audit is conducted in First quarter followed by Sample management and QA/QC Department in second quarter. Extraction, Metals/Mercury and Semi-Volatile Laboratory Internal Audit is conducted in third quarter. Internal Audit for Volatile, Air and Pesticide Laboratory are conducted in fourth quarter.

When audit findings cast a doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's environmental test results, corrective actions are taken. Clients are notified in writing if investigations show that the laboratory results may have been affected.
The project manager notifies the clients promptly, in writing, within 48 hours, of any event such as identification of defective measuring or test

equipment that casts doubt on the validity of results given in any test report or amendment to a report.

The area of activity audited, the audit findings and corrective actions that arise from them are recorded. The management ensures that these actions are discharged within the agreed time frame, per P210-Corrective-Preventive Action SOP.
Follow-up audit activities verify and record the implementation and effectiveness of the corrective action taken.

A review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery of potential issues is handled in a confidential manner until such time as a follow up of evaluation, full investigation, or other appropriate actions have been completed and issues clarified. All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of client. All documentation of these investigation and actions taken are maintained for at least five years.

14.9 **MANAGEMENT REVIEWS:** The executive management conducts a review of the laboratory's quality system and environmental testing activities annually to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. The review takes account of:

- The suitability of policies and procedures
- Reports from managerial and supervisory personnel
- The outcome of recent internal audits
- Corrective and preventive actions
- Assessments by external bodies
- The results of inter-laboratory comparisons or proficiency tests
- Changes in the volume and type of work
- Client feedback
- Complaints and other relevant factors, such as quality control activities, resources and staff training.

Findings from the management reviews and the actions that arise from them are recorded. The management ensures that those actions are carried out within an appropriate and agreed timescale, per P210-Corrective-Preventive Action SOP. The records of review findings and actions are maintained.

15. TRACEABILITY OF MEASUREMENTS

Objective: To establish procedures for achieving traceability of measurements between a measured value and a national reference standard.

15.1 METRIC MEASUREMENTS – THERMOMETER AND BALANCE CALIBRATION: Verification and/or validation of balances and thermometers are performed with National Institute of Standards and Technology (NIST) traceable standards. All new thermometers used in the laboratory are calibrated prior to their use and all thermometers are calibrated annually. A tag attached to the calibrated thermometer documents the date it was calibrated and any correction factor if necessary. The calibration readings are recorded in a logbook. Test equipment used in the laboratory requiring temperature control is assigned a separate calibrated thermometer. The temperature is recorded daily in a temperature log for all required equipment. Refer to SOP ID P208 - Thermometer Calibration SOP.

Class S Calibration weights are used to calibrate all the balances used in the laboratory. Calibration checks are performed on a daily basis and recorded in a logbook. Refer to P209-Scale Calibration SOP. An annual balance calibration is conducted by a certified agency or organization. Calibration certificates include the location of the equipment, model, serial number, manufacturer and sensitivity information. This information is maintained in the QA/QC office.

15.2 CHEMICAL STANDARDS: All reference and working standards used for calibration must be NIST traceable and have a traceability certificate. Vendors provide a traceability certificate for all chemical standards, which include a lot number and expiration date. Working standards are prepared from the vendor traceable standards and are documented in the "Standard Preparation Logbook (Electronic)" and include the vendor lot number, dates of preparation, and preparer's initials and date. Refer to individual method SOPs for Standard Preparation information. Reagents are checked for contamination by analyzing the Method Blank. . Refer to P220-Traceability SOP. Analytical standards are verified and documented. Refer to P202-Reagent Check SOP. The certificates of traceability are affixed to the logbook (Electronic) to keep a permanent record. The vials, in which working standards are kept, are labeled with the lot number, preparation date, and expiration date. All reagents that do not have an expiration date from the manufacturer will be labeled as expiring 10 years from the date the reagent container was opened. All expired standards must be stored separately from the working standards.

16. CALIBRATION AND VERIFICATION OF TEST PROCEDURES

Objective: To ensure that instrumentation is performing to predetermined operational standard prior to the analysis of any samples and that the data are of known quality and appropriate for a given regulatory agency requirements must be established by the laboratory.

16.1 ORGANIC TEST PROCEDURES

Tuning Criteria for GC/MS Instruments: Each GC/MS system must pass the performance criteria for 4-Bromofluorobenzene (BFB) or Decafluorotriphenylphosphine (DFTPP) before any samples, standards or blanks can be analyzed. The tuning standard must meet the criteria specified in each analytical SOP. The chromatogram should not contain any baseline drift and the peaks should be symmetrical. Each GC/MS system must be tuned every 12 hours for SW846 methods, OLM04.2 and SOM01.1 analyses and 24 hours for 600 series methods.

Initial Calibration: Second source standards are obtained from a different manufacturer than the original standards, unless one is not available and are used to verify the initial calibration. An initial calibration is run on all instruments. Initial calibration is rerun when continuing calibration criteria cannot be met. The criterion for an initial calibration curve consists of a minimum of five points for SW846 Methods, OLM04.2 and SOM01.1 analyses and a minimum of three points for 600 series methods. The lowest standard analyzed must be equal to or less than the reporting limit, however, the five points are specified in the analytical SOP for CLP work. The response factor (RF) must be calculated for all compounds. The Relative Standard Deviation (RSD) is used to determine linearity. See individual SOPs for limits, criteria and allowances. The system performance check compounds (SPCC) are checked for SW 846 methods for a minimum average response factor. These compounds must meet the minimum response factors specified in each analytical SOP. If the minimum average response factor for any SPCC does not meet the criteria then corrective action is required and the GC/MS system recalibrated. The initial calibration verification must be successfully completed prior to running any samples.

If more stringent standards or requirements are included in a mandated test method or by regulation, Chemtech will demonstrate that such requirements are met. If it is not apparent which standard is more stringent, then the requirements of the regulation or mandated test method are to be followed.

Continuing Calibration Verification (CCV): The initial calibration curve for each compound of interest is checked and verified once every 12 hours for SW846 methods, OLMO4.2 and SOM01.1 analyses, and once every 24 hours for 600 series methods. This is accomplished by analyzing a midpoint calibration standard and verifying all continuing calibration criteria for a given method are met. Sample, blank, and QC standards cannot be analyzed unless a CCV meets method criteria. For further details refer to the individual SOP's.

Formulas:

$$RF = \frac{\text{Area of compound x Concentration of ISTD}}{\text{Area of ISTD x Concentration of compound}}$$

$$\%\ RSD = \frac{SD}{RF} \times 100$$

where **SD** is the standard deviation for all compounds and **RF** is the average response factor

When the %RSD exceeds criteria for any analyte, a linear regression of the instrument response versus the concentration of the standards is performed for 600 series and SW846 methods. The regression will produce the slope and intercept terms for a linear equation in the form

$$y = ax + b,$$

where:

y = instrument response (peak area or height)
a = slope of the line(also called the coefficient of x)
x = concentration of the calibration standard
b = intercept

- The use of linear regression may not be used as a rationale for reporting results below the calibration range demonstrated by the analysis of the standards.
- The regression calculation will generate a correlation coefficient(r).

In order to be used for quantitative purposes, the correlation coefficient must be greater or equal to 0.99

16.2 INORGANIC TEST PROCEDURES

Balance Calibration: All balances are calibrated each day with 3 class "S" weights covering the expected range of analysis and recorded in the balance calibration logbook (Electronic). Refer to P209-Scale Calibration SOP. The non-reference weights are calibrated annually using reference weights and the results are recorded. The accuracy of the reference

weights is certified every five years. An outside contractor certifies each balance for accuracy once a year. A calibration sticker is placed on the balance and all associated information is maintained in the QA/QC department.

Titrant Standardization: All titrants used in the laboratory are standardized when opened to verify the titrant's normality in duplicate. These values are recorded in the appropriate analytical logbook. Each titrant must be within 90-110% of the known value. If not, the titrant is restandardized.

Instrument Calibration: An initial calibration is run on all instruments. Refer to individual method SOPs for method-specific calibration requirements.

Mercury analyzer must be calibrated using blank and 5 standards in graduated amounts that define the linear range of analysis. The correlation coefficient for the curve must be > 0.995.

Spectrophotometric analyses are calibrated by using a blank and minimum 5 standards. The correlation coefficient must be > 0.995, or as defined in the analytical SOP

If any calibration curve has a correlation coefficient < 0.995, corrective action is taken and a new calibration curve is analyzed. Samples, blanks, and standards are not analyzed until the curve passes the criteria. For all calibrations the lowest standard analyzed must be equal to or less than the reporting limit.

Formula: $y = ax \pm b$,

where:
y = instrument response (peak area or height)
a = slope of the line(also called the coefficient of x)
x = concentration of the calibration standard
b = intercept

Initial Calibration Verification (ICV): Second source standards are obtained from a different manufacturer than the original standards, whenever possible, or a different lot number from the same manufacturer is obtained, unless one is not available, and are used to verify the initial calibration. The ICV must be performed immediately after calibration of each analysis, as applicable. This is accomplished by analyzing a midpoint calibration standard. The ICV must have a percent recovery as specified in the individual method SOP. If the criterion is not met, corrective action

must be taken. If the source of the problem can be determined after corrective action has been taken, a new calibration MUST be generated. Samples, blank, and QC standards cannot be analyzed unless the ICV meets method criteria. The initial calibration shall be verified and documented for every analyte at each wavelength used for analysis.

Continuing Calibration Verification (CCV): CCV analysis is performed at a frequency specified in each method SOP. The CCV must be analyzed at the beginning of the run and after the last analytical sample, or as applicable per method SOP. The CCV concentration is at or near the midpoint of the calibration curve and is analyzed at every wavelength used for the analysis of each analyte. The CCV results must fall within the control limits specified in each analytical SOP.

Thermometer Calibration: Every liquid–in-glass thermometer used in the laboratory is certified annually, electronic and other non-liquid-in-glass thermometers are verified quarterly, against a NIST certified thermometer, which is traceable to the manufacturer. The certified reference thermometer has calibration verified annually. All data is recorded in a controlled logbook.

pH meter Calibration: Each pH meter is calibrated daily at pH of 4, 7, 10 and then checked with a ICV (pH 7) buffer solution. The calibration is recorded in the pH logbook along with the date and time of calibration. When the pH meter is used for longer than three hours, check pH at 7.0 (first source) every three hours. The pH cannot differ by more than ± 0.2 pH units from the standard buffer value or the meter must be recalibrated.

Spectrophotometer Wavelength Check: A wavelength check of each spectrophotometer is performed annually against Platinum/Cobalt standards and recorded in the maintenance logbook. If the wavelength does not meet the manufacturer's specified conditions, service is performed on the instruments.

Autoclave test strip: A temperature sensitive tape is used to verify the content of each autoclave run is processed.

Linear range Verification & Calibration for ICP - Metals: Linear range verification is performed for all ICP instruments. A series of calibration standards are analyzed over a broad range of concentration and data from these analyses are used to determine the valid analytical range for the instrument. ICP instrument calibration is routinely performed

using a single standard at a concentration within the linear range and a blank.

17. CALIBRATION, VERIFICATION, AND MAINTENANCE OF EQUIPMENT

Objective: To establish a system to ensure accurate calibration and maintenance of all laboratory equipment. All instrument maintenance activities must be recorded in the instrument logbooks. Instrument should be labeled as a dedicated piece of equipment when an instrument is used for a unique activity.

17.1 INSTRUMENT CALIBRATION: Instruments are calibrated according to the requirements set forth by the manufacturer or as dictated by the respective SOP's for the test method for which the instruments are used. The frequency and type of maintenance and calibration activity performed must be documented in the instrument logbook. If an instrument is out of working order, out of calibration or in need of repair, a tag is affixed to the instrument directing the analysts to use another instrument.

Support instruments are calibrated and verified using NIST traceable reference standards over the range of use. Balances, ovens, incubators, water baths, freezers, and refrigerators are checked daily if in use and readings are recorded in their respective logbooks.

Refer to analytical method SOPs for method-specific calibration requirements. Also Refer to P244-Calibration policy SOP.

17.2 INSTRUMENT MAINTENANCE: Some instruments are purchased with a service contract. If a service contract is purchased, it is recorded in the logbook along with a contact phone number. Refer to P227-Services and Daily Maintenance SOP and P255-Maintenance SOP. Calibration is necessary after instrument repair and prior to using any new instrument. Instrument servicing includes routine cleaning and the repair and/or replacement of any faulty parts. For further information refer to the instrument manual or the SOP for the test method the equipment is used.

17.3 CALIBRATION/MAINTENANCE LOG: Each instrument has an associated maintenance and calibration logbook (Electronic). The interval maintenance/ calibrations are guided by the manufacturer's instructions or as often as needed based on individual instrument performance. It may be modified by user's experience and frequency of use. The instrument is identified on the first page of the logbook. The logbook must document the calibration and maintenance of the instrument.

18. VERIFICATION PRACTICES

Objective: To establish a process for the verification practices in effect to assure adherence to the Quality Assurance Plan. A system for proficiency testing, use of reference materials, and internal QC schemes must be in place in order to ensure compliance.

18.1 PROFICIENCY TESTING (PT) PROGRAMS:

External PT Samples: Chemtech participates in NYSDOH Potable, Non Potable and Solid/Hazardous Categories and USEPA CLP. The results are used to evaluate the ability of the laboratory to produce accurate data. PT reports and raw data are retained in the laboratory for a minimum of five years. These records include results and supporting documentation of analyses of test samples and all related Quality Control analysis. The laboratory participates in the PT from other providers as well, e.g., client specific PT samples, Environmental Resources Association (ERA), Phenova and Absolute Standards.

All PT samples are handled (i.e. managed, analyzed and reported) in the same manner as real environmental samples utilizing the same staff, methods as used for routine analysis of that analyte, procedures, equipment, facilities, and frequency of analysis. When analyzing a PT sample, the same calibration, laboratory quality control and acceptance criteria, sequence of analytical steps, number of replicates and other procedures are used as when analyzing routine samples.

Chemtech does not send any PT sample, or a portion of a PT sample, to another laboratory for any analysis for which it seeks accreditation, or is accredited. Chemtech does not knowingly receive any PT sample or a portion of a PT sample from another laboratory for any analysis for which the sending laboratory seeks accreditation, or is accredited. Chemtech management or staff does not communicate with any individual at another laboratory (including intra-company communication) concerning the PT sample. Chemtech management or staff does not attempt to obtain the assigned value of any PT sample from their PT provider.

Internal PT Samples: The QA/QC Director is responsible for administering an in-house blind check sample program, at QA/QC Director's discretion. Quality control samples are obtained from the EPA and from a private supplier. The known samples are blindly introduced into the system as a typical sample and analyzed as such. The results are reported to the QA/QC Director and evaluated.

This process allows for close monitoring of the accuracy of laboratory analyses on blind samples. If a problem is discovered, the QA/QC Director brings it to the attention of the Company President and Laboratory and Department Manager. With the assistance of the Technical Director, the cause of the problem is determined and appropriate corrective action is taken. Another blind sample is sent through the laboratory to confirm the problem has been resolved.

18.2 USE OF REFERENCE MATERIAL AND SUPPLIES: The laboratory purchases external reference samples from known vendors. All reference samples are certified and the laboratory maintains the manufacturer's Certificate of Analysis on file. Pre-certified and pre-cleaned supplies are purchased for DoD Work. Each lot of supplies is analyzed to ensure that no target analytes are present at concentrations above ½ Reporting Limit for DoD Work.

18.3 INTERNAL QUALITY CONTROL PROCEDURES: The data acquired from QC procedures are used to judge the analytical quality of the data, to determine the need for a corrective action, and to interpret results after the implementation of corrective actions. Each test method SOP details the QC procedures to be followed.

Method Blank: A method blank is an aliquot of reagent water for aqueous samples and an aliquot of a solid matrix, whenever possible, carried through the entire sample preparation and analytical procedure. A method blank must not contain any target analyte(s) at concentrations that exceed method requirements. If it does, the source of contamination must be removed or minimized before proceeding with sample analysis.

Note: For DoD Work: A method blank must not contain any analyte at $\geq$1/2 Reporting Limit and for common laboratory contaminants, no analyte must be present at $\geq$ Reporting Limit. If method blank contamination does not meet criteria, reprocess the associated samples in a subsequent preparation batch, except when sample analysis results in non-detect. If no sample volume remains for reprocessing, then results will be reported with appropriate data qualifiers.

Laboratory Control Samples (LCS): A LCS is an aliquot of reagent water for aqueous samples and aliquot of a solid matrix, whenever possible, spiked with the target analyte list analyzed with each batch of samples to demonstrate the method accuracy within acceptance QC limits. The results are used to determine batch acceptance. Each method SOP includes detailed QC procedures and QC limits.

Sample Duplicates: Sample duplicates are performed to measure analytical precision. One duplicate sample must be analyzed from each group of samples of similar matrix type for each batch of 20 samples. If a duplicate result falls outside QC limits the original sample and the duplicate sample data are regarded as unreliable and may necessitate corrective action.

Matrix Spikes: Matrix spikes are analyzed at a frequency of one per twenty samples to measure analytical precision and accuracy of the specified matrix. If precision and accuracy are out of QC limits, corrective action is required.

Surrogate Spikes: Surrogates are organic compounds that are similar in behavior to the target analytes but are not found in nature. They are added to all blanks, samples, and standards except the tuning standards at a concentration specified in relevant SOP's. All surrogates must meet the recovery limits specified in each SOP. If any surrogate does not meet the limits, the sample must be reanalyzed.

Internal Standard: An internal standard (IS) is 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. Retention time (RT) for an IS is also compared to reference standards to assure that target analytes can be located by their individual relative RT. If the criteria for IS response or RT criteria are not achieved corrective action is required, e.g., recalibration and reanalysis.

Sample Analysis: The analyst is responsible for performing all QC requirements before and after analyzing the sample to make sure that required QC criteria are met. If the sample QC criteria are not met, the analyst must take corrective action to rectify any problems. If the analyst is not able to remediate the issue, then must notify the supervisor who will take necessary corrective action.

Storage Blank, GPC Blank and Blank Spike analysis: Storage and GPC Blank and GPC Blank Spikes are logged weekly every Monday, and monitored by the QA/QC Director. Storage Blanks are analyzed to ensure that cross-contamination has not affected the sample results. GPC Blank and Blank Spike samples are monitored to ensure efficiency of the GPC cleanup process. GPC Blank and Blank Spike may not be performed weekly, if no samples are processed through GPC. However, the GPC Blank and Blank spike must be performed whenever GPC cleanup is performed.

Data Package Review: Data review is performed at different levels to assure that all QC criteria are met. The analyst conducting the analysis performs first data review. The data is then submitted for supervisory review. The final review of the data is conducted in the QC department before the data are released to the client. The QA/QC Director conducts a spot check review of the completed data packages. For further details refer to "Procedures for Audits and Data Review" section of this QA Manual and P201-Data Review SOP.

Monitoring Quality Control Limits: Quality Control data generated from duplicate analysis and matrix spikes/matrix spike duplicates are monitored and plotted on Quality Control Charts. Control Charts are monitored quarterly. Refer to P211-Control Charts SOP. Chemtech utilizes the Quality Control charts to identify data trends and assure that all tests are within control.

Chemtech records the theoretical or true value, then calculates and plots the mean value. In general, our warning limits are ±2 Standard Deviations from the true value. Corrective action is taken when ±3 Standard Deviations from the mean value are encountered. The Percent Recovery for all quality control samples must be within the limits stated in the method.

In addition to control chart limits, the laboratory uses limits of 75-125% and RPD limits of ±20% for inorganic analysis. For organic analysis %R limits and RPD limits as stated in applicable methods are used.

In control charts application, any points beyond the control limits indicate an out of control situation. When data points are out of statistical control, Chemtech investigates the source of the statistical perturbation. When an out-of-control situation occurs, analyses must be stopped immediately until the problem has been identified and resolved. The control charts are also utilized to identify trends, which can be checked and resolved before the system goes out-of-control.

Annual Quality Audits: An annual quality review of the system is important to ensure that laboratory management can continue to be confident that all measures are being taken to produce the highest quality of data and services. Annual audits, along with day-to-day data review, provide effective means for ensuring that QC activities are being implemented and that each analyst performs in a manner consistent with the quality system. The QA/QC Director conducts the audits, which are scheduled and announced in advance. For further details refer to the "Data Review and Internal Quality Audits" section of this manual.

18.4 **EXTERNAL QUALITY CONTROL PROCEDURES:** Chemtech participates in hardcopy and electronic data audits as required, in addition to on-site evaluations performed by various agencies and clients.

19. LABORATORY MANAGEMENT POLICY FOR PERMITTED DEPARTURES FROM DOCUMENTED POLICIES AND PROCEDURES

Objective: To establish a process for an event which requires departure from the documented policies and procedures.

19.1 **PROCEDURE:** The Technical Director, Laboratory Manager, and QA/QC Director have the responsibility for ensuring that all personnel adhere to the laboratory's policies. A departure from documented policies is allowed if fully documented and approved by the appropriate level of authority. Documentation of the departure includes the reason for the departure, the effected SOP(s), intended results of the departure and the actual results. The client will be informed of any deviation from the contract.

If the departure affects data, the client is notified before conducting the analysis for approval. This departure is also noted in the case narrative of the final report.

If the Client requests a method modification that represents a significant departure from a reference method, the client must acknowledge in writing the authorization of the modification. The acknowledgment can be in the form of a contract modification or signing the quotation acceptance page.

The quotation details the analytical requirements including the test methods for the project, the acceptance page to be signed by the client, states that "the quotation accurately describes the analytical requirements".

20. CORRECTIVE ACTIONS FOR TESTING DISCREPANCIES

Objective: To establish a system for actions taken in response to non-conformance reports issued during performance, data review, or a client complaint. The goal of the corrective action program is to correct and monitor out-of-control events, which effect the integrity of analytical results. All conditions that adversely impact data quality must be identified and corrected.

20.1 OUT-OF-CONTROL EVENTS: Out-of-control situations are identified through analytical data validation procedures. An out-of-control event is a situation, which results in the development of unacceptable results. Once a problem has been identified, the QA/QC Director must contact the department supervisor using the Corrective Action (CA) report form. The supervisor must initiate investigation into cause, and must ensure that corrective action is implemented and is effective. The CA must be documented on the (CA) report form and filed in QA/QC office. Refer to Corrective Action SOP for details of the corrective action report forms.

There are many situations that present an out-of-control situation. Contamination, percent recoveries and duplicate variations that are not within control limits, and failing calibrations are examples of situations considered out-of-control. Whenever a situation of this nature is encountered, Chemtech diligently develops the appropriate corrective action.

20.2 CORRECTIVE ACTION PROCESS: A corrective action is a response to an out-of-control event, which brings back a system to produce acceptable results. Corrective actions taken to control an event can be: stop analytical work immediately; identify the symptom of the out-of-control event; identify the cause of the out-of-control event; implement a corrective action; confirm that a return to control has been achieved by analyzing reference samples; document entire process by completing a CA Report Form; complete and return the CA Report Form to the QA/QC office.

20.3 DEPARTURES FROM DOCUMENTED POLICIES AND PROCEDURES: Method SOP's provide QC acceptance criteria and specific protocols for corrective actions. When testing discrepancies are detected such as out-of-control QC, the analyst must follow the corrective action protocol as described in the applicable method SOP.

Technical Director and QA/QC Director first approve any corrective action taken that is not mentioned in the SOP. This action is recorded in the CA Report Form and is documented in the electronic database of

corrective actions. If necessary, the method SOP is than revised to incorporate the corrective action to make it a part of SOP for future uses.

20.4 **CORRECTIVE ACTION MONITORING:** Laboratory Manager, Department Managers and QA/QC Director routinely monitor corrective actions implemented in the laboratory for effectiveness and to ensure that the deficiency has been completely removed from the system. If the deficiency still exists after a given period of time, the corrective action is reevaluated and modified.

21. REPORTING ANALYTICAL RESULTS

Objective: To ensure that the reported results are accurate, clear, objective, and unambiguous. The contents of the final report must include all necessary information and must be clear and understandable for the end-user.

21.1 REQUIRED DOCUMENTATION: All documentation used to approve and defend reported data must be collected and should be available and referenced so it can be found at any time it may be needed. Chemtech reports meet all applicable regulatory and client requirements. Electronic reports can be customized to meet the client specific requirements.

Documentation for Sample Identification: Includes at minimum sample identification, chain-of-custody, Field QC, if any and any other related documents.

Documentation of the Analytical Performance: Analytical method used and method detection limit (MDL), reporting limit (RL), limit of detection (LOD), or limit of quantitation (LOQ), as required; Instrumentation (manufacturer, model, performance checks); Calibration data (initial and continuing); Detailed analytical work (raw data, run logs, standard and reagent preparation, calculations)

QA/QC Documentation and Data: Analysis of blanks; Source of QC check standards; Preparation of spike stock solution.

Checks and Validation of Analytical Data: QC review Checklists; Corrective actions (when applicable); Date and signature of approval of the reportable data of each parameter tested; Date and signature for approval of the final report.

21.2 SIGNIFICANT FIGURES IN ANALYTICAL REPORTS: Numerical data are often obtained with more digits than are justified by their accuracy and precision, therefore must be reported by the accuracy of the analytical method.

The number of significant figures refers to the number of digits reported for the value of a measured or calculated quantity indicating the accuracy and precision of the value. Nonzero integers always count as significant figures. Leading zeros are zeros that precede all the zero digits and do not count as significant figures. The zeros simply indicate the position of the decimal point.

Captive zeros are zeros between nonzero digits, and always count as significant figures. Trailing zeros are zeros at the right end of the number and are significant only if the number contains a decimal point. At Chemtech the results are reported to two significant figures.

When rounding a number carry at least one digit beyond the last significant digit throughout all calculations. Round the final result by changing all digits beyond the last significant digit to zeros; drop these zeros if they are to the right of the decimal point. Refer to P225-Rounding Rules SOP.

21.3 UNITS USED TO EXPRESS ANALYTICAL RESULTS: Units used to express analytical results depend on the analytical method used, the concentration of the analytes, and the matrices of the sample analyzed.

The most common unit used to express results is milligrams per liter (mg/L), which is equal to parts per million (ppm) or milligrams per kilogram (mg/Kg). Other units used are microgram per liter (µg/L), which is equal to parts per billion (ppb) or micrograms per kilogram (µg/Kg).

21.4 REPORT CONTENTS: The final report includes the following information:

Client Information: name and address of the client

Project Information: Client project name and location (if specified by the client)

Chemtech Reference Information: Chemtech project number

Evidence Receipt: Description and identification of samples, chain-of-custody

Case narrative (if applicable): Description and/or identification of analysis performed with a description of deviations from the SOP if required

Summary and Results: Analytical results supported by raw data, chromatograms, initial calibration and continuous calibration, etc.

Report is sequentially numbered and all raw data and chromatograms are initialed and dated by the analyst. The final report is signed and dated by the QC supervisor. Refer to P201-Data Review SOP.

21.5 DATA COLLECTION , REDUCTION, REPORTING AND VALIDATION PROCEDURE

Data collection:
All data is collected from the instrumentation electronically. This data is then transferred electronically to a data processing computer were the data is revised and verified for method adherence and compliance.

For some analysis the data cannot be transferred electronically. The data is then entered manually to the reporting software and verified by a peer review.

Data reduction:
Analyst then processes the data and saves all instrument data collected in a designated folder in Mars (data storage server). The data is then brought electronically into the data reporting system where the data is reviewed against the method requirements and QC limits.

Data reporting:
Once the data is approved, the forms are printed. The data package is arranged with the necessary forms, depending on the method and client specifications. Once the data package is complete, the package is then brought to the Reporting Department for review and validation.

Data validation:
The first review is done in the lab by the analyst performing the analysis with the help of the reporting software (EISC), which contains all the method requirements.

Supervisor for the department performs a secondary review.

The last review is done at the reporting department were data reviewers go through the data package in detail and verify compliance with the method and client requirements.

22. DATA REVIEW AND INTERNAL QUALITY AUDITS

Objective: To design a process to assess compliance of laboratory activities with the operational requirements of the QA manual and to evaluate the performance of all analytical departments. The validation of data must be accomplished by a data review procedure.

22.1 DATA REVIEW: At Chemtech there are several stages for the data review/validation process. The analyst performing the analysis conducts the first data review. The supervisor reviews the data after the analyst review. The QC/Report Production performs the final review.

Analyst Review: The analyst is responsible for ensuring that all work performed meets the specifications and criteria outlined in the Statement of Work. They are to double-check all aspects of their analyses, including instrumental conditions, QA/ QC limits, calculations, and compound identification. When manual integration's are performed, the raw data records shall include a complete audit trail for those manipulations. Raw data output showing the results of the manual integration's, a notation of the rationale for the manual integration, including the date and initials/signature of the person performing the manual operation must be included in the raw data file.

Supervisor Review: Supervisor performs a technical data review to ensure that proper analytical sequence was employed, all QA/QC criteria were met, compounds were properly identified and flagged if required, correct standard, dilutions, and calculations were made.

Quality Control/Report Production Review: The completed data is reviewed by the QC/Report Production. Sample information from the sample receiving documentation is compared to in-house laboratory information to ensure consistency. The data are checked for general completeness, compliance, and QA/QC requirements, and random calculations are performed. If a quality control measure is found to be out of control, and the results are to be reported, all samples associated with the failed quality control measure will be reported with the appropriate data qualifier(s).

If a defect is identified in the data package, that can be corrected before the data are released to the client, the data package is returned to the laboratory for corrections. Immediate action is taken by the affected department to rectify the problem and corrected data package is returned to QC/Report Production office for review and final release of the data.

Spot Check Review by QA/QC Director: The QA/QC Director performs spot-check reviews about 10% of the data before they are released to the client. He/she focuses on all elements of data deliverables including sample identification, sample custody documentation, analytical quality control, and client specifications and requirements.

22.2 INTERNAL QUALITY SYSTEM AUDITS: Annual internal audits are conducted under the direction of the QA/QC Director. These audits are used to detect and correct any specific problems. The audit involves a thorough laboratory inspection to evaluate the following areas: adherence to all laboratory procedures as specified in applicable New Jersey, Pennsylvania, New York and other state or federal program regulations; verification of methodology; adherence to all method QC requirements; frequency of duplicates, spikes, blanks, and QC sample analyses; maintenance of documentation in adherence with good laboratory practices; and verification that laboratory equipment, supplies, and reagents are properly maintained. The internal audits cover all laboratory and support systems and include the analyst qualifications and training documents.

A comprehensive audit checklist is used for the department to be audited based on the method SOP and includes the cycle of a sample analysis beginning from sample receiving till the disposal of the sample and the release of data to the client. Checklists are revised annually to incorporate corrective actions initiated during the previous year to be followed up and to ensure that the corrective actions are taken and followed in the affected areas. Refer to Internal Audit Report for a copy of the latest checklists. Deficiencies are noted on the checklist and CA reports are issued to the area being audited.

Findings of the audit are documented and copies of the findings are given to the Company President, the Technical Director, the Laboratory Manager, and the Department Supervisor. A copy of the findings is also provided to the analyst. Any problems and their prospective resolutions are discussed among the QA/QC Director, Technical Director, and Department Supervisor. After an agreed upon time period, it is the responsibility of the QA/QC Director to ensure that the required corrective action has been implemented. All audit documents are kept on file by the QA/QC Director in the QA office.

23. ELECTRONIC DATA

Objective: To establish a system to control, verify, validate and document computer software used by LIMS.

23.1 Software: To ensure that the software that is used to collect, analyze, process and/or maintain LIMS Raw Data, SOP's are established, approved and managed for:

Testing and quality assurance methods to ensure that all LIMS software accurately performs its intended functions, including acceptance criteria, tests to be used, personnel responsible for conducting the tests, documentation of test results, and test review and approval.

Change control methods that include instructions for requesting, testing, approving, documenting and implementing changes. When indicated, change control methods shall also include reporting and evaluating problems, as well as implementing corrective actions.

23.2 Documentation: Documentation is established and maintained to demonstrate the validity of all software used in the LIMS and includes:

A description of the software and functional requirements; a listing of all algorithms and formulas; and as they occur, testing and quality assurance, installation and operation/enhancement, and retirement.

23.3 Security: SOP's are established to implement appropriate security procedures to assure the integrity of LIMS data are adequate. Computer security training is given to all employees once when they are hired. Username and Passwords are changed on regular basis.

23.4 Electronic Audit: The organics laboratory uses two different software packages to collect the data and two different software packages to produce the report. Both the volatiles and semi-volatiles departments use the combination of Hewlett Packard (HP) Chemstation/Enviroforms and EISC to collect and produce reports. GC volatiles only use TurboChrom software to process and quantitate the data. TurboChrom generates 3 separate files. The raw files contain no quantitation, only the output from the instrument. The .TXT files contain a process file, and the rpt. file contains a detailed report table. The raw file cannot be tampered with or changed. This file is protected by the software to preserve the original output. The PST/PCB data is collected on a different version of Chemstation and the EISC software is used to produce the reports. HP and EISC have set up security for the data itself and there is no way to effect any changes to the raw data. The

quantitation is similarly secured by the software in that any data produced has information on it that can be used to determine its origin.

24. GLOSSARY

1. Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents.

2. Analytical Detection Limit: the smallest amount of an analyte that can be distinguished in a sample by a given measurement procedure throughout a given confidence interval.

3. Analyst: 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.

4. Audit: a systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity.

5. Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

6. Chain of custody: an unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples.

7. Confidential Business Information: Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products.

8. Confirmation: 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.

9. Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

10. Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

11. Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy.

12. Document Control: the act of ensuring that documents and revisions 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.

13. Holding Times: the maximum times that samples may be held prior to analysis and still be considered valid or not compromised.

14. Laboratory: a defined facility performing environmental analyses in a controlled and scientific manner.

15. Laboratory Control Sample (lab fortified blank, blank spike, QC check sample): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

16. Manager: the individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory.

17. Method Detection Limit : the minimum concentration of a substance an analyte 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.

18. NELAC standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference or TNI (The NELAC Institute).

19. Nonconformance: An indication or judgement that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

20. Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator.

21. Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical and/or biological integrity of the sample.

22. Proficiency testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

23. Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

24. Quality Assurance Plan: 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.

25. Quality Control Sample: an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

26. Quality System: 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 and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

27. Raw data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study.

28. Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

29. Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

30. Reporting Limit: A specific concentration at or above the lower quantitation limit that is reported to the client with confidence. It is often defined on a project-specific basis. If set by the client below the lower quantitation limit, method modification is required or the client will be required to accept the lowest technically valid value that can be provided by the laboratory.

31. Standard Operating Procedures: a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks.

32. Technical Director: individuals who has overall responsibility for the technical operation of the environmental testing laboratory.

33. Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons

25. REFERENCES

1. ISO/IEC DIS 17025: 2005. General requirements for the competence of calibration and testing laboratories.

2. 2009 TNI Standard

3. DOD Quality Systems Manual for Environmental Laboratories Version 5.0

26. CERTIFICATION LIST AND RESUMES OF KEY PERSONNEL

26.1 Certification List – Mountainside NJ

STATE	STATUS	LABORATORY ID	Certification Categories
NJ-NELAP	Certified	20012	DW, WW, SHW, Air
NY-ELAP	Certified	11376	DW, WW, SHW, Air
CONNECTICUT	Certified	PH-0649	DW, WW, SHW
MAINE	Certified	2012025	DW,WW,SHW
MARYLAND	Certified	296	DW
NEW HAMPSHIRE	Certified	255413	DW,WW,SHW
PENNSYLVANIA	Certified	68-548	DW
TEXAS	Certified	T10470448-10-1	WW
USDA	Certified	P330-16-00372	Soil Permit
USEPA	CLP Inorganic & Organic	CHM	metals, cyanide, volatile, semi-volatile, pesticide, PCB
DoD ELAP (L-A-B)	Certified	L2219	WW, SHW, Air

26.2 **Key Employee Resume** (additional resumes available upon request)

NAME: ***Divyajit Mehta*** **POSITION: Laboratory Director/Chief Operating Officer**

RESPONSIBILITIES: Responsible for all technical efforts of the Laboratory to meet all terms and conditions of EPA contract as well as all of CHEMTECH's clients. Experienced in the analysis of inorganic soil and water samples according to the requirements of the EPA Superfund, Contract Laboratory Program. Hands on experience in the use of the modern analytical instrumentation and wet chemical techniques. Currently responsible for the overall technical performance of the laboratory. Review the technical and QA/QC requirements during the analysis. Oversees the laboratory operations and compliance with all regulations.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
Gujarat University INDIA	1979	1982	*CHEMICAL* ENGINEERING		*BS, 1982*
NJIT	1984		*CHEMICAL ENGINEERING*		MS INCOMPLETE

Professional Experience

Name & Address of Employer: *CHEMTECH MOUNTAINSIDE, NJ 1/99-Present*	**Responsibilities included**: Oversee overall technical laboratory performance and compliance with regulations and contracts. Responsible for Corporate Health and Safety program.
Title of Position: *CHIEF OF OPERATIONS/LABORATORY DIRECTOR*	
Name & Address of Employer: CHEMTECH *ENGLEWOOD, NJ 1/89-1/99*	**Responsibilities included:** Responsible for the technical efforts of the inorganic department and compliance with EPA contract
Title of Position: *INORGANIC MANAGER*	

Professional Skills

Hands on experience in a variety of instruments such as GC/MS, ICP, GC and various Wet chemistry techniques.
Various training such NELAC training, instrument training and other seminars related with the Analytical procedures and instrumentation.

Computer Skills

Computer literate- MS Office- MS Word, MS Excel, MS Power Point
Use and design of Environmental Data Reduction Software
Enviroquant & Enviroforms, LIMS- Sample Master, EISC data reduction Software.

Other Achievements or Awards

Divyajit has completed various training in the Environmental field. Examples of these are: Inorganic Data validation training, Region II Organic data validation, Sample Master LIMS advance course, ICP training course and others. OSHA 40-hour Training Certified

Title of Position & Dates: *Project Management Director, 1/2008 – 2/2009*	

NAME: Himanshu N. Prajapati **POSITION:** QA/QC Director

Dates: 02/2013 – Present

RESPONSIBILITIES: Enforcement of all QA/QC requirements as per EPA, CLP protocols and all state regulations, Internal Audit of the lab, write and annually update Standard Operating Procedures, Assure that lab QA/QC practices are kept by conducting Internal Audit Annually, Verify all QC Client Contract compliance and Screening, Provide clients with technical support upon request, Development and maintenance of corrective action reports, regulatory and client document review, monitor external assessments, monitor compliance of lab systems with quality system guidelines established by federal and state agencies.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
L.D. College of Engineering Ahmedabad, Gujarat, India	1993	1997	***Chemical Engineering***	***NA***	***B.E. Chemical Engineering***
Stevens Institute of Technology NJ, USA	1999	-	***MS Chemical Engineering***	NA	

Professional Experience

Name & Address of Employer: ***CHEMTECH 284 Sheffield Street*** ***Mountainside, NJ 07092***	**Responsibilities Included:** Responsible for review of CLP packages, maintenance and troubleshooting of instruments, training other lab personnel in Semi-Volatile analysis and instrumentation. Prepare and analyze proficiency samples. Schedule work flow for other analysts.
Title of Position: *GC/MS Extractables Supervisor**; 10/02-02/13***	
Name & Address of Employer: ***CHEMTECH 284 Sheffield Street*** ***Mountainside, NJ 07092***	**Responsibilities Included:** Assist supervisor with all aspects of data deliverable production, review data based on SW-846, CLP and 40 CFR methodology, depending on project requirement. Verify all QC requirements, contract compliance, screening and method requirements
Title of Position: ***QC Analyst; 9/04-12/04***	
Name & Address of Employer: ***CHEMTECH 284 Sheffield Street*** ***Mountainside, NJ 07092***	**Responsibilities Included:** Perform BNA analysis as per EPA 600 series, SW 846 and CLP protocols. Assist supervisor with SOPs updates. Update LIMS system. Troubleshoot instrument.
Title of Position: GC/MS Analyst; 04/00-10/02	

Y*For additional information please see attachment.*

Professional Skills

Proficient with the analysis of samples for inorganic & organic parameters.

Computer Skills

MS Office- Word and Excel
Data Processing software

NAME: Umangi Modi **POSITION:** GC/MS Analyst

Dates: August 2015 – Present

RESPONSIBILITIES: Analyze samples using SW846, EPA CLP and 600 series methods. Prepare and analyze proficiency samples. Responsible for maintenance and troubleshooting of instruments.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
NJIT	-	December 2012	***Environmental Science***	**-**	***Master of Science***

Professional Experience

Name & Address of Employer: ***CHEMTECH 284 Sheffield Street*** ***Mountainside, NJ 07092***	**Responsibilities Included:** Perform General Chemistry analysis based on EPA 40 CFR series, SW 846 and CLP protocols. Assist supervisor with SOPs updates. Update LIMS system. Troubleshoot instrument
Title of Position: ***General Chemistry Analyst; 5/2014-08/2015***	

Y*For additional information please see attachment.*

Computer Skills

MS Office- Word and Excel
Data Processing software

NAME: Rajesh Parikh **POSITION:** Extraction Supervisor

DATES: March 2011-Present

RESPONSIBILITIES: Supervision of Extractions department, schedule and coordinate workflow for the extractions analysts. Extract samples for BNA, Pesticides, PCBs, Herbicides and TPH based on EPA 600 series, SW 846 and CLP methodologies. Updating LIM system. Review and updating of Extractions SOPs. Troubleshoot instrument. Prep and Analysis of Oil and Grease based on method SW 1664.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
University of Baroda India	1967	1971	***Chemistry***		***BS 1970***

Professional Experience

Name & Address of Employer: ***CHEMTECH*** 284 Sheffield St, Mountainside, NJ 07092 **Title of Position:** ***Extraction Analyst, June 2003-March 2011***	**Responsibilities included:** Extract samples for BNA, Pesticides, PCBs, Herbicides and TPH based on EPA 600 series, SW 846 and CLP methodologies. Assist supervisor with SOPs updates. Update LIMS system. Troubleshoot instrument. Prep and Analysis of Oil and Grease based on method SW 1664.
Name & Address of Employer: ***Godak Mills*** India **Title of Position:** ***Chemist Jan 1977-Nov 2002***	**Responsibilities included:** Testing and analysis of raw materials and Dyes. Analysis of In-process and finished products.
Name & Address of Employer: Calico Mills India **Title of Position:** Chemist Jan 1972-Dec 1976	**Responsibilities included:** Testing and analysis of raw materials and Dyes. Analysis of In-process and finished products.

Y*For additional information please see attachment.*

Professional Skills

Computer Skills

Microsoft Office 2000-Excel, Windows

NAME: Jaswal Sarabjit **POSITION: Metals Analysis Supervisor**

Dates: 12/89 to Present

RESPONSIBILITIES: Supervision of Metals departments. Flow of work; analyses of samples within holding times, scheduling of work with the analysts, verify the test results performed by analysts. Technical data review of analyses (ICP data run – Methods 6010, 200.7, CLP, Hg data run – Methods 7470, 7471, 245.1, CLP. Report preparation and handle centralize computer system for analytical reports.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
Punjab University, India	*1976*	*1981*	***Chemistry***	***------***	***BS; 1981***

Professional Experience

Name & Address of Employer: CHEMTECH 205 Campus Plaza 1, Edison, NJ 08837 **Title of Position & Dates:** ***Laboratory Chemist;*** ***7/88 to 12/89***	**Responsibilities included:** Analyses of General Chemistry and Metals parameters including cyanide, nitrate-nitrite, TKN, TDS, TSS, BOD, COD, TOC, hardness, etc. of wastewater, drinking water, soil, and sludges. Reporting of data as required.
Name & Address of Employer: JCT Mills (Nylon Plant). **Title of Position & Dates:** ***Laboratory Chemist;*** ***1/83 to 11/85***	**Responsibilities included:** Analysis of General Chemistry methods.

Professional Skills

- Experience in EPA methods, NYSDOH, NJDEP, and CLP requirements.
- Hands on experience for running ICP/Hg analyzer, TOC, Lachate, UV spectrophotometer, etc.
- Troubleshooting of above-mentioned instruments.

Computer Skills

MS Office – MS Word, MS Excel, MS PowerPoint

NAME: Ugochukwu Amadioha **POSITION: GC Extractables Supervisor**

DATES: MAY 06 – PRESENT

RESPONSIBILITIES: Supervision of Pesticide/PCB department, co-ordination of workflow in the department, analysis of samples within the specified holding times, scheduling the work with the analysts, and training of the new employees.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
COLLEGE OF NEW JERSEY	*1999*	*2003*	***Biology***	***------***	***BS 2003***

Professional Experience

Name & Address of Employer: CHEMTECH Mountainside, NJ 07092 **Title of Position:** ***GC and GC/MS analyst;*** ***10/04-05/06***	**Responsibilities included:** VOC water, soil and gases analysis by method EPA 600 and SW846. Operate Archon autosampler, GC FID. Prepare standards. Follow GLP. Daily calibration of lab scales, refrigerators, autoclaves.
Name & Address of Employer: Roche Molecular systems Branchburg, NJ **Title of Position:** ***PCR Control Scientist;*** ***06/05-02/06***	**Responsibilities included:** Support manufacturing of Qualitative standards and Internal Controls for Polymerase Chain Reaction kits. Operate PCR instruments and Real Time PCR. Review controlled testing and manufacturing documents.
Name & Address of Employer: Medco Health Solution, LLC Parsippany, NJ **Title of Position:** *Customer Services Representative;* *10/03-08/04*	**Responsibilities included:** Educate members about prescription drug benefits managed by Medco Health and on plan attributes as it relates to copay, deductible, Out of Pocket expenses and CAP.

Professional Skills

Lab Techniques in Cell and Molecular Biology and Genetics: PAGE and Agrose Gel Electrophoresis. Protein purification, DNA isolation, Column Affinity Chromatography, PCR and Restrictive Fragment Analysis, Pour Plating, Colony Isolation, and Aseptic techniques.

NAME: Mildred V. Reyes **POSITION: QC Supervisor**

DATES: Feb.2006-Present

RESPONSIBILITIES: Supervision of data deliverable production, data review based on SW-846, CLP and 40 CFR methodologies. Verify QC requirements, contract compliance and screening requirements.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
UNIVERSITY OF PUERTO RICO	*1982*	*1987*	***Biology***	***------***	***BS 1987***

Professional Experience

Name & Address of Employer: CHEMTECH Mountainside, NJ 07092 **Title of Position:** *QA/QC Director* *2002-2006*	**Responsibilities included:** Enforcement of QA/QC requirements, Internal Audit of the lab, Write and update SOP, Verify QC Client Contract Compliance and Screening, Provide clients with technical support.
Name & Address of Employer: CHEMTECH Mountainside, NJ 07092 **Title of Position:** ***QA/QC Supervisor*** ***1999-2002***	**Responsibilities included:** Supervision of all aspects of data deliverable production, data review of GC/MS Volatile and Semi volatile, Pesticides, PCBs, Herbicides, Metals and Wet Chemistry based on SW 846, EPA, CLP and 40 CFR methodologies. Verify all QC requirements, contract compliance, screening and requirements.
Name & Address of Employer: Analab/ICM Division 205 Campus Plaza 1, Edison, NJ 08837 **Title of Position:** ***GC, Supervisor*** ***1995-1999***	**Responsibilities included**: Supervision of four GC analysts; coordination of work flow and schedule; technical review of all data generated for GC Volatile, Pest, PCB Herbicides analysis; instrument trouble shooting and other technical problems.

Name & Address of Employer: Cycle Chem, INC Elizabeth, NJ **Title of Position:** *Production Chemist* *1993-1995*	**Responsibilities included:** Perform daily lab analysis on disposal material based on SW 846 and 40 CFR requirements. Analysis included PCB analysis, Metals and Wet Chemistry; inventory of all incoming samples
Name & Address of Employer: Safety Kleen, Linden, NJ **Title of Position:** ***Laboratory Technician*** ***1990-1993***	**Responsibilities included:** Senior Technician overseen laboratory operations during night shift. Perform daily lab analysis, which included Volatile Organic analysis, PCB analysis, and Wet Chemistry**.**

Other Achievements or Awards

Environmental Laboratories Seminar
Internal Assessment Training

Professional Skills

GC Volatile, Pesticides, PCBs, Herbicides analysis by GC using EPA, SW 846 and 40 CFR methodology.
ASP and CLP deliverable.

Computer Skills

MS Office- MS Excel, MS Word, MS Power Point
Use of Environmental data reduction software

NAME: Snehal Mehta **POSITION**: ***Sample Management Supervisor***

Dates: Jan.01 - Present

RESPONSIBILITIES: Login samples. Prepare bottle orders and receiving samples, sample custodian.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
Gujrat University	1993	1996	***Chemistry***	***-----***	***BS, 1996***

Professional Experience

Name & Address of Employer: Kroma Dyestuffs Ltd., India	**Responsibilities included:** Analyze soil, water and sludge analysis. Supervision of analysts. Data and technical review.
Title of Position & Dates: ***Analytical Chemist*** ***1994-1997***	

Computer Skills

MS Office – MS Word, MS Excel, MS PowerPoint

NAME: Semsettin (Sam) Yesiljurt **POSITION: GC/MS Analyst (Volatile)**

Dates: 7/2001 – Present

RESPONSIBILITIES: Analyze and QA/QC water and soil samples using SW 846 8000 series and EPA 600 series methods. Preparing data packages to be reported to the client. Keeping track of projects pertaining to the department. Troubleshooting of instruments and other technical problems according to methodology.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
Gazi University Ankara, Turkey	*1976*	*1980*	***Chemical Engineering***	***------***	***BS, 1980***

Professional Experience

Name & Address of Employer: CHEMTECH Consulting 205 Campus Plaza, Raritan Ctr. Edison NJ **Title of Position & Dates:** ***GC Analyst 7/99 – 7/01***	**Responsibilities included:** Analyze and QA/QC water and soil samples using SW 846 8000 series and EPA 600 series methods for Pest, PCB, Herb. Preparing data packages to be reported to the client. Troubleshooting of instruments and other technical problems according to methodology.
Name & Address of Employer: All Test Environmental Lab **Title of Position & Dates:** ***GC/MS analyst, 2/99 – 7/99***	**Responsibilities included:** Analyze and QA/QC water and soil samples using SW 846 8000 series and EPA 600 series methods.
Name & Address of Employer: Technion **Title of Position & Dates** *GC/MS Analyst 8/96-2/99*	**Responsibilities included:** Analyze and QA/QC water and soil samples using SW 846 8000 series and EPA 600 series methods.
Name & Address of Employer: Technion **Title of Position:** ***GC Analyst 4/93-8/96***	**Responsibilities included:** Analyze and QA/QC water and soil samples using SW 846 8000 series and EPA 600 series methods.

Professional Skills

- Troubleshooting of GC/MS, Tekmar autosampler
- Data package production using Enviroforms and EISC software
- Acquisition and analysis of samples using Enviroquant and RTE software
- ASP Deliverables, CLP Deliverables

Computer Skills

MS Office – MS Word, MS Excel, MS PowerPoint
Use of Environmental Data Reduction Software – Enviroquant & Enviroform, EISC, LIMS

NAME: Mohammad Ahmed **POSITION: Laboratory Manager**

Dates: Nov. 2005 - Present

RESPONSIBILITIES: Responsible for all technical efforts of the Laboratory to meet all terms and conditions of CHEMTECH clients. Hands-on experience in the use of modern analytical instrumentation and wet chemical techniques. Currently responsible for the overall technical performance of the laboratory. Review technical and QA/QC requirements during the analysis. Oversee the laboratory operations and compliance with all regulations.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
University of Punjab	1996	2001	***Science***	***-----***	***BS, 2001***

Professional Experience

Name & Address of Employer: CHEMTECH Mountainside, NJ	**Responsibilities included:** Oversee all technical laboratory performance and compliance with regulations and contracts.
Title of Position & Dates: ***Laboratory Manager Nov. 2005-Present***	
Name & Address of Employer: Naturex	**Responsibilities included:** Responsible for SOP prep. and review, method development, perform analysis using different instruments, calibrate and maintain instruments.
Title of Position & Dates: ***Senior Chemist Oct.2005-Nov.2006***	
Name & Address of Employer: Garden State Laboratories	**Responsibilities included:** Supervise organic department, oversee sampling projects, produce monthly reports, supervise PT analysis.
Title of Position & Dates: ***Team Leader May 2001-Oct.2005***	
Name & Address of Employer: Accutest laboratories	**Responsibilities included:** Responsible for laboratory audits, review data, create SOPs, perform organic and inorganic analysis.
Title of Position & Dates: ***Senior Chemist Sept..2002-Oct.2003***	

Professional Skills

- Hands on experience in a variety of instruments such as GC/MS, ICP, GC, and various Wet chemistry methods.

Computer Skills

- ***MS Office – MS Word, MS Excel***
- Use of Environmental Data Reduction Software – Enviroquant, EISC, LIMS

NAME: Jacob Tsvik **POSITION: Systems Manager**

DATES: October 2004- Present

RESPONSIBILITIES: Quality Control of all computer systems, including hardware, software, documentation and procedures. Generates and updates the automated deliverables in accordance to client specifications. Installation, training, maintenance and operation of programs as they pertain to providing open architecture systems that promote adaptability, efficiency, reliability and system integration. Develop, design and implement CHEMTECH's LIMS system. Develop US Army. US Navy and US Air Force and commercial client EDDs based on each individual requirement.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
COPE Institute, NY	1995	2002	***-----***	***-----***	***2002***
University of Technology, Ukraine	1978	1983	-----	-----	BS, Engineering

Professional Experience

Name & Address of Employer: Bris Avrohom, Hillside, NJ **Title of Position & Dates:** Field Network Technician, 06/2002 – 03/2004	**Responsibilities included:** Support users for Network Client Installation and support, Install and setup Windows 95/98 and Windows NT, 2000, XP workstations and create user accounts, home directories, assign permissions to shares. Install 3com cards, hubs, test connectivity. Provide Level 1, 2 support. Perform system backup. Resolve service interruptions.
Name & Address of Employer: BLS Technology Inc., Brooklyn, NY **Title of Position & Dates:** Consultant, 08/1996 – 03/2002	**Responsibilities included:** Physical inventory, Asset tag placement, Maintain and troubleshoot entire network, Administer domain accounts, Software installation and troubleshooting, Install and support Client 32, Deal with TCP/IP address, Upgrade and repair desktop computers.
Name & Address of Employer: J & R Computer World, NY **Title of Position & Dates:** Computer Technician, 01/1995 – 07/1996	**Responsibilities included:** Upgrade and repair desktop and laptop computers, Install and configure external and internal devices, Heavy phone troubleshooting and support, on-site troubleshooting and user orientation.

Professional Skills

Windows NT, 2000, XP, Linux system, Microsoft Office, PC and PC components, laptops, cables and adapters, NIC, Routers, Hubs, Switches, Cables and connectors, UPS, Printers, Scanners, Modems, ISDN, DSL, Video equipment.

Computer Skills

- ***MS Office 2000, C, C++, Basic, Java 2.0, HTML Languages***
- ***Windows, Linux, MD DOS***
- SQL Server 7.0

NAME: ***Amit Patel*** **POSITION**: ***General Chemistry Supervisor***

Dates: ***October 2010-Present***

RESPONSIBILITIES: Perform General Chemistry analysis as per SW846 protocol. Update LIMS system. Troubleshoot instruments. Train new staff.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
Gujarat University	1996	2000	***Chemical Engineering***	***-----***	***Gujarat University***

Professional Experience

Name & Address of Employer: 02/05 – 10/10 **Title of Position & Dates:** ***GC/MS Volatiles Supervisor*** **Name & Address of Employer:** 02/05 – 10/10 **Title of Position & Dates:** ***GC/MS Volatiles Supervisor***	**Responsibilities included:** Analyze and QA/QC water and soil samples using SW 846 8000 series, EPA CLP and EPA 600 series methods. Preparing data packages to be reported to the client. Keeping track of projects pertaining to the department. Troubleshooting of instruments and other technical problems according to methodology.
Name & Address of Employer: Sanghi Industries Ltd. **Title of Position & Dates:** ***Assistant Engineer, 11/02 – 10/04*** **Name & Address of Employer:** Sanghi Industries Ltd. **Title of Position & Dates:** ***Assistant Engineer, 11/02 – 10/04***	**Responsibilities included:** Worked as assistant engineer in cement plant using 100% lignite as fuel.

Professional Skills

- Project on Thionile Chloride
- Seminar on Composting – a solid waste management system

Computer Skills

MS Office- MS Excel, MS Word, MS Power Point
Use of Environmental data reduction software

NAME: ***Kurt Hummler*** **POSITION**: ***Project Manager***

Dates: Feb. 1998 - Present

RESPONSIBILITIES: Responsible for setting up client projects and maintaining direct client contact throughout the project to ensure that all client requirements are fulfilled.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
University of North Carolina	1987	1991	***Political Science***	***-----***	***BA***

Professional Experience

Name & Address of Employer: CHEMTECH 284 Sheffield Street Mountainside, NJ	**Responsibilities included:** Responsible for communicating with client and laboratory all information pertaining to the project.
Title of Position & Dates: Project Manager, Feb. 1998-Present	
Name & Address of Employer: Lab Resources Inc.	**Responsibilities included:** Responsible for marketing and managing the project.
Title of Position & Dates: Project/Marketing Manager, 08/97 – 01/98	
Name & Address of Employer: Core Labs, Inc.	**Responsibilities included:** Worked as project manager.
Title of Position & Dates: Project Manager, 02/92 – 05/97	

Computer Skills

MS Office – MS Word, MS Excel, MS PowerPoint

NAME: Emanuel Hedvat **POSITION: President**

RESPONSIBILITIES: Primarily responsible for all operations and business activities. Develop and implement strategies and initiatives. Responsible for growth and direction of Chemtech. Responsible for the profitability of the company, the quality of analyses performed and the high level of service provided to clients. Delegate authority to Laboratory Directors, all Managers, and Quality Assurance/Quality Control Director to conduct day-to-day operations and execute quality assurance duties.

Educational Background

College/University	Dates Attended		Major	Minor	Degree & Date
	From	To			
Fairleigh Dickenson University			Chemistry	---	BS
Fairleigh Dickenson University			Chemistry	---	***MS, 1983***

Professional Experience

Name & Address of Employer: Chemtech **Title of Position & Dates:** ***President***	**Responsibilities included:** Oversee overall laboratory performance and compliance. Maintain quality service. Discuss analytical requirements with Disposal facilities and Regulatory Agencies. Develop Sampling and Analysis Plans. Create Site Maps. Generate Electronic Diskette Deliverables for interpretation of analytical results as per Disposal Facility requirements. Perform sampling per regulatory agency requirements.

Professional Skills

Mr Hedvat has over 25 years of experience in the environmental testing industry including on-site laboratories. With extensive experience in corporate management. He has conducted numerous field chromatography studies at various US Navy bases. Developed and implemented numerous analytical techniques in support of remedial investigations studies. His knowledge on environmental testing stems from having served as Laboratory Director, Field Services Director and Project Management Director.

Computer Skills

Microsoft office 2003; excel, word, power point

Other Achievements or Awards

Active Registration and Awards:
American Chemical Society
American Society for Testing & Materials
Water Pollution Control Federation
Society of American Military Engineers

27. Laboratory SOP List

(a list of current SOP revisions and reviewed dates available upon request)

Document Title	Document Control Number
Quality Assurance Manual	A2040129
Chemical Hygiene Plan	A2040232
Conflict of Interest Plan	A2070189
Affirmative Action Program Executive	A2070190
AAP Section 503 and 4212-01	A2070191
Procedural SOPs	
P201-Data Review	A2040102
P202-Reagent Check	A2040103
P203-Laboratory Limits and Demonstration of Capability	A2040104
P204-Chain-of-Custody Procedure	A2040139
P205-Chemical Waste Disposal	A2040106
P207-ASTM Type II Water	A2040108
P208-Thermometer Calibration	A2040109
P209-Scale Calibration	A2040110
P210-Corrective-Preventative Action	A2040111
P211-Control Charts	A2040112
P212-Water Purity	A2040113
P213-Calibration of Auto Pipettes	A2040114
P214-Subcontracting	A2040115
P215-Hood Calibration	A2040116
P216-Calibration and Temperature Setting	A2040117
P217-Glassware Cleaning	A2040118
P218-Chemical Storage	A2040119
P219-Disposal of Chemicals	A2040120
P220-Traceability	A2040121

Document Title	Document Control Number
P222-Standard Operating Procedure Preparation	A2040123
P223-Material Safety Data and Records	A2040126
P224-Bottle Preparation	A2070104
P225-Rules for Rounding	A2040124
P226-Corrections	A2040127
P227-Service and Daily Maintenance	A2040127
P228-Storage and Disposal of PCB Materials	A2040139
P229-Computer Backup and Storage	A2070074
P230-Sample Aliquot	A2070075
P231-Data Archive	A2070076
P232-Data Storage	A2040105
P234-Field Sampling	A2070091
P235-Worklist	A2070098
P236-Fax Procedure	A2070099
P237-Training	A2070105
P238-Field Chlorine Test	A2070130
P241-Air Canister Cleanup	A2070133
P243-Manual Integration Policy and Electronic Logbook	A2070146
P244-Calibration Policy	A2070147
P250-Log-in Procedure	A2040128
P251-Quotation Project Chronicle	A2070151
P252-Ethics Policy	A2070178
P253-Uncertainty Policy	A2070179
P254-Purchasing and Supplies	A2070194
P255-Maintenance	A2070195
P256-Storage Blank	A2070196
P257-Foreign Soils	A2070201

Document Title	Document Control Number
GC VOC SOPs	
M8015B/C-GRO	A2040028
MRSK-175	A2070198
GCMS VOC SOPs	
M524.2-DWVOA	A2040035
M64/SM6210B-MSVOA	A2040037
M8260B/C-SWGCMSVOA	A2040038
MTO15-Air VOC	A2070131
MSOM02.4-GCMS VOA	A3040273
MSOM02.4-GCMS VOA Trace	A3040274
Extractions SOPs	
M3510C,3580A-Extraction SVOC	A2040001
M3510C,3580A-Extraction DRO	A2040002
M3510C,3580A-Extraction PCB	A2040004
M3510C,3580A-Extraction Pesticide	A2040005
M3610-Alumina Cleanup	A2070036
M3620C-Florisil Cleanup	A2070037
M3630-Silica Gel Cleanup	A2070038
M3640A-GPC Cleanup	A2070039
M3660B-Sulfur Cleanup	A2070040
M3665A-Sulfuric Acid Cleanup	A2070041
M3545A-Pressurized Fluid Extraction	A2070091A
M3520C-Pest/PCB Liquid-Liquid Extraction	A2070100
M3541-ASE Extraction	A2070095
MSOM02.4-Sample Preparation	A3040269
M3535A-HPLC Explosives Preparation	A2070137
M8330/A-Explosives Salting Preparation	A2070138

Document Title	Document Control Number
O.17-CWA Breakdown Product Extraction from Solids	A2070207
O.18-CWA Breakdown Product Extraction from Water	A2070208
O.19-White Phosphorus Extraction from Soil	A2070257
O.20-White Phosphorus Extraction from Water	A2070258
P.1-Biological Tissue Homogenization	A2070282
P.5-Percent Lipid Determination	A2070283
GCMS SVOC SOPs	
M625-BNA	A2040030
M8270C/D-BNA	A2040031
MSOM02.4-SVOC	A3040272
M8330A-Nitroaromatics	A2040007
L.2-Explosives Residues by 8330A/8330B	A2070203
M.4-CWA Breakdown Products by GCMS	A2070211
M.5-White Phosphorus Analysis by GCMS	A2070265
GC SVOC SOPs	
M608-WW Pesticide PCB	A2040017
M8015B/C-DRO	A2040018
M8081A/B-Pesticide	A2040020
M8082/A=PCB	A2040021
M8151A-Herbicide	A2040022
M8015B-Fingerprint	A2070141
MOLC03.2-Pesticide PCB	A2040023
MSOM02.4-PCB	A3040270
MSOM02.4-Pesticide	A3040271
MNJDEP-EPH	A2070199
MOQA-QAM-025-TPH	A2070182

Document Title	Document Control Number
Metals SOPs	
M3005A-Digestion	A2040143
M3010A-Digestion	A2040011
M3050B-Digestion	A2070023
M7470A-Mercury	A2040095
M7471A/B-Mercury	A2040096
M200.7-Trace Elements	A2070019
M200.7/2340B-Hardness	A2040097
M6010B/C-Trace Elements	A2040091
M6010-SM2340B-Hardness	A2070192
M200.8-Trace Elements	A2070103
M6020/A-Metals ICPMS	A2070102
MILM05.4HGS-Mercury in Soil	A2070158
MILM05.4HGW-Mercury in Water	A2070155
MILM05.4-Metals ICPMS	A2070156
MILM05.4-Trace Metals	A2070153
MISM01.2-Trace Metals	A2070198
MISM01.2-Metals ICPMS	A2070199
MISM01.2-Mercury in Soil	A2070200
MISM01.2-Mercury in Water	A2070201
MISM01.3-Mercury in Soil	A2070285
MISM01.3-Mercury in Water	A2070286
MISM01.3-Trace Metals	A2070288
MISM01.3-Metals ICPMS	A2070287
MPM10-Digestion	A2070189
P.3-Biological Tissue Digestion	A2070281
MISM02.4-Trace Metals	A3040267
MISM02.4-Metals ICPMS	A3040266

Document Title	Document Control Number
MISM02.4-Mercury in Soil	A3040264
MISM02.4-Mercury in Water	A3040265
General Chemistry SOPs	
M1010A-Flash Point	A2040041
M1110-Corrosivity	A2040043
M1311-TCLP	A2040044
MSM2540B/160.4&SM2540G-Total Solids and Total Volatile Solids	A2040046
M180.1-Turbidity	A2040048
M300.0-Inorganic Anions	A2040050
M3060A/7196A-Hexavalent Chromium	A2040051
MSM3500-Cr B-Hexavalent Chromium	A2040058
M365.3/SM4500-P E,B5	A2040061
MSM5210B-BOD&CBOD	A2040063
MSM4500-Cl G-Residual Chlorine	A2040065
MSM4500-SO4 E-Sulfate	A2040067
M9010C-Total, Ammenable & Reactive Cyanide	A2040077
M9040C-pH	A2040081
M9045C-pH	A2040082
M9060/A-TOC	A2040083
MAVS	A2040087
MLloyd Kahn TOC	A2040088
M120.1-Conductivity	A2070007
MSM2150B-Odor	A2070021
MSM2320B-Alkalinity	A0010001
MSM2120B-Color	A2070020
M5220C/D-COD	A2070010
MSM4500-H B-pH	A2070045
M5540C-MBAS	A2070048

Document Title	Document Control Number
M9041A-pH	A2070049
M9056/A-Inorganic Anions	A2070050
M9065-Phenolics	A2070051
M9071B-Oil&Grease	A2070053
M9080-Cation Exchange	A2070054
M9081-Cation Exchange	A2070055
M9095A/B-Free Liquids	A2070056
M-Percent Solids	A2070004
M1312-SPLP	A2070068
M1664A-Oil&Grease	A2040047
MSM4500-NH3 B,G/H-Ammonia	A2040057
M9012A/B-Total, Ammenable & Reactive Cyanide	A2070088
M9030B-Sulfide	A2070070
M9050A-Conductivity	A2070090
M1030-Ignitability	A2070064A
M9034/SM4500-S F-Sulfide	A2070069
M420.1-Phenolics	A2070106
M1498-REDOX Potential	A2070089
M9038-Sulfate	A2070134
MILM05.4CN-Cyanide	A2070154
M-Percent Solids (ILM05.4)	A2070157
MASTM D1037-92-Acidity	A2070161
MISM02.4-Cyanide	A3040263
M-Percent Solids (ISM02.4)	A3040268
MSM2130B-Turbidity	A2070159
MSM2510B-Conductivity	A2070164
MSM2540C-Total Dissolved Solids	A2070173
MSM2540D-Total Suspended Solids	A2070172

Document Title	Document Control Number
MSM2540F-Settleable Solids	A2070174
MSM2550B-Temperature	A2070160
MSM4500-Cl C, E-Chloride	A2070162
MSM4500-CN C,E-Cyanide	A2070168
MSM4500-CN C,G-Amenable Cyanide	A2070169
MSM4500-O C-Dissolved Oxygen	A2070165
MSM4500-O G-Dissolved Oxygen	A2070166
MSM4500-SO3 B-Sulfite	A2070175
MSM4500-NO2 B-Nitrite	A2070163
MSM4500-NOrg B or C-TKN	A2070176
M9013-Cyanide Distillation	A2070171
M9031-Sulfide	A2070177
MHACH8146-Ferrous Iron	A2070193
MHACH8110-Formaldehyde	A2070190
MSM5310C-TOC	A2070167
M9014-Reactive Cyanide	A2070069A
MSM4500-CO2 C-Carbon Dioxide	A2070199
MSM2520B-Salinity	A2070254
MSM1500-KMnO4-Potassium Permanganate	A2070255
MLOI-Loss on Ignition	A2070280
MISM01.2-Cyanide	A2070202
MISM01.3-Cyanide	A2070289
J.21-Nitrocellulose	A2070213

28. NELAC Certificate and Parameter List

Current certificates and certified scopes available upon request

Appendix E

Community Air Monitoring Plan

GEI Consultants

Consulting
Engineers and
Scientists

Community Air Monitoring Plan

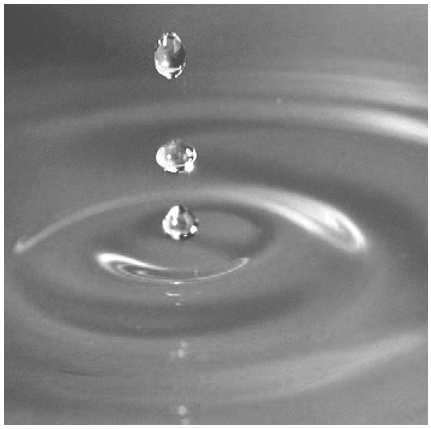
Hunts Point Parcel D
Property Located directly to the north of 400 Food Center Drive (Block 2781, Lot 500), Bronx, NY 10474

Prepared For:
New York City Economic Development Corporation
110 William Street
New York, NY 10038

Submitted by:
GEI Consultants, Inc., P.C.
1385 Broadway
20th Floor
New York, NY 10018
(212)-687-8282

October 2018

Project No. 1705341



Community Air Monitoring Plan

1.1 Introduction

The purpose of the Community Air Monitoring Plan (CAMP) is to provide a measure of protection for the downwind community (i.e., off-site receptors including businesses and off-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. During all ground intrusive activities at the Site, continuous real-time air monitoring for particulates, Volatile Organic Compounds (VOCs), Hydrogen Sulfide (H_2S), and Hydrogen Cyanide (HCN) will be conducted. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting, and the installation of soil borings or monitoring wells.

1.2 VOC, H_2S, HCN and Monitoring, Response Levels, and Actions

VOCs, H_2S, and HCN will be monitored at one location on the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during all ground intrusive activities. Upwind concentrations will be measured continuously at one location to establish background conditions. Monitoring locations will be adjusted if wind direction changes. Monitoring will be conducted using a MultiRAE Pro configured to monitor for VOCs, H_2S, and HCN at each upwind and downwind monitoring station. The equipment will be calibrated at least daily for the contaminants of concern. Each MultiRAE Pro will be set to record 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for VOCs or H_2S or 3 ppm above background for HCN for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the level readily decreases (per instantaneous readings) below 5 ppm over background for VOCs or H_2S or 3 ppm over background for HCN, work activities can resume with continued monitoring.
2. If levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background for VOCs and H_2S or 3 ppm over background for HCN but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities 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 commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for VOCs and H_2S or 3 ppm over background for HCN for the 15-minute average.

3. If the VOCs, H_2S, or HCN level is above 25 ppm at the perimeter of the work area, activities will be shutdown.
4. All 15-minute readings will be recorded. Instantaneous readings, if any, used for decision purposes will also be recorded.

1.3 Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at one upwind location and two downwind locations around the perimeter of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using a DustTrak II, a real-time monitoring device capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

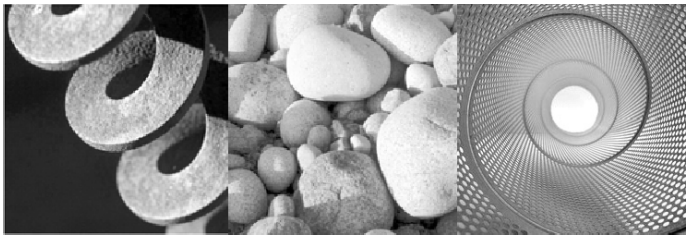
1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 $\mu g/m^3$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/m3 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/m3 of the upwind level and in preventing visible dust migration.

3. All 15-minute readings will be recorded. Instantaneous readings, if any, used for decision purposes will also be recorded.

Appendix F

Health and Safety Plan



GEI Consultants

Consulting
Engineers and
Scientists

Health and Safety Plan

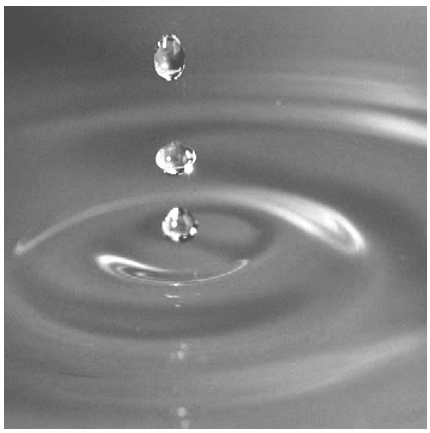
Hunts Point Food Distribution Center – Site D
Food Center Drive
Bronx, New York

Prepared For:
New York City Economic Development Corporation
110 William Street
New York, New York 10038

Submitted by:
GEI Consultants, Inc, P.C.
1385 Broadway, 20th Floor
New York, New York 10018

October 2018

GEI Project No. 1705431



Kevin McCarty
Senior Consultant

Lesley Gastwirth
Regional Health and Safety Officer

Table of Contents

Tables

Appendices

1. Emergency Contact Information

Table 1. Emergency Information

Important Phone Numbers		Directions to Hospital
Local Police:	911	To Hospital (3.31 mi, ~ 11 min): 1. Head northwest on Food Center Drive towards Halleck St (0.5 mi) 2. Turn right onto Halleck St (0.2 mi). 3. Turn left onto Randall Ave (0.7 mi). 4. Randall Ave becomes Laggett Ave (0.4 mi). 5. Turn left onto Southern Blvd (0.3 mi). 6. Take the 2nd right onto E 149th St (1.2 mi). 7. Make a U-turn at Park Ave onto E 149th St (0.08 mi). 8. Hospital is on the right. To Occupational Clinic (2.48 mi, ~ 8 min): 1. Head northwest on Food Center Rd towards Halleck St (0.5 mi). 2. Turn right onto Halleck St (0.5 mi). 3. Slight left onto Edgewater Rd (0.5 mi). 4. Turn right onto Bruckner Blvd (0.1 mi). 5. Take the 1st left onto Bronx River Ave (0.4 mi). 6. Turn right onto Westchester Ave (0.5 mi). 7. Medcare Urgent Care is on the left.
Fire Department:	911	
Ambulance:	911	
State Police or County Sheriff:	911	
Lincoln Medical Center: 234 E 149th St Bronx, NY 10451	(718) 579-5000	
Medcare Urgent Care-Walk In: 1643 Westchester Avenue Bronx, NY 10472	(718) 328-1900	
Project Manager: Kevin McCarty	(212) 845-9965 office (917) 510-5147 cell	
Corporate Health and Safety Officer : Steven Hawkins	(860) 368-5348 office (860) 916-4167 cell	
Regional Health and Safety Officer Lesley Gastwirth	404.592.0050 office 404.667.7444 cell	
Client Contact: Kevin McCarty	(212) 440-6714 office (917) 510-5147 cell	
Nearest Telephone Location: On-site cellular		

2. Background Information

2.1 General

Engineer GEI Consultants, Inc. (GEI)
1385 Broadway, 20th Floor
New York, New York 10018

Project Name Hunts Point – Site D
Food Center Drive
Bronx, New York 10474

This Health and Safety Plan (HASP) establishes policies and procedures to protect GEI personnel from the potential hazards posed by the activities at the Site D parcel of the Hunts Point Food Distribution Center located north of the Krasdale Foods Inc Distribution Center at 400 Food Center Drive, Bronx, New York. GEI is working in partnership with the New York City Economic Development Corporation (NYCEDC) as the Remedial Team for the cleanup of Hunts Point Site D. Reading of the HASP is required of on-site GEI personnel and will be reviewed by GEI subcontractors.

Subcontractors will prepare their own Site-specific HASP and may use this as a guide. The plan identifies measures to minimize accidents and injuries, which may result from project activities or during adverse weather conditions. A copy of this HASP will be maintained on site for the duration of the work.

Included in Section 1 and Appendix A is a route to the nearest medical facility from the Site with directions and contact information. Safety data sheets (formerly known as Material Safety Data Sheets [MSDS]), specific to chemicals that may be encountered while working at the Site, are in Appendix B. Appendix C details the signs, symptoms, care and procedures to both heat and cold stress. Appendix D includes the Tailgate Safety Briefing form, the Project Safety Briefing form, the Accident/Incident Report Form and the Near Miss Reporting Form. Appendix E contains the GEI Health and Safety (H&S) Standard Operating Procedures (SOPs) that apply to this project.

2.2 Project Description

This plan is written to cover operations to be performed as part of the in-situ stabilization (ISS) treatability study which involves the delineation of soil and groundwater impacts from purifier waste material that was stockpiled on site during manufactured gas plant (MGP) operations from the early 1900s to the 1960s. The Site D parcel is adjacent to the main

property used for the production of manufactured gas, and purifier waste. Additionally, a historic bulkhead traverses the site, and its extents are unknown at the time of this plan.

Proposed investigation activities at the site include installing soil borings and groundwater wells for the collection of purifier waste and soil and groundwater samples for analytical tests and ISS treatability bench scale tests. Borings will be performed across the entire wooded Site D parcel. Bench scale tests will be performed on samples from both locations.

The following tasks are planned and are covered by this Site Safety Plan:

- Soil borings;
- Soil and waste sampling;
- Monitoring well sampling;
- Groundwater sampling;
- Pumping tests;
- ISS field activities;
- Test pit excavation;
- Other as applicable.

2.3 Site Description

The Site (Parcel D) is located in a commercial and industrial area on the northeastern portion of the Hunts Point former MGP in the Borough of Bronx, New York City, Bronx County, New York (Figure 1). The property is approximately 7.2-acres, set along the waterfront at the confluence of the Bronx and East Rivers. A single small structure exists on the Site which is a Con Ed gas metering station that sits on an easement that traverses the northern portion of the Site from the water's edge to the western boundary. The remainder of the parcel is an unimproved vacant lot over grown with vegetation. The Site is bounded by a rail line immediately along the western edge and Food Center Drive just beyond the rail corridor, Chef's Warehouse to the north, Krasdale Food to the south, and the Bronx River to the east and is currently zoned M3-1 (manufacturing). M3 zoning districts are designated for areas with heavy industries that generate noise, traffic, or pollutants. Typical uses include power plants, solid waste transfer facilities and recycling plants, and fuel supply depots (New York City Department of City Planning 2013 – NYC.gov).

3. Statement of Safety and Health Policy

GEI is committed to providing a safe and healthy work environment for its employees. To maintain a safe work environment, GEI has established an organizational structure and a Corporate Health and Safety Program to promote the following objectives:

- Reduce the risk of injury, illness, and loss of life to GEI employees.
- Maintain compliance with federal, state, and other applicable safety regulations; and minimize GEI employees' work exposure to potential physical, chemical, biological, and radiological hazards.

Safety policy and procedure on any one project cannot be administered, implemented, monitored, and enforced by any one individual. The total objective of a safe, accident free work environment can only be accomplished by a dedicated, concerted effort by every individual involved with the project from management down to all employees.

Each GEI employee must understand their value to the company; the costs of accidents, both monetary, physical, and emotional; the objective of the safety policy and procedures; the safety rules that apply to the safety policy and procedures; and what their individual role is in administering, implementing, monitoring, and compliance of their safety policy and procedures. This allows for a more personal approach to compliance through planning, training, understanding, and cooperative effort, rather than by strict enforcement. If for any reason an unsafe act persists, strict enforcement will be implemented.

4. Hazard/Risk Analysis

The potential hazards associated with site conditions and activity hazards related to GEI on-site activities have been identified in this section.

4.1 Special Site Conditions or Concerns

- Chemical/Contaminant Exposure – purifier waste and MGP-related constituents
- Traffic – The majority of traffic on the project site will be construction traffic and logging traffic. Food Center Drive is an extremely busy roadway, located west of the site.
- Drill Rig/Equipment – Drilling contractor will use direct push or rotosonic drill rigs. Specific attention given to rotating equipment, pinch points, and overhead equipment.
- Cold Stress/Heat Stress – depends on time of year
- Bio hazards (insect bites, poison ivy, etc.).
- Inclement weather/hazardous winter conditions – Cold stress, slippery surfaces, and icy conditions are possible dangers.
- Utilities – Large utilities along Food Center Drive and north of the site on the Dairyland property (Con Edison gas lines).

Safety equipment will include: First aid kit, fire extinguisher, eye wash bottles, adequate supply of drinking water and electrolyte fluids, hand cleaner, insect repellent, sunscreen, and cell phone.

4.2 Activity Hazard Analysis

The potential hazards for this project associated with site conditions and activity hazards associated with GEI on-site activities have been identified in Table 2. General hazards and control measures that are applicable to all site activities are identified in the General Hazards section. The site-specific tasks, potential hazards, and control measures established to reduce the risk of injury or illness are identified in the Activity Hazard section of Table 2. Health and Safety SOPs for routine hazards and common site conditions are referenced in the table below and included in Appendix E.

Table 2. Activity Hazard Analysis

General Hazards These Hazards Apply to All Site Activities	Control Measure
Chemical / Contaminant Exposure – Skin and eye injury/irritation	• Wear protective coveralls (e.g. Tyvek ®) with shoe covers, safety glasses, face shield, Nitrile gloves. • Dispose of gloves after use and wash hands. • Avoid contact with pooled liquids and limit contact with contaminated soils/groundwater. • See SOP HS-009
Cold Stress – Hypothermia, Frostbite	• Take breaks in heated shelters when working in extremely cold temperatures. • Drink warm liquids to reduce the susceptibility to cold stress. • Wear protective clothing (recommended three layers: an outside layer to break the wind, a middle layer to provide insulation, and an inner layer of cotton of synthetic weave to allow ventilation). • Wear a hat and insulated boots. • Keep a change of dry clothing available in case clothes become wet. • Do heavy work during the warmer parts of the day and take breaks from the cold. • If possible shield work areas from drafts of wind and use insulating material on equipment handles when temperatures are below 30°F • Watch for symptoms of cold stress. (see Appendix C in HASP)
Dusty Conditions – Eye and respiratory irritation	• Avoid travel at extreme times • Wear protective gear – dust masks, safety glasses
Heat stress – Fainting, Fatigue, Heat Stroke	• Increase water intake while working. • Increase number of rest breaks and/or rotate workers in shorter work shifts. Rest in cool, dry areas. • Watch for signs and symptoms of heat exhaustion and fatigue. • Plan work for early morning or evening during hot months. • Use ice vests when necessary. • In the event of heat stroke, bring the victim to a cool environment and initiate first aid procedures. • See Appendix C of the HASP
Inclement Weather	• Listen to local forecasts for warnings about specific weather hazards such as tornados, thunder storms, and flash floods. • If the storms produce thunder and/or lightning, leave the work area immediately and move to a safe area. • Discuss an action plan prior to the severe weather. • Wear appropriate PPE for the type of weather that could be encountered. • Stop work until conditions are suitable. Take cover in vehicles or shelter as appropriate. • See SOP HS-010

General Hazards These Hazards Apply to All Site Activities	Control Measure
Insects – Bites, Stings, Allergic Reactions	• Apply insect repellent prior to performing field work and as often as needed throughout the work shift • Wear proper protective clothing (work boots, socks and light colored clothing) • Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk). • When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible • Field personnel who may have insect allergies should have bee sting allergy medication on site and should provide this information to the SSO and the CHSO prior to commencing work. • Field personnel should perform a self-check at the end of the day for ticks. • See SOP HS-001
Physical Injury – Slips, Trips and Falls	• Wear PPE that properly fits, is in good condition and appropriate for the activities and hazards. • Maintain good visibility of the work area. • Avoid walking on uneven, steeply sloped or debris ridden ground surfaces. • Plan tasks prior to preforming them including an activity hazard analysis. • Keep trafficked areas free from slip/trip/fall hazards. • Maintain weed growth in sampling areas, especially on slopes. • Wear shoes with traction. • Avoid traversing steep areas in slippery conditions. • Do not carry heavy objects to sampling areas, on steeply sloped areas, or where steep areas must be traversed to arrive at sample points.
Utilities – Shock, Electrocution, Fire, Explosion	• A thorough underground utility survey must be conducted prior to intrusive activities. Coordination with utility locating services, property owner(s) or utility companies must be conducted. • Utilities are to be considered live or active until documented otherwise. • For overhead utilities within 50 feet, determine with the utility company the appropriate distance. Minimum distance for clearance is based on voltage of the line. • If exposing a utility, proper support and protection must be provided so that the utility will not be damaged. • If a gas line is contacted, the contractor must notify police, fire, and emergency personnel, and evacuate employees according to the site evacuation procedures. No attempt should be made to tamper with or correct the damaged utility. • See SOP HS-014

General Hazards These Hazards Apply to All Site Activities	Control Measure
Vehicular Traffic – Struck by injury, crushing	• Increase visibility of the work area to others by using cones, flags, barricades, proper lighting and caution tape to define work area. • Use a "spotter" to locate oncoming vehicles. • Use vehicle to block work area. • Engage police detail for all work conducted in appropriate areas. • Wear high-visibility, reflective vest at all times. • Maintain minimum DOT defined distances to other traffic lanes. • See SOP HS-016.

Activity	Potential Hazard	Control Measures
Construction Site Entry	Struck-by, caught-in-between equipment, crushing, pinch points	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or (electrical hazard) EH-rated safety boots with composite toe and shank; safety glasses; nitrile/neoprene gloves; and earplugs. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Wear a high-visibility, reflective vest when working near equipment or motor vehicle traffic. • Position yourself in a safe location when filling out logs talking with the contractor. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation. • See HS-018
Cutting Cores	Cuts/lacerations	• Use care when cutting cores. Use mechanical shears, electric knife or self-retracting safety blade when handling cores. • Eliminate hazard by having the drillers open the cores for you. • When using cutting tools, follow the safety precautions listed below: • Keep free hand out of the way. • Secure work if cutting through thick material. • Use only sharp blades; dull blades require more force that results in less knife control. • Pull the knife through the object; pulling motions are easier to manage. • Do not put the knife in your pocket. • Wear leather or Kevlar® gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

Activity	Potential Hazard	Control Measures
Dense Non-Aqueous Phase Liquid (DNAPL) Recovery	Contaminant Exposure, Repetition, Slips/Trips/Falls	• Wear proper PPE during sampling including Tyvek or Tyvek apron with sleeves, Nitrile gloves, and face shield/safety glasses. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
Drilling Oversight/ Sampling/ Well Installation	Contaminant Exposure, Noise, Contact with Utilities, Cuts/Scrapes, Heavy Lifting, Repetition, Slips/Trips/Falls	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses; Nitrile/neoprene gloves; and earplugs. • Confirm utility locate has been completed. • Confirm adequate clearance from overhead utilities. • Dispose of gloves after use and wash hands. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.
Drum Handling	Contaminant Contact • Cuts or Abrasions Heavy Lifting , Slips/Trips/Falls	• Wear proper PPE during sampling including nitrile gloves and safety glasses and face shield as appropriate. • Use proper dollies or drum moving tools. • Use applicable tools to open/close drum lids. • Do not handle drums with bulging sides. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Use proper lifting techniques. • Ask fellow worker for help. • Keep trafficked areas free from slip/trip/fall hazards. • See SOP HS-003
Excavation and Test Pit Oversight	Crushing, entrapment, falls, fire/explosion	• Prior to excavating, determine utility locations and have locations marked by utility companies and the property owner. • Utilities shall be properly supported and barriers should be erected around excavations in remote areas. • Backfill temporary excavations when work is completed. • Personnel must remain 2 feet from the face of the excavation. • Sides, slopes, and faces shall meet OSHA requirements. • Excavation entry will be allowed only with proper sloping or shoring. • See SOP HS-006
Groundwater Sampling/ Pump Test/ Hydraulic conductivity Test	Contaminant Exposure, Heavy Lifting, Repetition, Slips/Trips/Falls	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses and Nitrile/neoprene gloves. • Dispose of gloves after use and wash hands. • User proper lifting techniques. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.

Activity	Potential Hazard	Control Measures
Heavy Equipment – Working Near	Struck-by, caught-in-between equipment, crushing, pinch points	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or (electrical hazard) EH-rated safety boots with composite toe and shank; safety glasses; nitrile/neoprene gloves; and earplugs. • Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. • Coordinate hand signals with operators. • Stay Alert! Pay attention to equipment backup alarms and swing radii. • Wear a high-visibility, reflective vest when working near equipment or motor vehicle traffic. • Position yourself in a safe location when filling out logs talking with the contractor. • Notify the contractor immediately if any problems arise. • Do not stand or sit under suspended loads or near any pressurized equipment lines. • Do not operate cellular telephones in the vicinity of heavy equipment operation. • See SOP HS-018
Heavy Lifting	Back injury, knee injury	• Use proper lifting techniques. • Ask fellow worker for help. • Use a mechanical lifting device or a lifting aid where appropriate. • If you must lift, plan the lift before doing it. • Check your route for clearance. • Bend at the knees and use leg muscles when lifting. • Use the buddy system when lifting heavy or awkward objects. • Do not twist your body while lifting. • See SOP HS-025
Managing MGP Purifier Waste	Contaminant exposure	• Purifier waste is a mix of wood shavings and iron oxide used to adsorb sulfur and cyanide compounds. MGP tar may be present in purifier waste. The waste was typically burned to reduce its volume for disposal, so it may have a burnt odor. • Purifier waste contains high concentrations of sulfur and cyanide. It may evolve hydrogen cyanide gas, or turn bright blue due to oxidation of cyanide compounds. • Work in well ventilated spaces and use gloves when handling this waste material. • Monitor for hydrogen cyanide with an appropriate gas meter in the breathing zone when working with purifier waste.
Soil Sampling/Soil Vapor Sampling	Contaminant Exposure, Cuts/Scrapes, Heavy Lifting, Repetition, Slips/Trips/Falls	• Wear hardhat; high visibility reflective safety vest; steel-toed, steel-shank boots or composite toe and shank; safety glasses; Nitrile/neoprene gloves; and earplugs as necessary. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Excavation entry will be allowed only with proper sloping or shoring. • Take regular breaks and do not work in unusual positions for long periods of time. • Keep trafficked areas free from slip/trip/fall hazards.

Activity	Potential Hazard	Control Measures
Waste Characterization	Contaminant Contact • Wear proper PPE during sampling including nitrile gloves and safety glasses. Cuts or Abrasions, Slips/Trips/Falls	• Wear proper PPE during sampling including nitrile gloves and safety glasses. • Dispose of gloves after use and wash hands. • Wear work gloves over nitrile gloves. • Keep trafficked areas free from slip/trip/fall hazards.

Personal Protective Equipment (PPE) is the initial level of protection based on the activity hazards and Site conditions which have been identified. Upgrades to respiratory protection may be required based on the designated Action Levels found in Section 9. General on-site provisions will include: extra nitrile, leather, and/or Kevlar gloves, extra protective coveralls (e.g. Tyvek®) with boot covers, drinking water and electrolyte fluids, reflective vest, first aid kit, fire extinguisher, hearing protection, and washing facilities.

If Site conditions suggest the existence of a situation more hazardous than anticipated, the Site personnel will evacuate the immediate area. The hazard, the level of precautions, and the PPE will then be reevaluated with the assistance and approval of the CHSO and the Project Manager (PM).

4.2.1 Handling Drums and Containers

Regulations for handling drums and containers are specified by Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.120(j). Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury. Handling of drums/containers during the Site investigation and remediation activities may be necessary. If drum/container handling is necessary, it will be performed in accordance with applicable regulations.

4.2.2 Utility Hazards

The Site may have shallow, buried utilities and also overhead utilities in certain areas. It will be necessary for parties disturbing the existing ground surface and conducting operations with heavy equipment having high clearances to exercise caution in performing project-related work with respect to the presence of utilities. Utility companies with active, buried lines in the Site area will be asked by the Contractor performing intrusive activities to mark their facilities. Employees will use these data to choose work locations.

4.2.2.1 Underground Utilities

No excavating, drilling, boring, or other intrusive activities will be performed until an underground utility survey, conducted by knowledgeable persons or agencies, has been made. This survey will identify underground and in-workplace utilities such as the following:

- Electrical lines and appliances;
- Telephone lines;
- Cable television lines;
- Gas lines;
- Pipelines;
- Steam lines;
- Water lines;
- Sewer lines; and/or
- Pressurized air lines.

The location of utilities will be discussed with GEI employees and subcontractors during a Site Safety Briefing. Identified utilities should be marked or access otherwise restricted to avoid chance of accidental contact.

Even when a utility search has been completed, drilling, boring, and excavation should commence with caution until advanced beyond the depth at which such utilities are usually located. Utilities will be considered “live” or active until reliable sources demonstrate otherwise.

4.2.2.2 Overhead Utilities

Overhead transmission and distribution lines will be carried on towers and poles which provide adequate safety clearance over roadways and structures. Clearances will be adequate for the safe movement of vehicles and for the operation of construction equipment.

Overhead or above-ground electric lines should be considered active until a reliable source has documented them to be otherwise. Elevated work platforms, ladders, scaffolding, man-lifts, and drill or vehicle superstructures will be erected a minimum of 20 feet (the actual distance is dependent upon the voltage of the line) from overhead electrical lines until the line is de-energized, grounded, or shielded so arcing cannot occur between the work location or superstructure.

4.2.3 Excavations and Trenches

The safety requirements for excavations and trenches must be determined by a competent person who is capable of identifying existing and predictable hazards and work conditions that are unsanitary, hazardous, or dangerous to GEI employees. The competent person must also have the authorization to take prompt corrective measures to eliminate unsatisfactory conditions. GEI employees will not enter trenches.

The following are general requirements for work activities in and around excavations:

- Prior to initiation of excavation activity (or ground intrusive activity, such as drilling), the location of underground installations will be determined. The New York 811 center will be contacted by the Contractor/Subcontractor a minimum of 72 hours prior to excavation activities. It may also be necessary to temporarily support underground utilities during excavation. When excavations approach the estimated location of underground installations, the exact location of the underground installations will be determined by means that are safe for GEI employees, i.e., hand dig, test pits, etc.
- Excavations should be inspected daily by the excavating company's competent person prior to commencement of work activities. Evidence of cave-ins, slides, sloughing, or surface cracks or excavations will be cause for work to cease until necessary precautions are taken to safeguard employees.
- Excavated and other materials or equipment that could fall or roll into the excavation, and vehicular traffic and heavy equipment will be placed at least 5 feet from the edge of the excavation.
- Excavation operations will cease immediately during hazardous weather conditions such as high winds, heavy rain, lightning, and heavy snow.

Employees will refer to GEI's Excavation Safety SOP for further information.

4.2.4 Fire and Explosion

When conducting excavating activities, the opportunity for encountering fire and explosion hazards exists from contamination in soil and the possibility of free product in underground structures and pipelines. Additionally, the use of diesel-powered excavating equipment could present the possibility of encountering fire and explosion hazards.

4.2.5 Heat Stress

Employees may be exposed to the hazards associated with heat stress when ambient temperatures exceed 70ºF. Employees should increase water intake while working in conditions of high heat. Enough water should be available so that each employee can

consume 1 quart of water per hour. In addition, they should increase number of rest breaks and/or rotate employees in shorter work shifts. Employees should rest in cool, dry, shaded areas for at least 5 minutes. Employees should not wait until they feel sick to cool down. Watch for signs and symptoms of heat exhaustion and fatigue. In the event of heat stroke, bring the victim to a cool environment, call for help, and initiate first aid procedures

The procedures to be followed regarding avoiding heat stress are provided in Appendix C – Heat Stress Guidelines and in GEI's Heat Stress program.

4.2.6 Cold Stress

Employees may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia, as well as slippery surfaces, brittle equipment, and poor judgment. The procedures to be followed regarding avoiding cold stress are provided in Appendix C – Cold Stress Guidelines and in GEI's Cold Stress program.

4.2.7 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, and generators. Employees who will perform suspected or established high noise tasks and operations for short durations (less than 1-hour) will wear hearing protection. If deemed necessary by the SSO, the CHSO will be consulted on the need for additional hearing protection and the need to monitor sound levels for Site activities. Other employees who do not need to be in proximity of the noise should distance themselves from the equipment generating the noise.

4.2.8 Hand and Power Tools

In order to complete the various tasks for the project, personnel may use hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Work gloves, safety glasses, and hard hats will be worn by the operating personnel when using hand and power tools and Ground Fault Circuit Indicator (GFCI)-equipped circuits will be used for power tools.

4.2.9 Slips, Trips, and Falls

Working in and around the Site may pose slip, trip, and fall hazards due to slippery and uneven surfaces. Excavation at the Site may cause uneven footing in trenches and around the soil piles. Steep slope and uneven terrain conditions at the Site are also a primary concern. GEI employees will wear proper foot gear and will employ good work practice and housekeeping procedures to minimize the potential for slips, trips, and falls.

4.2.10 Manual Lifting

Manual lifting of objects and equipment may be required. Failure to follow proper lifting technique can result in back injuries and strains. Employees should use a buddy system and/or power equipment to lift heavy loads whenever possible and should evaluate loads before trying to lift them (i.e., they should be able to easily tip the load and then return it to its original position). Carrying heavy loads with a buddy and proper lifting techniques include: 1) make sure footing is solid; 2) make back straight with no curving or slouching; 3) center body over feet; 4) grasp the object firmly and as close to your body as possible; 5) lift with legs; and 6) turn with your feet, don't twist.

4.2.11 Projectile Objects and Overhead Dangers

Overhead dangers, including but not limited to falling debris and equipment, can occur while operating drill rigs. GEI employees will maintain a minimum distance from large overhead operations and to maintain proper communication with heavy equipment operators and their handlers, should work necessitate their presence beyond the minimum safety distance. Proper PPE will be worn during these types of activities including steel-toed/shank boots, safety vests, and hard hats.

4.2.12 Cuts and Lacerations

The core sampling program may require employees to use powered cutting tools (circular saw or shears) or a hooked knife to cut open the sample liner. Safety box cutters will be utilized for routine operations such as opening boxes of supplies or cutting rope or string. When using cutting tools, follow the safety precautions listed below:

- Keep free hand out of the way.
- Secure work if cutting through thick material.
- Use only sharp blades; dull blades require more force that results in less knife control.
- Pull the knife through the object and away from your body; pulling motions are easier to manage.
- Do not put the knife in your pocket.
- Wear leather or Kevlar® gloves when using knives or blades, or when removing sharp objects caught or dangling in sampling gear.

4.3 Chemical Hazards

The characteristics of compounds at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this HASP should reduce the potential for exposure to the compounds discussed below.

4.3.1 Volatile Organic Chemicals

Volatile organic chemicals (VOCs), such as benzene, toluene, ethyl benzene, and xylene (BTEX) are present as soil and groundwater contaminants, and in some cases chemical components in non-aqueous phase liquids (NAPL) such as oil or tar within soils and abandoned pipelines. These compounds are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. These compounds generally have a depressant effect on the Central Nervous System (CNS), may cause chronic liver and kidney damage, and some are suspected human carcinogens. Benzene is a known human carcinogen. Acute exposure may include headache, dizziness, nausea, and skin and eye irritation. The primary route of exposure to VOCs is through inhalation and therefore respiratory protection is the primary control against exposure to VOCs.

4.3.2 Heavy Metals

Heavy metals such as arsenic, chromium, and mercury have been detected in site samples. Exposure to high concentrations of arsenic can cause dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, and hyper pigmentation of skin. Chronic exposure to arsenic has resulted in lung cancer in humans. Arsenic is regulated by specific OSHA standards. They are 29 CFR 1910.1025/1926.52 and 29 CFR 1910.1018/1926.1118, respectively. These standards include specific requirements for air monitoring, signs and labels, training and medical surveillance.

Exposure to chromium can cause acute symptoms such as irritation of the eyes, nose and throat as well as wheezing and coughing. Chronic effects include nosebleeds, nasal congestion, dermatitis, and loss of sight. Exposure to mercury can cause dizziness, salivation nausea, vomiting, diarrhea, constipation, emotional disturbance, and kidney injury. Chronic exposure to mercury can cause CNS damage.

These metals are at environmental concentrations and are not expected to be at concentrations that exposure symptoms would occur. As with SVOCs, the primary route of exposure is through inhalation of dust particles when soil is disturbed and becomes airborne.

4.3.3 Purifier Waste

There are two typical byproducts which resulted from MGP processes, purifier waste and coal tar. Manufactured gas had to be cooled, purified, and a number of other impurities had to be removed prior to use. Sulfur and cyanide compounds were removed by passing the gas through "purifier beds" made up of either lime or wood chips permeated with iron filings. The beds of purifier material would eventually load up with tar and other materials and become unusable. Purifier waste is typically found as a dark mixture of wood chips with a strong burnt odor. Once exposed at the ground surface, the waste often developed an iridescent blue color known as "Prussian Blue."

4.3.3.1 Cyanide

Cyanide compounds are common by-products of manufactured gas production. Hydrogen cyanide is toxic because it is a chemical asphyxiant. It replaces the oxygen in the blood and thereby suffocates the cells. Ferro cyanides are not considered toxic because the hydrogen cyanide ion is bound too tightly to the iron and cannot therefore replace the oxygen. It takes a great amount of heat and/or acid to release cyanide gas from the ferro cyanide molecule; therefore, hydrogen cyanide is not a concern at this Site. However, we plan to monitor for hydrogen cyanide during earth-disturbing activities at sites where MGP-related contaminants have been found.

4.3.4 Coal Tar and Coal Tar Products

Coal tar products, which are semi-volatile organic compounds (SVOCs) consist of a mixture of acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluorethene, benz(a)pyrene, benzo(e)pyrene, benzo(g,h,i)peryline, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3cd)pyrene, 2-methyl naphthalene, naphththalene, phenanthrene, phenols, pyrene.

Some coal tar products and other SVOCs are present at the Site within impacted soil and groundwater and as a dense non-aqueous phase liquid (DNAPL) by-product of gas production within soils, former manufactured gas plant (MGP) structures, and abandoned pipelines.

Coal tar products such as those listed above may cause contact dermatitis. Direct contact can be irritating to the skin and produce itching, burning, swelling, and redness. Direct contact or exposure to the vapors may be irritating to the eyes. Conjunctivitis may result from prolonged exposure. Coal tar is considered to be very toxic, if ingested. High levels of exposure to coal tar, though not anticipated during work activities conducted during this project, may increase the risk of cancer including lung, kidney, and skin cancer. Naphthalene

is also an eye and skin irritant and can cause nausea, headache, fever, anemia, liver damage, vomiting, convulsions, and coma. Poisoning may occur by ingestion of large doses, inhalation, or skin absorption.

The major route of entry for the work activities to be conducted at this Site is through direct contact. Exposure is most likely when handling soil and water samples. Inhalation may occur when the soil is disturbed causing respirable and nuisance dust particles to become airborne.

4.3.5 Evaluation of Organic Vapor Exposure

Air monitoring reduces the risk of overexposure by indicating when action levels have been exceeded and when PPE must be upgraded or changed. Action Levels for VOCs and associated contingency plans for the work zone are discussed within Section 9 of this HASP.

Exposure to organic vapors will be evaluated and/or controlled by:

- Monitoring air concentrations for organic vapors in the breathing zone with a photoionization detector (PID) or a flame ionization detector (FID).
- When possible, engineering control measures will be utilized to suppress the volatile organic vapors. Engineering methods can include utilizing a fan to promote air circulation, utilizing volatile suppressant foam, providing artificial ground cover, or covering up the impacted material with a tarp to mitigate volatile odors.
- When volatile suppression engineering controls are not effective and organic vapor meters indicate concentrations above the action levels, then appropriate respiratory protection (i.e., air purifying respirator with organic vapor cartridge) will be employed.

4.3.6 Evaluation of Skin Contact and Absorption

Skin contact by contaminants may be controlled by use of proper hygiene practices, PPE, and good housekeeping procedures. The proper PPE (e.g., Tyvek®, gloves, safety glasses) as described in Section 5 will be worn for activities where contact with potential contaminated media or materials are expected.

SDSs for decontamination chemicals and laboratory reagents that may be used on Site are included in Appendix B. Specific chemical hazards information from the occupational health sources are summarized in Table 3.

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Hydrogen Cyanide	74-90-8	4.7 ppm (5 mg/m^3) STEL [skin]	10 ppm (11 mg/m^3) [skin]	Inhalation Ingestion Absorption Skin/Eye Contact	Asphyxia; weakness, headache, confusion; nausea, vomiting; increased rate and depth of respiration or respiration slow and gasping; thyroid, blood changes	CNS, CVS, thyroid, blood	Colorless or pale-blue liquid or gas (above 78°F) with a bitter, almond-like odor. VP: 630 mmHg IP: 13.60 eV
Arsenic	7440-38-2	0.01 mg/m3	0.01 mg/m3 A.L. .005mg/m3	Inhalation Skin Absorption Ingestion Skin Contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen	Liver, kidneys, skin, lungs, lymphatic system	Metal: Silver-gray or tin-white, brittle, odorless solid FP: NA IP: NA LEL: NA UEL: NA VP: 0 mm
Benzene	71-43-2	0.5 ppm (Skin)	1 ppm TWA 5 ppm STEL	Inhalation Skin Absorption Ingestion Skin Contact	Irritation of eyes, skin, nose, respiratory system, giddiness, headache, nausea; staggering gait, fatigue, anorexia, weakness, dermatitis, bone marrow depression, potential carcinogen	Eyes, skin, CNS, bone marrow, blood	FP: 12o F IP: 9.24 eve LEL: 1.2% UEL:7.8% VP: 75 mm
Chromium (Chromic Acid and Chromates)	1333-82-0	0.05 mg/m3	0.1 mg/m3	Inhalation Ingestion Skin Contact	Irritates respiratory system, nasal, septum perforation, liver and kidney damage, leucocytosis (increased blood leucocytes), leukopenis (reduced blood leucocytes), moncytosis (increased monocytes), Eosinophilia, eye injury, conjunctivitis, skin ulcer, sensitivity dermatitis, potential carcinongen	Blood, respiratory system, liver, kidney, eyes, skin, lung cancer	FP:NA IP:NA VP: Very Low LEL: NA UEL: NA
Ethylbenzene	100-41-4	100 ppm	100 ppm	Inhalation Ingestion Skin Contact	Eye, skin, mucous membrane irritation; headache; dermatitis, narcosis; coma	Eyes, skin, respiratory system, CNS	FP: 55o F IP: 8.76 eV LEL: 0.8% UEL:6.7% VP: 7 mm
Lead	7439-92-1	0.050 mg/m^3	0.05 mg/m^3 A.L. 0.03 mg/m^3	Inhalation Ingestion Skin Contact	Weakness, insomnia; facial pallor; pale eye, anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis of wrist and ankles; irritated eyes, hypotension	Eyes, GI tract, CNS, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid. FP: N/A IP: N/A LEL: N/A UEL: N/A VP: 0 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data
Mercury	7439-97-6	0.025 mg/m^3	0.10 mg/m^3	Inhalation Skin Absorption Ingestion Skin Contact	Irritated eyes and skin, chest pain, cough, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, fatigue, weakness, stomatitis, salivation, gastrointestinal disturbance, weight loss, proteinuria	Eyes, skin, respiratory tract, CNS	Silver-white, heavy odorless liquid. FP: N/A IP: N/A LEL: N/A UEL: N/A VP: 0.0012 mm
Naphthalene	91-20-3		10 ppm (50 mg/m^3) TWA	Inhalation Skin Absorption Ingestion Skin and/or Eye Contact	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage	Eyes, skin, blood, liver, kidneys, CNS	FP: 174°F IP: 8.12 eV LEL: 0.8% UEL: 6.7% VP: 0.08 mm
PAHs as Coal Tar	65996-93-2	0.2 mg/m^3		10 ppm (50 mg/m^3) TWA	Inhalation, ingestion, skin contact	Respiratory system, CNS, liver, kidneys, skin, bladder, carcinogen	Black or dark brown amorphous residue
Portland Cement	65997-15-1	10 $\mu g/m^3$ (total) TWA 5 $\mu g/m^3$ (resp)	TWA 50 mppcf	Inhalation, Ingestion, Skin and/or Eye Contact	Irritation eyes, skin, nose; cough, expectoration; exertional dyspnea (breathing difficulty), wheezing, chronic bronchitis; dermatitis	Eyes, skin, respiratory system	Gray, odorless powder FP: NA IP: NA LEL: NA UEL: NA VP: 0 mmHg
Toluene	108-88-3	50 ppm	200 ppm	Inhalation Skin Absorption Ingestion Skin Contact	Eye, nose irritation; fatigue, weakness, confusion, euphoria, dizziness, headache; dilated pupils, tearing of eyes; nervousness, muscle fatigue, insomnia, tingling in limbs; dermatitis	Eyes, skin, respiratory system, CNS, liver, kidneys	FP: 40o F IP: 8.82 eV LEL: 1.1% UEL:7.1% VP: 21 mm
VOCs1	NA	0.5 ppm (Skin)	0.5 ppm TWA 2.5 ppm STEL	Inhalation, Skin Absorption, Ingestion, Skin Contact	Irritate eyes and skin; headaches; dizziness; nausea; kidney; liver damage; depress CNS	Skin, eyes, liver, kidney, CNS	Colorless volatile liquid, sometimes with a sweet or solvent odor
Xylene	1330-20-7	100 ppm	100 ppm	Inhalation Skin Absorption Ingestion, Skin Contact	Eye, skin, nose, throat irritation; dizziness, excitement, drowsiness; incoordination, staggering gait; corneal damage; appetite loss, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, Central Nervous System, GI tract, blood, liver, kidneys	FP: 90o F LEL: 0.9% UEL: 6.7% VP: 9 mm

Table 3. Chemical Data

Compound	CAS #	ACGIH TLV	OSHA PEL	Route of Exposure	Symptoms of Exposure	Target Organs	Physical Data

Abbreviations:

°F = degrees Fahrenheit
ACGIH = American Conference of Industrial Hygienists
A.L. = Action Level
atm = atmosphere
C = ceiling limit, not to be exceeded
CAS # = chemical abstract services number
CNS = Central Nervous System
CTPV = Coal Tar Pitch Volatiles
CVS = Cardiovascular System
eV = electron volt
f/cc = fibers per cubic centimeter
FP = Flash point
GI = Gastro-intestinal
H2S = Hydrogen Sulfide
HCN = Hydrogen Cyanide
hr = hour
IP = Ionization Potential
LEL = Lower explosive limit
mg/m^3 = micrograms per cubic meter
min = minute
mm = millimeter
mmHg = millimeters of mercury
N/A = not applicable
OSHA = Occupational Safety and Health Administration
PAH = Polycyclic Aromatic Hydrocarbons
PCB = Polychlorinated Biphenyls
PEL = Permissible exposure limit
ppm = parts per million
Skin = significant route of exposure
STEL = Short-term exposure limit (15 minutes)
TWA = Time-weighted average (8 hours)
VP = vapor pressure approximately 68°F in mm Hg

4.4 Biological Hazards

Areas of the Site may be wooded, surrounded with brush, or landscaped. Therefore, employees working on this project should be aware of the potential biological hazards at this Site. Each is discussed in detail below.

4.4.1 Poisonous Plants

Persons working on the Site should be aware of the possible presence of poisonous plants and insects. Poison ivy is a climbing plant with leaves that consist of three glossy, greenish leaflets. Poison ivy has conspicuous red foliage in the fall. Small yellowish-white flowers appear in May through July at the lower leaf axils of the plant. White berries appear from August through November. Poison ivy is typically found east of the Rockies. Poison oak is similar to poison ivy but its leaves are oak-like in form. Poison oak occurs mainly in the south and southwest. Poison sumac typically occurs as a small tree or shrub and may be 6 to 20 feet in height. The bark is smooth, dark and speckled with darker spots. Poison sumac is typically found in swampy areas and east of the Mississippi. The leaves have 7 to 13 smooth-edged leaflets and drooping clusters of ivory-white berries that appear in August and last through spring.

Poison Oak

Poison Ivy

Poison Sumac

The leaves, roots, stems and fruit of these poisonous plants contain urushiol. Contact with the irritating oil causes an intensely itching skin rash and characteristic, blister-like lesions.

The oil can be transmitted on soot particles when burned and may be carried on the fur of animals, equipment, and apparel.

Proper identification of these plants is the key to preventing contact and subsequent dermatitis. Wear long sleeves and pants when working in wooded areas. In areas of known infestation, wear Tyvek® coveralls and gloves. Oils are easily transferred from one surface to another. If you come in contact with these poisonous plants, wash exposed areas immediately with cool water to remove the oils. Some commercial products such as Tecnu's Poison Oak-n-Ivy Cleanser claim to further help with the removal of oils.

4.4.2 Ticks

4.4.2.1 Lyme Disease

Ticks are bloodsuckers, attaching themselves to warm-blooded vertebrates to feed. Deer ticks are associated with the transmission the bacteria that causes Lyme disease. Female deer ticks are about ¼-inch in length and are black and brick red in color. Males are smaller and all black. If a tick is not removed, or if the tick is allowed to remain for days feeding on human blood, a condition known as tick paralysis can develop. This is due to a neurotoxin, which the tick apparently injects while engorging. This neurotoxin acts upon the spinal cord causing incoordination, weakness, and paralysis.

The early stages of Lyme disease, which can develop within a week to a few weeks of the tick bite, are usually marked by one or more of these signs and symptoms:

- Tiredness
- Chills and fever
- Headache
- Muscle and/or join pain
- Swollen lymph glands
- Characteristic skin rash (i.e. bullseye rash)

4.4.2.2 Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is spread by the American dog tick, the lone-star tick, and the wood tick, all of which like to live in wooded areas and tall, grassy fields. The disease is most common in the spring and summer when these ticks are active, but it can occur anytime during the year when the weather is warm.

Initial signs and symptoms of the disease include sudden onset of fever, headache, and muscle pain, followed by development of a rash. Initial symptoms may include fever, nausea, vomiting, severe headache, muscle pain, and/or lack of appetite.

The rash first appears 2 to 5 days after the onset of fever and is often not present or may be very subtle. Most often it begins as small, flat, pink, non-itchy spots on the wrists, forearms, and ankles. These spots turn pale when pressure is applied and eventually become raised on the skin. Later signs and symptoms include rash, abdominal pain, joint pain, and/or diarrhea.

The characteristic red, spotted rash of Rocky Mountain spotted fever is usually not seen until the 6th day or later after onset of symptoms, and this type of rash occurs in only 35% to 60% of patients with Rocky Mountain spotted fever. The rash involves the palms or soles in as many as 50% to 80% of patients; however, this distribution may not occur until later in the course of the disease.

4.4.2.3 Prevention

Tick season lasts from April through October; peak season is May through July. You can reduce your risk by taking these precautions:

- During outside activities, wear long sleeves and long pants tucked into socks. Wear a hat, and tie hair back.
- Use insecticides to repel or kill ticks. Repellents containing the compound n,n-diethyl-meta-toluamide (DEET) can be used on exposed skin except for the face, but they do not kill ticks and are not 100% effective in discouraging ticks from biting. Products containing permethrin kill ticks, but they cannot be used on the skin -- only on clothing. When using any of these chemicals, follow label directions carefully.
- After outdoor activities, perform a tick check. Check body areas where ticks are commonly found: behind the knees, between the fingers and toes, under the arms, in and behind the ears, and on the neck, hairline, and top of the head. Check places where clothing presses on the skin.
- Remove attached ticks promptly. Removing a tick before it has been attached for more than 24 hours greatly reduces the risk of infection. Use tweezers, and grab as closely to the skin as possible. Do not try to remove ticks by squeezing them, coating them with petroleum jelly, or burning them with a match. Keep ticks in a zip-lock baggie in case testing needs to be performed.
- Report any of the above symptoms and all tick bites to the PM and CHSO for evaluation.

4.4.3 Mosquito- Borne Disease – West Nile Virus

West Nile encephalitis is an infection of the brain caused by the West Nile virus, which is transmitted by infected mosquitoes. Following transmission from an infected mosquito, West Nile virus multiplies in the person's blood system and crosses the blood-brain barrier to reach the brain. The virus interferes with normal CNS functioning and causes inflammation of the brain tissue. However, most infections are mild and symptoms include fever, headache, and body aches. More severe infections may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. Persons over the age of 50 have the highest risk of severe disease.

Prevention centers on public health action to control mosquitoes and on individual action to avoid mosquito bites. To avoid being bitten by the mosquitoes that cause the disease, use the following control measures:

If possible, stay inside between dusk and dark. This is when mosquitoes are most active. When outside (between dusk and dark), wear long pants and long-sleeved shirts. Spray exposed skin with an insect repellent, preferably containing DEET.

4.4.4 Wasps and Bees

Wasps (hornets and yellow-jackets) and bees (honeybees and bumblebees) are common insects that may pose a potential hazard to the field team if work is performed during spring, summer, or fall. Bees normally build their nests in the soil. However, they use other natural holes such as abandoned rodent nests or tree hollows. Wasps make a football-shaped, paper-like nest either below or above the ground. Yellow-jackets tend to build their nests in the ground but hornets tend to build their nests in trees and shrubbery. Bees are generally more mild-mannered than wasps and are less likely to sting. Bees can only sting once while wasps sting multiple times because their stinger is barbless. Wasps sting when they feel threatened. By remaining calm and not annoying wasps by swatting, you lessen the chance of being stung.

Wasps and bees inject a venomous fluid under the skin when they sting. The venom causes a painful swelling that may last for several days. If the stinger is still present, carefully remove it with tweezers. Some people may develop an allergic reaction (i.e. anaphylactic shock) to a wasp or bee sting. If such a reaction develops, seek medical attention at once. If a GEI employee is allergic to bees or wasps notify the SSO and if, needed, the location of the epi pen.

4.4.5 Sun Exposure

Employees are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 15, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should wear safety glasses that offer protection from ultraviolet A and B (UVA/UVB) rays.

5. Personal Protective Equipment

The PPE specified in Table 4 represents PPE selection required by 29 CFR 1910.132, and is based on the Activity Hazard Analysis of Section 4 (Table 2). Specific information on the selection rationale activity can be found in the GEI Health and Safety Manual.

The PPE program addresses elements, such as PPE selection based on Site hazards, use and limitations, donning and doffing procedures, maintenance and storage, decontamination and disposal, training and proper fitting, inspection procedures prior to / during / and after use, evaluation of the effectiveness of the PPE program, and limitations during temperature extremes, heat stress, and other appropriate medical considerations. A summary of PPE for each level of protection is in Table 4.

Table 4. Site-Specific PPE

Task	PPE Level	Site-Specific Requirements	Respirator
Mobilization/Demobilization			
Reconnaissance	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
Mobilization/Demobilization of Equipment and Supplies	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D – None
Establishment of Site Security, Work Zones, and Staging Area	D	Hard hat, safety glasses, steel toe/shank safety boot, reflective vest, leather work gloves, hearing protection as needed	D - None
Construction			
Drilling, Groundwater Well Installation, Pumping Tests, Excavation, Test Pit Excavation, Backfilling, Grading Observation, Sampling	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed	Level D initially, Level C-If action levels exceeded (see Section 9 of HASP)
Hazardous Materials Assessment			
Sampling: Groundwater and Soil, and Purifier Waste	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest, leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed	D - None
Demolition/Remediation Observation			
Observe Contractor Activities	D	Hard hat, safety glasses, steel toe/shank safety boot with overboot as needed, reflective vest,	D - None

		leather work gloves as needed, nitrile gloves, hearing protection as needed, Tyvek as needed	

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the Site and this HASP will be revised with oversight of the CHSO or GEI personnel will not re-enter the Site until conditions allow.

For most work conducted at the site, Level D PPE will include long pants, hard hats, safety glasses with side shields, and steel toe/shank or EH-rated safety boots. When work is conducted in areas where non-aqueous phase liquid (NAPL), purifier waste, or tar-saturated soil is anticipated, employees will wear, at a minimum, modified Level D PPE, which can include Tyvek® coveralls and safety boots with overboots.

5.1 OSHA Requirements for PPE

Personal protective equipment used during the course of this field investigation must meet the following OSHA standards:

Table 5. OSHA Standards for PPE

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1 1968
Respiratory	29 CFR 1910.134	ANSI Z88.1 1980
Head	29 CFR 1910.135	ANSI Z89.1 1969
Foot	29 CFR 1910.136	ANSI Z41.1 1999 or ASTM F-2412-2005, and ASTM F-2413-2005

CRF = Code of Federal Regulations
ANSI = American National Standards Institute
ASTM = American Society for Testing and Materials

On-site GEI personnel who have the potential to don a respirator must have a valid fit test certification and documentation of medical clearance. The CHSO will maintain such information on file for on-site personnel. The PM will obtain such information from the subcontractor's site supervisor prior to the initiation of such work. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency (less than 20.7%).
- Imminent Danger to Life and Health (IDLH) concentrations.
- If contaminant levels exceed designated use concentrations.

6. Key Project Personnel/Responsibilities and Lines of Authority

6.1 GEI Personnel

- Kevin McCarty — Project Manager
- Gary Rozmus — In-House Consultant
- Amber Ahles — Assistant Project Manager
- Jon Williams — Project Engineer
- Andy Adinolfi — Groundwater Model SME
- Richard Crockett — Site Safety Officer
- Stacey Ng — Field Personnel
- Craig Hayes — Field Personnel
- Steven Hawkins — Corporate Health and Safety Officer
- Lesley Gastwirth — Regional Health and Safety Officer

The implementation of health and safety at this project location will be the shared responsibility of the PM, the CHSO, the SSO, other GEI personnel implementing the proposed scope of work.

6.1.1 GEI Project Manager

The PM, Kevin McCarty, is responsible for confirming that the requirements of this HASP are implemented. Some of the PM's specific responsibilities include:

- Conducting and documenting the Project Safety Briefing for GEI project employees and forwarding the signed form (Appendix D) to the Safety Team;
- Verifying that the GEI staff selected to work on this program are sufficiently trained for Site activities;
- Assuring that personnel to whom this HASP applies, including subcontractor personnel, have received a copy of it;
- Providing the CHSO with updated information regarding conditions at the Site and the scope of Site work;
- Providing adequate authority and resources to the on-site SSO to allow for the successful implementation of necessary safety procedures;
- Supporting the decisions made by the SSO and CHSO;

- Maintaining regular communications with the SSO and, if necessary, the CHSO;
- Verifying that the subcontractors selected by GEI to work on this program have completed GEI environmental, health and safety requirements and has been deemed acceptable for the proposed scope of work; and
- Coordinating the activities of GEI subcontractors and confirming that they are aware of the pertinent health and safety requirements for this project.

6.1.2 GEI Corporate Health and Safety Officer

The CHSO, Steven Hawkins, is the individual responsible for the review, interpretation, and modification of this HASP. Modifications to this HASP which may result in less stringent precautions cannot be undertaken by the PM or the SSO without the approval of the CHSO. Specific duties of the CHSO include:

- Writing, approving, and amending the HASP for this project;
- Advising the PM and SSO on matters relating to health and safety on this Site;
- Recommending appropriate PPE and safety equipment to protect personnel from potential Site hazards;
- Conducting accident investigations; and
- Maintaining regular contact with the PM and SSO to evaluate Site conditions and new information which might require modifications to the HASP.

6.1.3 GEI Site Safety Officer

GEI field staff are responsible for implementing the safety requirements specified in this HASP. However, one person will serve as the SSO. For this program Richard Crockett will serve as the SSO. The SSO will be on-site during all activities covered by this HASP. The SSO is responsible for enforcing the requirements of this HASP once work begins. The SSO has the authority to immediately correct situations where noncompliance with this HASP is noted and to immediately stop work in cases where an immediate danger is perceived. Some of the SSO's specific responsibilities include:

- Conducting/attending the Project Safety Briefing prior to beginning work, and subsequent safety meetings as necessary;
- Conduct daily Safety Tailgate meeting (can be combined with "pre-entry") briefing for Site-related work;

- Verifying that personnel to whom this HASP applies have attended and participated in the Project Safety Briefing and subsequent safety meetings that are conducted during the implementation of the program;
- Maintaining a high level of health and safety consciousness among employees implementing the proposed activities;
- Procuring the air monitoring instrumentation required and performing air monitoring for investigative activities;
- Procuring and distributing the PPE and safety equipment needed for this project for GEI employees;
- Verifying that PPE and health and safety equipment used by GEI is in good working order;
- Verifying that the selected contractors are prepared with the correct PPE and safety equipment and supplies;
- Notifying the PM of noncompliance situations and stopping work in the event that an immediate danger situation is perceived;
- Monitoring and controlling the safety performance of personnel within the established restricted areas to confirm that required safety and health procedures are being followed;
- Stopping work in the event that an immediate danger situation is perceived; and
- Reporting accident/incident and preparing accident/incident reports, if necessary.

6.1.4 GEI Field Personnel

GEI field personnel covered by this HASP are responsible for following the health and safety procedures specified in this HASP and for performing their work in a safe and responsible manner. Some of the specific responsibilities of the field personnel are as follows:

- Reading and signing the HASP in its entirety prior to the start of on-site work;
- Attending and actively participating in the required Project Safety Briefing prior to beginning on-site work and any subsequent safety meetings that are conducted during the implementation of the program;
- Stopping work in the event that an immediate danger situation is perceived;
- Bringing forth any questions or concerns regarding the content of the HASP to the PM or the SSO, prior to the start of work;

- Reporting accidents, injuries, and illnesses, regardless of their severity, to the SSO, CHSO, and HR; and
- Complying with the requirements of this HASP and the requests of the SSO.

6.1.5 Lines of Authority will be as follows:

On Site – GEI will have responsibility for safety of its employees during the work performed at the Site D parcel of the Hunts Point Food Distribution Center. GEI's field representative will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. GEI's field representative will be available for communication with the GEI PM and with the EDC and Integral representatives.

GEI employees have the authority to stop work activities if an unanticipated hazard is encountered or a potential unsafe condition is observed. The GEI employee should contact the Corporate Health and Safety Officer and the Project Manager to discuss the stop work conditions and potential control methods that can be implemented.

6.2 Subcontractors

GEI has not finalized the subcontractor list of firms to assist in performing work on this project.

GEI requires its subcontractors to work in a responsible and safe manner. Subcontractors hired by GEI are required to submit documentation of their safety practices as part of GEI's Subcontractor Management Program for evaluation and approval before the start of work. Subcontractors for this project will be required to develop their own HASP for protection of their employees, but, at a minimum, must adhere to applicable requirements set forth in this HASP.

7. Training Program

7.1 HAZWOPER Training

In accordance with OSHA Standard 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response" (HAZWOPER) responders will, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. At a minimum, the training will have consisted of instruction in the topics outlined in the standard. Personnel who have not met the requirements for initial training will not be allowed to work in any Site activities in which they may be exposed to hazards (chemical or physical). Proof of training will be submitted to the PM or his/her representative prior to the start of field activities.

7.2 Annual 8-Hour Refresher Training

Annual 8-hour refresher training will be required of hazardous waste site field personnel in order to maintain their qualifications for fieldwork. The training will cover a review of 29 CFR 1910.120 requirements and related company programs and procedures. Proof of current 8-hour refresher training will be submitted to the PM or his/her representative prior to the start of field activities.

7.3 Supervisor Training

Personnel acting in a supervisory capacity will have received 8 hours of instruction in addition to the initial 40-hour training. In addition, supervisors will have 1 year of field experience and training specific to work activities (i.e., sampling, construction observation, etc.)

7.4 Site-Specific Training

Prior to commencement of field activities, the PM or the SSO will verify GEI field personnel assigned to the project will have completed training that will specifically address the activities, procedures, monitoring, and equipment used in the Site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight the provisions contained within this HASP and applicable GEI H&S SOPs (Appendix E). This training will be documented on the Project Safety Briefing Form Appendix D). The signed form will be forwarded to the Safety Team at SafetyTeam@geiconsultants.com. In addition, GEI personnel will sign the plan to document that they understand the hazards and control measures presented and agree to comply with the procedures established in the HASP. Personnel that have not received project-specific training will not be allowed on-site.

7.5 On-Site Safety Briefings

Other GEI personnel will be given health and safety briefings daily by the SSO or field representative to assist GEI personnel in safely conducting work activities. The briefing will include GEI subcontractors. The briefings can include information on new operations to be conducted, changes in work practices, or changes in the Site's environmental conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. Documentation of these briefings will be recorded in the GEI field book, if the project duration is less than 5 days. If the project is longer than 5 days, the Tailgate Safety Briefing Form (Appendix D) will be used to document briefings. The meetings will also be an opportunity to periodically update the employees on monitoring results.

7.6 First Aid and CPR

The PM will verify that GEI field staff has current certifications in first aid and Cardiopulmonary Resuscitation (CPR), so that emergency medical treatment is available during field activities. The training will be consistent with the requirements of the American Red Cross Association. GEI employees also attend annual Bloodborne Pathogens training in compliance with OSHA regulations.

8. Medical Surveillance Program

GEI maintains a continuous, corporate, medical surveillance program that includes a plan designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. GEI's CHSO is responsible for the administration and coordination of medical evaluations conducted for GEI's employees at branch office locations. Comprehensive examinations are given to GEI field personnel on an annual or biennial basis (as determined to be appropriate by the CHSO) participating in hazardous waste operations. The medical results of the examinations aid in determining the overall fitness of employees participating in field activities.

Under the CHSO's supervision, field personnel undergo a complete initial physical examination, including a detailed medical and occupational history, before they participate in hazardous waste site investigations. Extensive annual/biennial reexaminations are also performed. Upon completion of these tests, personnel are certified by an occupational health physician as to whether they are fit for field work in general, and fit to use respiratory protection.

If a GEI employee or other project worker shows symptoms of exposure to a hazardous substance and wishes to be rechecked, he/she will be directed to the nearest area hospital or medical facility.

GEI subcontractor personnel that will enter any active waste handling or other active non-"clean" area must certify that they are participating in a medical surveillance program that complies with OSHA regulations for hazardous waste operations (i.e., 29 CFR 1910.120 and 29 CFR 1926.65). Proof of medical clearance will be submitted to the GEI PM or SSO prior to the start of field activities.

9. Monitoring

Air monitoring will be performed to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of worker protection needed on-site in the event that intrusive work is conducted. Work requiring air monitoring includes the installation and/or abandonment of test borings and monitoring wells, and intrusive ISS activities.

GEI will conduct CAMP and work zone monitoring for on-site GEI employees during intrusive activities. CAMP monitoring will include upwind and downwind measurement using a PID and combustible gas indicator (CGI) for VOCs, LEL/Oxygen (O_2), hydrogen sulfide (H_2S), and hydrogen cyanide (HCN)) at each boring location. Upon completion of the boring activities for the bench scale work, the CAMP data will be tabulated and presented to NYSDEC. Activities requiring air monitoring will be conducted in accordance with a pre-approved work plan. GEI will monitor and document daily Site conditions and operations and inform field representatives of results. If Action Levels are exceeded, the SSO will immediately implement Site action(s) according to Table 6 below and notify the PM and CHSO.

GEI will provide the following equipment for health and safety monitoring of on-site GEI personnel:

- PID with 10.6 eV lamp or equivalent
- Particulate Meter (PM-10 capable)
- Multi-gas Meter: volatile organic compounds (VOCs) / oxygen ($O_{2)}$ / hydrogen sulfide (H_2S) / hydrogen cyanide (HCN) meter

9.1 Equipment Use

Air monitoring equipment will be calibrated and maintained in accordance with manufacturer's requirements. Calibrations will be recorded in the project notes daily or on a daily calibration form.

9.1.1 Photoionization Detector

Organic vapor concentrations will be measured using a PID during intrusive activities. During intrusive operations, organic vapor concentrations will be measured continuously. Organic vapor concentrations will be measured upwind of the work site(s) to determine

background concentrations at least twice a day, (once in the morning and once in the afternoon). The SSO will interpret monitoring results using professional judgment and according to the alert and Action Limits set forth in the associated Site Work Plan.

9.1.2 Particulate Meter

A particulate meter will be used to measure airborne particulate matter during intrusive activities. Monitoring will be continuous and readings will be averaged over a 15-minute period for comparison with the Action Levels. Monitoring personnel will make a best effort to collect particulate monitoring data from downwind of the intrusive activity. If off-site sources are considered to be the source of the measured dust, upwind readings will also be collected.

9.1.3 Multi-Gas Meter

A multi-meter will be used to monitor for combustible gases and O_2 content in the work zone during intrusive activities. The multi-meter will also be equipped with a PID, H_2S sensor and an HCN sensor. H_2S monitoring will be completed as an average every 15 minutes or, if a sulfur odor is present, monitoring will be continuous. HCN monitoring will be completed as an average every 15 minutes or, if an almond odor is detected, monitoring will be continuous. VOC monitoring will also be completed on a 15-minute average.

The CAMP and work zone air monitoring will be conducted during bench scale and ISS activities. Table 6 provides a summary of real time air monitoring Action Levels and contingency plans for work zone activities. The below Action Levels are determined by halving the Permissible Exposure Limits (PELs) or Threshold Limit Values (TLVs) as set forth by OSHA and the American Conference of Government Industrial Hygienists (ACGIH). O_2 values are based on the maximum use limits of a full face respirator if oxygen were being displaced by a chemical. Site action will take place by the field SSO if sustained measurements are recorded.

Table 6. Real-Time Work Zone Air Monitoring Action Levels

Air Monitoring Instrument	Monitoring Location	Action Level (above background)	Site Action
PID	Work Zone	< 5.0 ppm	Continue working. No respiratory protection is required.
		> 5.0 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, upgrade to Level C.
O_2 Meter	Work Zone	< 20.7%	Stop work, withdraw from work area, ventilate area, notify PM and CHSO.
		> 21.1%	Stop work, withdraw from work area, notify PM and CHSO.
H_2S Meter	Work Zone	< 5.0 ppm	Continue working. No respiratory protection is required.
		> 5.0 ppm	Stop work, cover excavation, withdraw from work area, institute engineering controls, notify PM and CHSO.
HCN Meter	Word Zone	< 3.0 ppm	Continue working. No respiratory protection required.
		> 3.0 ppm	Stop work, cover excavation, withdraw from work area, institute engineering controls, notify PM and CHSO.
Particulate Meter	Work Zone	<100 µg/m^3	Continue working. No respiratory protection required.
		>100 µg/m^3	Implement work practices to reduce/minimize airborne dust generation, e.g., spray/misting of soil with water. Stop and re-evaluate work activities if dust concentration is above 150 µg/$m^{3.}$

10. Site Control Measures

10.1 Site Zones

Site zones are intended to control the potential spread of contamination and to assure that only authorized individuals are permitted into potentially hazardous areas. A three-zone approach will be utilized. It will include an Exclusion Zone (EZ), Contamination Reduction Zone (CRZ) and a Support Zone (SZ). Specific zones will be established on the work site by the Contractor when operations begin for each task requiring such delineation. Maps depicting the zones will be available at the Site.

This project is being conducted under the requirements of 29 CFR 1910.120, and any personnel working in an area where the potential for exposure to Site contaminants exists, will only be allowed access after proper training and medical documentation.

The following will be used for guidance in revising these preliminary zone designations, if necessary.

Support Zone – The SZ is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for medical emergency. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone.

Contamination Reduction Zone – The CRZ is established between the EZ and the SZ. The CRZ contains the contamination reduction corridor and provides an area for decontamination of personnel and portable hand-held equipment, tools and heavy equipment. A personnel decontamination area will be prepared at each exclusion zone. The CRZ will be used for EZ entry and egress in addition to access for heavy equipment and emergency support services.

Exclusion Zone – Activities which may involve exposure to Site contaminants, hazardous materials, and/or conditions should be considered an EZ. This zone will be clearly delineated by cones, tapes, or other means. The Contractor may establish more than one EZ where different levels of protection may be employed or different hazards exist. The size of the EZ will be determined by the Contractor allowing adequate space for the activity to be completed, field members, and emergency equipment.

The Contractor is responsible for constructing, maintaining, and enforcing the zones.

10.2 Buddy System

GEI personnel should be in line-of-site or communication contact with another on-site person. The other on-site person should be aware of his or her role as a "buddy" and be able to provide assistance in the event of an emergency. A copy of this plan will be given to any person acting as a GEI "buddy" for informational purposes.

10.3 Sanitation for Temporary Work Sites

We assume that temporary sanitary facilities including toilets will be available on-site.

10.4 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. Activities planned for the Site are anticipated to occur outside during daylight hours. However, if work is performed after dark, they will be equipped with illumination that meets or exceeds requirements specified in OSHA Standard 29 CFR 1926.56 "Illumination." Employees will not work on sites that are not properly lighted.

10.5 Smoking

Smoking is prohibited at or in the vicinity of hazardous operations or materials. Where smoking is permitted, safe receptacles will be provided for smoking materials.

10.6 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the Site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the Site.

11. Accident Reporting

GEI will report incidents involving GEI personnel or subcontractor personnel, such as: lost time injuries, injuries requiring medical attention, near miss incidents, fires, fatalities, accidents involving the public, chemical spills, vehicle accidents, and property damage. The following steps must be followed when an incident occurs:

1. In life-threatening situations, immediately call 9-1-1.
2. Stop work activity to address any injury, illness, property damage, spill or other emergency.
3. **Immediately** report any incidents to your Supervisor/Project Manager and Regional Health & Safety Officer.
4. If your injury or illness is not life-threatening, call Medcor Triage at 1-800-775-5866 to speak with a medical professional.
5. Complete an Incident Report Form **immediately** after addressing the incident.

For vehicle accidents involving another vehicle or damage to property, the employee will take pictures of each vehicle or property involved in the incident and obtain a police report. In some municipalities police will not be dispatched to a non-injury accident, but every effort needs to be made to try and obtain the report.

The Incident Report Form and the Near Miss Reporting Form can be found in Appendix D, on the GEI Health and Safety smartphone app, or on the Safety page of the GEI Intranet. To report subcontractor injuries or incidents, follow the same verbal reporting procedures and submit an email describing the event to the PM and the Safety Team.

11.1 Injury Triage Service

If a GEI employee experiences a work related injury that is not life-threatening, the employee will initiate a call to Medcor Triage at 1-800-775-5866. The injured employee will detail any medical symptoms or complaints which will be evaluated by a Registered Nurse (RN) specially trained to perform telephonic triage. The RN will recommend first aid self-treatment or refer the injured employee for an off-site medical evaluation by a health professional at a clinic within GEI's workers compensation provider network. GEI employees are still required to follow our Accident Reporting procedures as listed above.

12. Decontamination Procedures

A decontamination pad will be established for personnel decontamination and equipment decontamination during ISS activities.

12.1 Personnel Decontamination Station

A personnel decontamination station where employees can drop equipment and remove PPE will be set up at the decontamination pad by the Contractor. It will be equipped with basins for water and detergent, and trash bag(s), or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a basin/sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.)

The following specific decontamination procedure will be used as necessary by GEI personnel or subcontractor personnel wearing PPE from Level D through Level C.

- ***Step 1 –*** Equipment drop (respirator, tools, monitoring equipment, etc.) Decontaminate as appropriate (per GEI's field representative's instructions).
- ***Step 2 –*** Boot wash/rinse (wash with non-foaming detergent, rinse with fresh water spray). Remove boots. If inner and outer gloves are worn, wash outer gloves, remove and save for later use, or remove and discard outer gloves and place in trash bag/can provided in the decontamination area.
- ***Step 3 –*** Hard hat removal; wash if visibly contaminated (use same wash as in Step 2).
- ***Step 4 –*** If Tyvek® (or equivalent) suit was worn and is visibly contaminated, remove and place in trash bag/can provided in the decontamination area or decontaminate (wash) and store for reuse. Contaminated washable coveralls should be removed and bagged for washing.
- ***Step 5 –*** Respirator and/or eye protection removal (as applicable). Wash (per Step 2) to remove visible contamination.
- ***Step 6 –*** Remove outer gloves.
- ***Step 7 –*** Wash potentially exposed skin (use water and soap at indoor sink).
- ***Step 8 –*** Disinfect respirator per manufacturer's recommendations.

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate containers) and disposed of in an approved facility.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with applicable state and federal regulations.

12.2 Heavy Equipment Decontamination

Heavy equipment decontamination will be performed by the Contractor within the limits of the on-site decontamination pad in accordance with the contract specifications. A steam generator and brushes will be used to clean demolition equipment and other tools. No heavy equipment will be permitted to leave the Site unless it has been thoroughly decontaminated.

Wastewater from the heavy equipment and personnel decontamination areas will be collected and disposed of in accordance with applicable state and federal regulations. The Contractor will be responsible for ultimate disposal of investigation-derived wastes.

12.3 Decontamination Equipment Requirements

The following equipment, if required, should be in sufficient supply to implement decontamination procedures for GEI's equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handled soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol and/or Nitric Acid
- Liquid detergent and paper towels
- Plastic trash bags

The Contractor performing decontamination procedures is responsible for verifying that the above materials, as required for their operation, are in sufficient supply.

13. Supplemental Contingency Plan Procedures

13.1 Hazard Communication Plan

GEI personnel have received hazard communication training as part of their annual health and safety training and new employee health and safety orientation training. Hazardous materials used on the Site will be properly labeled, stored, and handled. SDS will be available to potentially exposed employees.

13.2 Fire

In the event of a fire personnel will evacuate the area. GEI's field representative will contact the local fire department with jurisdiction and report the fire. Notification of evacuation will be made to the PM and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the PM.

13.3 Medical Support

In case of minor injuries, on-site care will be administered with the Site first aid kit. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger. Notify the PM and the CHSO of the emergency.

Section 1 and Table 1 of this HASP contain detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. In addition, Appendix A includes maps to the hospital and/or occupational health clinic. GEI field personnel will carry a cellular telephone.

13.4 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 30 miles per hour (mph), heavy rains or snow squalls, thunderstorms, tornados, and lightning storms. If severe weather is approaching, the decision to evacuate GEI personnel and subcontractor personnel from the Site will be the responsibility of GEI's field representative. Notification of evacuation will be made to the PM and the CHSO. The field representative will account for GEI personnel and subcontractor personnel and report their status to the PM. If safe, work can resume 30 minutes after the last clap of thunder or flash of lightening.

13.5 Spills or Material Release

If a hazardous waste spill or material release occurs, if safe, the SSO or their representative will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS for the material spilled or released;
- Source of the release or spillage of hazardous material;
- An estimate of the quantity released and the rate at which it is being released;
- The direction in which the spill or air release is moving;
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result;
- Potential for fire and/or explosion resulting from the situation; and
- Estimates of area under influence of release.

If the spill or release is determined to be within the on-site emergency response capabilities, the SSO will verify implementation of the necessary remedial action. If the release is beyond the capabilities of the Site personnel, personnel will be evacuated from the immediate area and the local fire department will be contacted. The SSO will notify the PM and the CHSO.

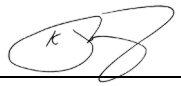
14. Health and Safety Plan Sign-Off

GEI personnel conducting site activities will be familiar with the information in this HASP. After reviewing this plan, please sign the copy in the project files, and bring a copy of the plan with you to the Site. By signing this site-specific HASP you are agreeing that you have read, understand, and will adhere to the provisions described in this plan while working on the Project Site below.

Site Name: Hunts Point – Site D

Investigation: Pre-Design Investigation and Remedial Action

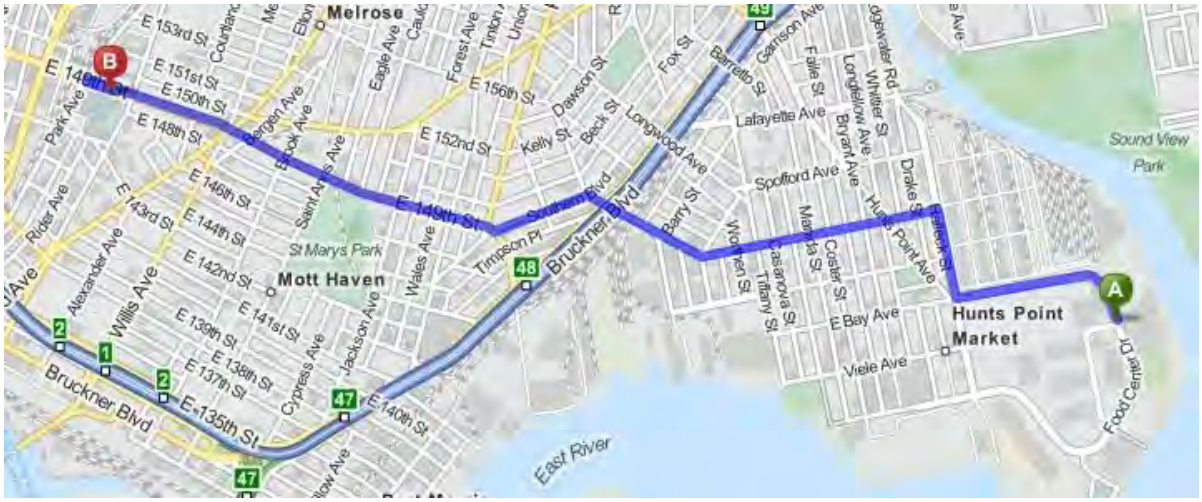
GEI Project No: 1705341

Print Name	Signature
Kevin McCarty	
Project Manager: Kevin McCarty	

Appendix A

Map to Hospital and Occupational Health Clinic

Map to Hospital



A Krasdale Foods Inc

400 Food Center Drive, Bronx, NY 10474

1. Head northwest on Food Center Drive towards Halleck St (0.5 mi)
2. Turn right onto Halleck St (0.2 mi).
3. Turn left onto Randall Ave (0.7 mi).
4. Randall Ave becomes Laggett Ave (0.4 mi).
5. Turn left onto Southern Blvd (0.3 mi).
6. Take the 2nd right onto E 149th St (1.2 mi).
7. Make a U-turn at Park Ave onto E 149th St (0.08 mi).
8. Hospital is on the right.

B Lincoln Medical Hospital

243 E 149th Street, Bronx, NY 10451

Total Mileage: 3.31 miles
Trip Time: 11 minutes

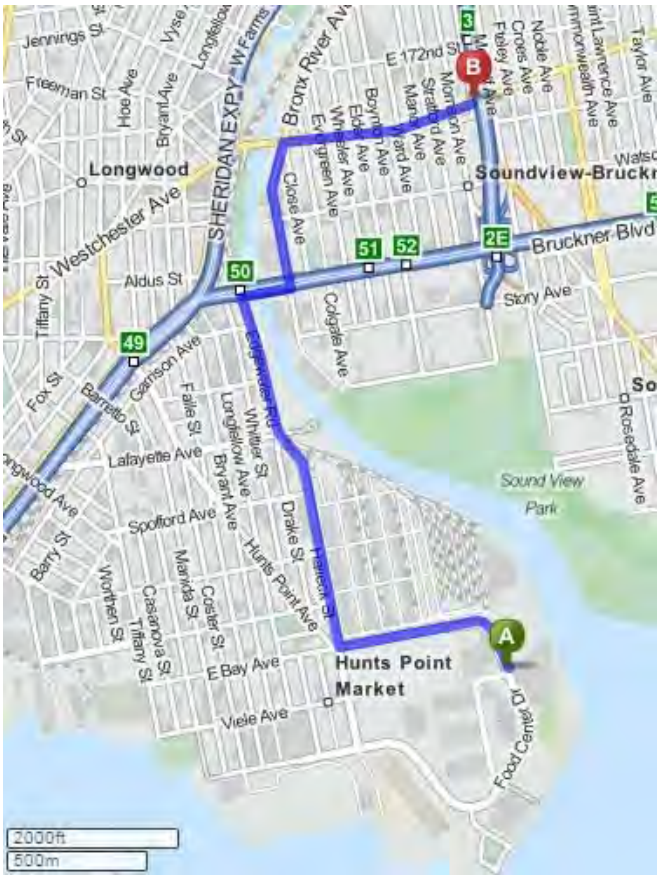
Map to Occupational Health Clinic

A Krasdale Foods Inc
400 Food Center Drive, Bronx, NY 10474

1. Head northwest on Food Center Rd towards Halleck St (0.5 mi).
2. Turn right onto Halleck St (0.5 mi).
3. Slight left onto Edgewater Rd (0.5 mi).
4. Turn right onto Bruckner Blvd (0.1 mi).
5. Take the 1st left onto Bronx River Ave (0.4 mi).
6. Turn right onto Westchester Ave (0.5 mi).
7. Medcare Urgent Care is on the left.

B Medcare Urgent Care-Walk In
1643 Westchester Avenue, Bronx 10472

Total Mileage: 2.48 miles
Trip Time: 8 minutes



Appendix B

Safety Data Sheets

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Liquinox
Synonyms:
Product number: Liquinox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer
Alconox, Inc.
30 Glenn Street
White Plains, NY 10603
1-914-948-4040

Supplier
Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Alcohol ethoxylate
Sodium alkylbenzene sulfonate
Sodium xylenesulphonate
Lauramine oxide

2.2 Label elements:

Eye irritation, category 2A.
Skin irritation, category 2.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P501 Dispose of contents and container as instructed in Section 13.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	10-25
CAS number: 1300-72-7	Sodium Xylenesulphonate	Eye Irrit. 2; H319	2.5-10
CAS number: 84133-50-6	Alcohol Ethoxylate	Skin Irrit. 2 ; H315 Eye Dam. 1; H318	2.5-10
CAS number: 1643-20-5	Lauramine oxide	Skin Irrit. 2 ; H315 Eye Dam. 1; H318	1-2

3.4 Additional Information: None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.

Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.

Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection

8.1 Control parameters :

84133-50-6, Alcohol Ethoxylate, AIHA TWA 10 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.

Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	Pale yellow liquid	**Explosion limit lower:** **Explosion limit upper:**	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C:**	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density:**	Not determined or not available.
pH-value:	8.5 as is	**Relative density:**	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities:**	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water):**	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature:**	Not determined or not available.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

Evaporation rate:	Not determined or not available.	**Decomposition temperature:**	Not determined or not available.
Flammability (solid, gaseous):	Not determined or not available.	**Viscosity:**	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 >5000 mg per kg Rat, Oral) - product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Alcohol Ethoxylate: May cause mild to moderate skin irritation.

Sodium Alkylbenzene Sulfonate: Causes skin irritation.

Lauramine oxide: Causes skin irritation.

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation.

Alcohol Ethoxylate: Causes moderate to severe eye irritation and conjunctivitis.

Sodium xylenesulphonate: Rabbit: irritating to eyes.

Lauramine oxide: Causes serious eye damage.

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Lauramine oxide: Fish, LC0 24.3 mg/l, 96h [Killifish (Cyprinodontidae)]
Lauramine oxide: Aquatic invertebrates, (LC50): 3.6 mg/l 96 hours [Daphnia (Daphnia)].
Lauramine oxide: Aquatic plants, EC50 Algae 0.31 mg/l 72 hours [Algae]
Alcohol Ethoxylate: Aquatic invertebrates, (LC50): 4.01 mg/l 48 hours [Daphnia (daphnia)].

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** None **Label:** None **LTD.QTY:** None
US DOT **Limited Quantity Exception:**	None

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

Bulk:	**Non Bulk:**
RQ (if applicable): None	**RQ (if applicable)**: None
Proper shipping Name: None	**Proper shipping Name**: None
Hazard Class: None	**Hazard Class**: None
Packing Group: None	**Packing Group**: None
Marine Pollutant (if applicable): No	**Marine Pollutant (if applicable)**: No
additional information.	additional information.
Comments: None	**Comments**: None

14.4 Packing group: ADR, ADN, DOT, IMDG, IATA	None
14.5 Environmental hazards :	None
14.6 Special precautions for user:	None
Danger code (Kemler):	None
EMS number:	None
Segregation groups:	None

14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

14.8 Transport/Additional information:

Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as guidance for safe handling,

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 03/10/2016 **Revision** : 03/10/2016

Trade Name: Liquinox

use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

NFPA: 1-0-0

HMIS: 1-0-0

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**
CHEMICAL FAMILY NAME:	Detergent.
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER:	Not Applicable
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada** 800-255-3924
	International calls 813-248-0585
BUSINESS PHONE:	914-948-4040
DATE OF PREPARATION:	May 2011
DATE OF LAST REVISION:	February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS

EUROPEAN and (GHS) Hazard Symbols

Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

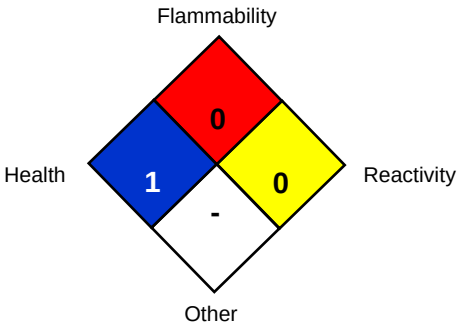
RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT: Not Flammable
AUTOIGNITION TEMPERATURE: Not Applicable
FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS: As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact: Not Sensitive.
Explosion Sensitivity to Static Discharge: Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD (BLUE)	1
FLAMMABILITY HAZARD (RED)	0
PHYSICAL HAZARD (YELLOW)	0

PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: **0** = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.
SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

SAFETY DATA SHEET

Isobutylene

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

SDS # : 001031

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene)

CAS number/other identifiers

CAS number : 115-11-7

Product code : 001031

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Isobutylene	**ACGIH TLV (United States, 3/2015).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state : Gas. [Liquefied compressed gas.]

Color : Colorless.

Molecular weight : 56.12 g/mole

Molecular formula : C4-H8

Boiling/condensation point : -6.9°C (19.6°F)

Melting/freezing point : -140.7°C (-221.3°F)

Critical temperature : 144.75°C (292.6°F)

Odor : Characteristic.

Odor threshold : Not available.

pH : Not available.

Flash point : Closed cup: -76.1°C (-105°F)

Burning time : Not applicable.

Burning rate : Not applicable.

Evaporation rate : Not available.

Flammability (solid, gas) : Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.

Lower and upper explosive (flammable) limits : Lower: 1.8%
Upper: 9.6%

Vapor pressure : 24.3 (psig)

Vapor density : 1.94 (Air = 1)

Specific Volume (ft ^{3}/lb) : 6.6845

Gas Density (lb/ft ^{3}) : 0.1496 (25°C / 77 to °F)

Relative density : Not applicable.

Solubility : Not available.

Solubility in water : 0.263 g/l

Partition coefficient: n-octanol/water : 2.34

Auto-ignition temperature : 465°C (869°F)

Decomposition temperature : Not available.

SADT : Not available.

Section 9. Physical and chemical properties

Viscosity : Not applicable.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Section 11. Toxicological information

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.

Carcinogenicity : No known significant effects or critical hazards.

Mutagenicity : No known significant effects or critical hazards.

Teratogenicity : No known significant effects or critical hazards.

Developmental effects : No known significant effects or critical hazards.

Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Isobutylene	2.34	-	low

Section 12. Ecological information

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: Forbidden. **Cargo aircraft** Quantity limitation: 150 kg **Special provisions** 19, T50	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **Explosive Limit and Limited Quantity Index** 0.125 **ERAP Index** 3000 **Passenger Carrying Ship Index** Forbidden **Passenger Carrying Road or Rail Index** Forbidden **Special provisions** 29	-	-	**Passenger and Cargo Aircraft**Quantity limitation: 0 Forbidden **Cargo Aircraft Only** Quantity limitation: 150 kg

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 14. Transport information

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): This material is listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Isobutylene	100	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

International lists

National inventory

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : This material is listed or exempted.

Malaysia : Not determined.

Section 15. Regulatory information

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Canada

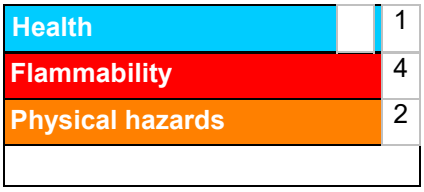
WHMIS (Canada) : Class A: Compressed gas.
Class B-1: Flammable gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.
Class B-1: Flammable gas.

Hazardous Material Information System (U.S.A.)



Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

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

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
Flam. Gas 1, H220 Press. Gas Liq. Gas, H280	Expert judgment Expert judgment

History

Date of printing : 7/11/2016

Date of issue/Date of revision : 7/11/2016

Date of previous issue : No previous validation

Section 16. Other information

Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Safety Data Sheet
H2S Mix CH4

Section 1: Product and Company Identification

SpecAir Specialty Gases
22 Albiston Way
Auburn, ME 04210
Phone: 207-784-5788
Toll Free: 800-292-6218
Fax: 207-784-5383
http://www.specair.com/

Product Code: H2S Mix CH4

Synonyms:
Recommended Use:
Usage Restrictions:

Section 2: Hazards Identification

Warning

Hazard Classification:
Gases Under Pressure

Hazard Statements:
Contains gas under pressure; may explode if heated
Toxic to aquatic life

Precautionary Statements

Storage:
Protect from sunlight.
Store in well-ventilated place.

Section 3: Composition/Information on Ingredients

	CAS #	Concentration

Hydrogen Sulfide	7783-06-4	10 ppm - 100 ppm
Carbon Monoxide	630-08-0	50 ppm - 800 ppm
Methane	74-82-8	1.45% - 2.5%
Oxygen	7782-44-7	12% - 20.9%
Nitrogen	7727-37-9	Balance

	Chemical Substance	Chemical Family	Trade Names
Hydrogen Sulfide	HYDROGEN SULFIDE	inorganic, gas	HYDROGEN SULFIDE (H2S); DIHYDROGEN MONOSULFIDE; DIHYDROGEN SULFIDE; HYDROSULFURIC ACID; SULFUR DIHYDRIDE; SULFURETED HYDROGEN; SULFUR HYDRIDE; STINK DAMP; SEWER GAS; RCRA U135; UN 1053; H2S
Carbon Monoxide	CARBON MONOXIDE	inorganic, gas	CARBON OXIDE; CARBON OXIDE (CO); UN 1016; CO
Methane	METHANE, COMPRESSED GAS	hydrocarbons, gas	FIRE DAMP; MARSH GAS; METHYL HYDRIDE; NATURAL GAS; METHANE; UN 1971; R50; CH4
Oxygen	OXYGEN, COMPRESSED GAS	inorganic, gas	OXYGEN; DIOXYGEN; MOLECULAR OXYGEN; OXYGEN MOLECULE; PURE OXYGEN; UN 1072; O2
Nitrogen	NITROGEN, COMPRESSED GAS	inorganic, gas	DIATOMIC NITROGEN; DINITROGEN; NITROGEN; NITROGEN-14; NITROGEN GAS; UN 1066; N2

Section 4: First Aid Measures

	Skin Contact	Eye Contact	Ingestion	Inhalation	Note to Physicians
Hydrogen Sulfide	Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.	Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.	If a large amount is swallowed, get medical attention.	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.	For inhalation, consider oxygen.
Carbon Monoxide	Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.	Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.	If a large amount is swallowed, get medical attention.	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.	For inhalation, consider oxygen.
Methane	Wash exposed skin with soap and water.	Flush eyes with plenty of water.	If a large amount is swallowed, get medical attention.	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.	For inhalation, consider oxygen.
Oxygen	None expected	None expected	Not likely route of exposure	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.	None
Nitrogen	Wash exposed skin with soap and water.	Flush eyes with plenty of water.	If a large amount is swallowed, get medical attention.	If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.	For inhalation, consider oxygen.

Section 5: Fire Fighting Measures

	Suitable Extinguishing Media	Products of Combustion	Protection of Firefighters

	Suitable Extinguishing Media	Products of Combustion	Protection of Firefighters
Hydrogen Sulfide	Let burn unless leak can be stopped immediately. Large fires: Use regular foam or flood with fine water spray.	Sulfur oxides	▪ Any self-contained breathing apparatus with a full facepiece. ▪ Protective material types: butyl rubber, polyvinyl chloride (PVC), neoprene
Carbon Monoxide	Carbon dioxide, regular dry chemical Large fires: Use regular foam or flood with fine water spray.	Carbon dioxide	▪ Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply. ▪ Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.
Methane	Carbon dioxide, regular dry chemical Large fires: Use regular foam or flood with fine water spray.	Carbon monoxide, carbon dioxide, water	▪ Respiratory protection may be needed for frequent or heavy exposure. Any self-contained breathing apparatus with a full facepiece. ▪ Respiratory protection may be needed for frequent or heavy exposure. Any self-contained breathing apparatus with a full facepiece.
Oxygen	Non-flammable. Use extinguishing agent appropriate for the material which is burning. Use water in large quantities for fires involving oxygen.	Oxides of burning material	▪ Respiratory protection may be needed for frequent or heavy exposure. ▪ None
Nitrogen	Non-flammable. Use suitable extinguishing media for surrounding fire. Cylinders may rupture or explode if exposed to heat.	Non-flammable	▪ Respiratory protection may be needed for frequent or heavy exposure.

Section 6: Accidental Release Measures

	Personal Precautions	Environmental Precautions	Methods for Containment
Hydrogen Sulfide	Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas. Ventilate closed spaces before entering. Evacuation radius: 150 feet. For tank, rail car or tank truck: 800 meters (1/2 mile). Do not touch spilled material.	Avoid heat, flames, sparks and other sources of ignition.	Stop leak if possible without personal risk. Remove sources of ignition. Reduce vapors with water spray. Do not get water directly on material.
Carbon Monoxide	Keep unnecessary people away, isolate hazard area and deny entry. Ventilate closed spaces before entering.	Avoid heat, flames, sparks and other sources of ignition. Keep out of water supplies and sewers.	Stop leak if possible without personal risk. Reduce vapors with water spray. Remove sources of ignition.
Methane	Keep unnecessary people away, isolate hazard area and deny entry. Ventilate closed spaces before entering.	Avoid heat, flames, sparks and other sources of ignition.	Stop leak if possible without personal risk. Reduce vapors with water spray. Remove sources of ignition.
Oxygen	Keep unnecessary people away, isolate hazard area and deny entry. Ventilate closed spaces before entering.	Avoid contact with combustible materials.	Stop leak if possible without personal risk.
Nitrogen	Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind and keep out of low areas.	No significant effects from contamination expected.	Stop leak if possible without personal risk.

	Methods for Cleanup	Other Information
Hydrogen Sulfide	Collect runoff for disposal as potential hazardous waste. Dike for later disposal. Absorb with sand or other non-combustible material. Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash).	Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).
Carbon Monoxide	Stop leak, evacuate area. Wear protective equipment.	Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
Methane	Not available	Not available
Oxygen	Stop leak and ventilate	None
Nitrogen	N/A	N/A

Section 7: Handling and Storage

	Handling	Storage

	Handling	Storage
Hydrogen Sulfide	Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Store in a cool, dry place. Store in a well-ventilated area. Avoid contact with light. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Notify State Emergency Response Commission for storage or use at amounts greater than or equal to the TPQ (U.S. EPA SARA Section 302). SARA Section 303 requires facilities storing a material with a TPQ to participate in local emergency response planning (U.S. EPA 40 CFR 355.30). Keep separated from incompatible substances.	Subject to handling regulations: U.S. OSHA 29 CFR 1910.119.
Carbon Monoxide	Keep separated from incompatible substances.	Store and handle in accordance with all current regulations and standards. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101.
Methane	Store and handle in accordance with all current regulations and standards. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101.	Keep separated from incompatible substances.
Oxygen	Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101.	Keep separated from incompatible substances.
Nitrogen	Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101.	Keep separated from incompatible substances.

Section 8: Exposure Controls/Personal Protection

	Exposure Guidelines
Hydrogen Sulfide	HYDROGEN SULFIDE: 20 ppm OSHA ceiling 50 ppm OSHA peak 10 minute(s) (once if no other measurable exposure occurs) 10 ppm (14 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993) 15 ppm (21 mg/m3) OSHA STEL (vacated by 58 FR 35338, June 30, 1993) 10 ppm ACGIH TWA 15 ppm ACGIH STEL 10 ppm (15 mg/m3) NIOSH recommended ceiling 10 minute(s) TLV-TWA: 1ppm Upper respiratory irritation (ACGIH)
Carbon Monoxide	CARBON MONOXIDE: 50 ppm (55 mg/m3) OSHA TWA 35 ppm (40 mg/m3) OSHA TWA (vacated by 58 FR 35338, June 30, 1993) 200 ppm (229 mg/m3) OSHA ceiling (vacated by 58 FR 35338, June 30, 1993) 25 ppm ACGIH TWA 35 ppm (40 mg/m3) NIOSH recommended TWA 10 hour(s) 200 ppm (229 mg/m3) NIOSH recommended ceiling
Methane	METHANE, COMPRESSED GAS: ALIPHATIC HYDROCARBON GASES ALKANE (C1-C4): 1000 ppm ACGIH TWA METHANE: No occupational exposure limits established. ALIPHATIC HYDROCARBON GASES ALKANE (C1-C4): 1000 ppm ACGIH TWA
Oxygen	OXYGEN, COMPRESSED GAS: No occupational exposure limits established.
Nitrogen	NITROGEN, COMPRESSED GAS: NITROGEN: ACGIH (simple asphyxiant)

Engineering Controls

Handle only in fully enclosed systems.

	Eye Protection	Skin Protection	Respiratory Protection
Hydrogen Sulfide	Wear splash resistant safety goggles with a face shield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.	Wear appropriate chemical resistant clothing.	Any self-contained breathing apparatus with a full facepiece.
Carbon Monoxide	Eye protection not required, but recommended.	Protective clothing is not required.	Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.
Methane	Eye protection not required, but recommended.	Protective clothing is not required.	Respiratory protection may be needed for frequent or heavy exposure. Any self-contained breathing apparatus with a full facepiece.
Oxygen	Eye protection not required, but recommended.	Protective clothing is not required.	Respiratory protection may be needed for frequent or heavy exposure.
Nitrogen	Eye protection not required, but recommended.	Protective clothing is not required.	Respiratory protection may be needed for frequent or heavy exposure.

General Hygiene considerations

- Avoid breathing vapor or mist
- Avoid contact with eyes and skin
- Wash thoroughly after handling and before eating or drinking

Section 9: Physical and Chemical Properties

	Physical State	Appearance	Color	Change in Appearance	Physical Form	Odor	Taste
Hydrogen Sulfide	Gas	Colorless	Colorless	N/A	Gas	Rotten egg odor	N/A
Carbon Monoxide	Gas	Colorless	Colorless	N/A	Gas	Odorless	Tasteless
Methane	Gas	Colorless	Colorless	N/A	Gas, liquid	Odorless	Tasteless
Oxygen	Gas	Clear	Colorless	N/A	Gas	Odorless	Tasteless
Nitrogen	Gas	Clear	Colorless	N/A	Gas	Odorless	Tasteless

	Flash Point	Flammability	Partition Coefficient	Autoignition Temperature	Upper Explosive Limits	Lower Explosive Limits
Hydrogen Sulfide	Flammable	Not available	Not available	500 F (260 C)	44-46%	4.0-4.3%
Carbon Monoxide	Flammable	Not available	1479.11 (log = 3.17) (estimated from water solubility)	1128-1202 F (609-650 C)	0.74	12.0-12.5%
Methane	-369 F (-223 C)	Not available	724.44 (log = 2.87) (estimated from water solubility)	999 F (537 C)	15%	5%
Oxygen	Not flammable	Not available	Not available	Nonflammable	Nonflammable	Nonflammable
Nitrogen	Not flammable	Not available	Not available	Nonflammable	Nonflammable	Nonflammable

	Boiling Point	Freezing Point	Vapor Pressure	Vapor Density	Specific Gravity	Water Solubility	pH	Odor Threshold	Evaporation Rate	Viscosity
Hydrogen Sulfide	-78 to -77 F (-61 to -60.3 C)	-123 F (-86 C)	15200 mmHg @ 25 C	1.2 (Air=1)	1.192	2.58-2.9% @ 20 C	4.5-<7 (saturated solution)	0.13 ppm	Not applicable	0.0128 cP @ 25 C
Carbon Monoxide	-312.7 F (-191.5 C)	-326 F (-199 C)	760 mmHg @ -191 C gas; cannot be liquefied at room temperature	0.968 (Air=1)	Not applicable	2.3% @ 20 C	Not applicable	Not available	Not applicable	0.01657 cP @ 0 C
Methane	-260 F (-162 C)	-297 F (-183 C)	760 mmHg @ -161 C	0.555 (Air=1)	Not applicable	3.5% @ 17 C	Not applicable	Not available	Not applicable	0.01118 cP @ 27 C
Oxygen	-297 F (-183 C)	-360 F (-218 C)	760 mmHg @ -183 C	1.1 (Air=1)	Not applicable	3.2% @ 25 C	Not applicable	Not available	Not applicable	0.02075 cP @ 25 C
Nitrogen	-321 F (-196 C)	-346 F (-210 C)	760 mmHg @ -196 C	0.967 (Air=1)	Not applicable	1.6% @ 20 C	Not applicable	Not available	Not applicable	0.01787 cP @ 27 C

	Molecular Weight	Molecular Formula	Density	Weight per Gallon	Volatility by Volume	Volatility	Solvent Solubility
Hydrogen Sulfide	34.08	H2-S	1.539 g/L @ 0 C	Not available	Not available	Not applicable	Soluble: Carbon disulfide, alcohol, ether, glycerol, gasolines, kerosene, crude oil, alkali solutions
Carbon Monoxide	28.01	C-O	1.250 g/L @ 0 C	Not available	100%	Not applicable	Soluble: Alcohol, benzene, acetic acid, ethyl acetate, chloroform, cuprous chloride solutions
Methane	16.04	C-H4	0.717 g/L @ 0 C	Not available	Not applicable	Not applicable	Soluble: Alcohol, ether, benzene, organic solvents
Oxygen	31.9988	O2	1.309 g/L @ 25 C	Not available	Not applicable	Not applicable	Soluble: Alcohol
Nitrogen	28.0134	N2	1.2506 g/L	Not available	100%	1	Soluble: Liquid ammonia

Section 10: Stability and Reactivity

	Stability	Conditions to Avoid	Incompatible Materials
Hydrogen Sulfide	Stable at normal temperatures and pressure.	Stable at normal temperatures and pressure.	Combustible materials, metals, oxidizing materials, halogens, metal oxides, metal salts, bases, rust, oxidants, oxygen, copper powder, acetaldehyde, silver fulminate
Carbon Monoxide	Stable at normal temperatures and pressure.	Stable at normal temperatures and pressure.	Oxidizing materials, halogens, metal oxides, metals, combustible materials, lithium
Methane	Stable at normal temperatures and pressure.	Stable at normal temperatures and pressure.	Halogens, oxidizing materials, combustible materials
Oxygen	Stable at normal temperatures and pressure.	Stable at normal temperatures and pressure.	Combustible materials, halo carbons, metals, bases, reducing agents, amines, metal salts, oxidizing materials, alkaline earth and alkali metals
Nitrogen	Stable at normal temperatures and pressure.	Stable at normal temperatures and pressure.	Metals, oxidizing materials

	Hazardous Decomposition Products	Possibility of Hazardous Reactions
Hydrogen Sulfide	Oxides of sulfur	Will not polymerize.
Carbon Monoxide	Oxides of carbon	Will not polymerize.
Methane	Oxides of carbon	Will not polymerize.
Oxygen	Miscellaneous decomposition products	Will not polymerize.
Nitrogen	Oxides of nitrogen	Will not polymerize.

Section 11: Toxicology Information

Acute Effects

	Oral LD50	Dermal LD50	Inhalation
Hydrogen Sulfide	444 ppm inhalation-rat LC50	Irritation 0.000125 ppm/5 hour(s) eyes-human	Irritation, lack of sense of smell, sensitivity to light, nausea, vomiting, difficulty breathing, headache, drowsiness, dizziness, disorientation, tremors, visual disturbances, suffocation, lung congestion, internal bleeding, heart damage, nerve damage, brain damage, coma, death
Carbon Monoxide	LC50 Inhalation Gas. Rat 1807 ppm 4 hours	Not available	Changes in body temperature, changes in blood pressure, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, hallucinations, pain in extremities, tremors, loss of coordination, hearing loss, visual disturbances, eye damage, suffocation, blood disorders, convulsions, coma
Methane	Not available	Not available	Nausea, vomiting, difficulty breathing, irregular heartbeat, headache, drowsiness, fatigue, dizziness, disorientation, mood swings, tingling sensation, loss of coordination, suffocation, convulsions, unconsciousness, coma
Oxygen	Not established	Not established	Irritation, changes in body temperature, nausea, difficulty breathing, irregular heartbeat, dizziness, disorientation, hallucinations, mood swings, pain in extremities, tremors, lung congestion, convulsions
Nitrogen	Not available	Not available	Nausea, vomiting, difficulty breathing, headache, drowsiness, dizziness, tingling sensation, loss of coordination, convulsions, coma

	Eye Irritation	Skin Irritation	Sensitization
Hydrogen Sulfide	Irritation, sensitivity to light, visual disturbances	Irritation liquid: frostbite	Harmful if inhaled, respiratory tract irritation, skin irritation, eye irritation, blood damage
Carbon Monoxide	No information on significant adverse effects	No information on significant adverse effects	Blood damage, suffocation
Methane	No information on significant adverse effects	No information on significant adverse effects	Difficulty breathing
Oxygen	No information on significant adverse effects	No information on significant adverse effects	No significant target effects reported.
Nitrogen	Contact with rapidly expanding gas may cause burns or frostbite	No information on significant adverse effects	Difficulty breathing

Chronic Effects

	Carcinogenicity	Mutagenicity	Reproductive Effects	Developmental Effects
Hydrogen Sulfide	Not available	Not available	Available.	No data

	Carcinogenicity	Mutagenicity	Reproductive Effects	Developmental Effects
Carbon Monoxide	Not available	Available.	Available.	No data
Methane	Not available	Not available	Not available	No data
Oxygen	Not known.	Available.	Available.	No data
Nitrogen	Not hazardous	Not available	Not available	No data

Section 12: Ecological Information

Fate and Transport

	Eco toxicity	Persistence / Degradability	Bioaccumulation / Accumulation	Mobility in Environment
Hydrogen Sulfide	Fish toxicity: Acute LC50 7 ug/L Fresh water Fish - Fathead minnow - Pimephales promelas - FRY 96 hours; 14.9 ug/L 96 hour(s) LC50 (Mortality) Fathead minnow (Pimeph Invertibrate toxicity: 9730 ug/L 1.5 hour(s) (Mortality) Mediterranean mussel (Mytilus galloprovincialis) Algal toxicity: Not available Phyto toxicity: Not available Other toxicity: Not available	Highly toxic to aquatic life.	Not available	Not available
Carbon Monoxide	Fish toxicity: 75000 ug/L 1 day(s) LC100 (Mortality) Orangespotted sunfish (Lepomis humilis) Invertibrate toxicity: Not available Algal toxicity: Not available Phyto toxicity: Not available Other toxicity: Not available	Relatively non-persistent in the environment. Highly volatile from water.	Not available	Not expected to leach through the soil or the sediment.
Methane	Fish toxicity: Not available Invertibrate toxicity: Not available Algal toxicity: Not available Phyto toxicity: Not available Other toxicity: Not available	Relatively non-persistent in the environment. Moderately volatile from water.	Accumulates very little in the bodies of living organisms.	Not expected to leach through the soil or the sediment.
Oxygen	Fish toxicity: Not available Invertibrate toxicity: Not available Algal toxicity: Not available Phyto toxicity: Not available Other toxicity: Not available	Not available	Low bioaccumulation	Not available
Nitrogen	Fish toxicity: Not available Invertibrate toxicity: Not available Algal toxicity: Not available Phyto toxicity: Not available Other toxicity: Not available	Not available	Not available	Not available

Section 13: Disposal Considerations

Hydrogen Sulfide	Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U135.
Carbon Monoxide	Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.
Methane	Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.
Oxygen	Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001.
Nitrogen	Dispose in accordance with all applicable regulations.

Section 14: Transportation Information

U.S. DOT 49 CFR 172.101

DOT Information For This Mixture

Shipping Name	Compressed gas, n.o.s. (Nitrogen, Oxygen)
UN Number	UN1956
Hazard Class	2.2
Hazard Information	Non-Flammable Gas

Individual Component Information

	Proper Shipping Name	ID Number	Hazard Class or Division	Packing Group	Labeling Requirements	Passenger Aircraft or Railcar Quantity Limitations	Cargo Aircraft Only Quantity Limitations	Additional Shipping Description
Hydrogen Sulfide	Hydrogen sulfide	UN1053	2.3	Not applicable	2.3; 2.1	Forbidden	Forbidden	Toxic-Inhalation Hazard Zone B
Carbon Monoxide	Carbon monoxide, compressed	UN1016	2.3	Not applicable	2.3; 2.1	Forbidden	25 kg	Toxic-Inhalation Hazard Zone D
Methane	Methane, compressed	UN1971	2.1	Not applicable	2.1	Forbidden	150 kg	N/A
Oxygen	Oxygen, compressed	UN1072	2.2	Not available	2.2; 5.1	75 kg or L	150 kg	N/A
Nitrogen	Nitrogen, compressed	UN1066	2.2	Not applicable	2.2	75 kg or L	150 kg	N/A

Canadian Transportation of Dangerous Goods

	Shipping Name	UN Number	Class	Packing Group / Risk Group
Hydrogen Sulfide	HYDROGEN SULFIDE; or HYDROGEN SULPHIDE	UN1053	2.3; 2.1	Not applicable
Carbon Monoxide	Carbon monoxide, compressed	UN1016	2.3; 2.1	Not applicable
Methane	Methane, compressed	UN1971	2.1	Not applicable
Oxygen	Oxygen, compressed	UN1072	2.2; 5.1	Not applicable
Nitrogen	Nitrogen, compressed	UN1066	2.2	Not applicable

Section 15: Regulatory Information

U.S. Regulations

	CERCLA Sections	SARA 355.30	SARA 355.40
Hydrogen Sulfide	100 LBS RQ	500 LBS TPQ	100 LBS RQ
Carbon Monoxide	Not regulated.	Not regulated.	Not regulated.
Methane	Not regulated.	Not regulated.	Not regulated.
Oxygen	Not regulated.	Not regulated.	Not regulated.
Nitrogen	Not regulated.	Not regulated.	Not regulated.

SARA 370.21

	Acute	Chronic	Fire	Reactive	Sudden Release
Hydrogen Sulfide	Yes	No	Yes	No	Yes
Carbon Monoxide	Yes	No	Yes	No	Yes
Methane	Yes	No	Yes	No	Yes
Oxygen	No	No	Yes	No	Yes
Nitrogen	Yes	No	No	No	Yes

SARA 372.65

Hydrogen Sulfide	HYDROGEN SULFIDE: Administrative stay issued Aug. 22, 1994
Carbon Monoxide	Not regulated.

Methane	Not regulated.
Oxygen	Not regulated.
Nitrogen	Not regulated.

OSHA Process Safety

Hydrogen Sulfide	1500 LBS TQ
Carbon Monoxide	Not regulated.
Methane	Not regulated.
Oxygen	Not regulated.
Nitrogen	Not regulated.

State Regulations

	CA Proposition 65
Hydrogen Sulfide	Not regulated.
Carbon Monoxide	Known to the state of California to cause the following: Carbon monoxide Developmental toxicity (Jul 01, 1989)
Methane	Not regulated.
Oxygen	Not regulated.
Nitrogen	Not regulated.

Canadian Regulations

	WHMIS Classification
Hydrogen Sulfide	A, B1, D1A, D2B.
Carbon Monoxide	A, B1, D1A, D2A.
Methane	A, B1
Oxygen	A,C
Nitrogen	A

National Inventory Status

	US Inventory (TSCA)	**TSCA 12b Export Notification**	**Canada Inventory (DSL/NDSL)**
Hydrogen Sulfide	Listed on inventory.	Not listed.	Listed on inventory.
Carbon Monoxide	Listed on inventory.	Not listed.	Listed on inventory.
Methane	Listed on inventory.	Not listed.	Listed on inventory.
Oxygen	Listed on inventory.	Not listed.	Not determined.
Nitrogen	Listed on inventory.	Not listed.	Listed on inventory.

Section 16: Other Information

	NFPA Rating
Hydrogen Sulfide	HEALTH=4 FIRE=4 REACTIVITY=0
Carbon Monoxide	HEALTH=3 FIRE=4 REACTIVITY=0
Methane	HEALTH=1 FIRE=4 REACTIVITY=0
Oxygen	HEALTH=0 FIRE=0 REACTIVITY=0
Nitrogen	HEALTH=1 FIRE=0 REACTIVITY=0

0 = minimal hazard, 1 = slight hazard, 2 = moderate hazard, 3 = severe hazard, 4 = extreme hazard

Appendix C

Heat Stress and Cold Stress Guidelines

Heat Stress Guidelines

Form	Signs & Symptoms	Care	Prevention[3]
Heat Rash	Tiny red vesicles in affected skin area. If the area is extensive, sweating can be impaired.	Apply mild lotions and cleanse the affected area.	Cool resting and sleeping areas to permit skin to dry between heat exposures.
Heat Cramps	Spasm, muscular pain (cramps) in stomach area and extremities (arms and legs).	Provide replacement fluids with minerals (salt) such as Gatorade.	Adequate salt intake with meals[1]. ACCLIMATIZATION[2]
Heat Exhaustion	Profuse sweating, cool (clammy) moist skin, dizziness, confusion, pale skin color, faint, rapid shallow breathing, headache, weakness, and/or muscle cramps.	Remove from heat, sit or lie down, rest, replace lost water with electrolyte replacement fluids (water, Gatorade) take frequent sips of liquids in amounts greater than required to satisfy thirst.	ACCLIMATIZATION[2] Adequate salt intake with meals[1], only during early part of heat season. Ample water intake, frequently during the day.
Heat Stroke	HOT Dry Skin. Sweating has stopped. Mental confusion, dizziness, nausea, chills, severe headache, collapse, delirium, and/or coma.	HEAT STROKE IS A MEDICAL EMERGENCY • Remove from heat. • COOL THE BODY AS RAPIDLY AS POSSIBLE by immersing in cold (or cool) water, or splash with water and fan. • Call for Emergency Assistance. • Observe for signs of shock.	ACCLIMATIZATION[2] Initially moderate workload in heat (8 to 14 days). Monitor worker's activities.

Footnotes:

1.) American diets are normally high in salt, sufficient to aid acclimatization. However, during the early part of the heat season, (May, June), one extra shake of salt during one to two meals per day may help, so long as this is permitted by your physician. Check with your personal physician.

2.) ACCLIMATIZATION - The process of adapting to heat is indicated by worker's ability to perform hot jobs less fluid loss, lower concentrations of salt loss in sweat, and a reduced core (body) temperature and heart rate.

3.) Method to Achieve Acclimatization - Moderate work or exercise in hot temperatures during early part of heat season. Adequate salt (mineral) and water intake. Gradually increasing work time in hot temperatures. Avoid alcohol. Normally takes 8 to 14 days to achieve acclimatization. Lost rapidly, if removed from strenuous work (or exercise) in hot temperature for more than approximately 5 days.

Cold Stress Guidelines

Stress	Symptoms	What to do
Mild Hypothermia	• Body Temp 98 to 90°F • Shivering • Lack of coordination, stumbling, fumbling hands • Slurred speech • Memory loss • Pale, cold skin	• Move to warm area • Stay active • Remove wet clothes and replace with dry clothes or blankets • Cover the head • Drink warm (not hot) sugary drink
Moderate Hypothermia	• Body temp 90 to 86°F • Shivering stops • Unable to walk or stand • Confused and/or irrational	• All of the above, plus: o Call 911 o Cover all extremities completely o Place very warm objects, such as hot packs on the victim's head, neck, chest, and groin
Severe Hypothermia	• Body temp 86 to 78°F • Severe muscle stiffness • Very sleepy or unconscious • Ice cold skin • Death	• Call 911 • Treat victim very gently • Do not attempt to re-warm
Frostbite	• Cold, tingling, stinging, or aching feeling in the frostbitten area, followed by numbness • Skin color turns red, then purple, then white or very pale skin • Cold to the touch • Blisters in severe cases	• Call 911 • Do not rub the area • Wrap in soft cloth • If help is delayed, immerse in warm (not hot) water
Trench Foot	• Tingling, itching, or burning sensation • Blisters	• Soak feet in warm water, then wrap with dry cloth bandages • Drink a warm (not hot) sugary drink

Appendix D

Forms

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

GEI Consultants

Accident/Incident Report Form

SECTION A — ACCIDENT/INCIDENT DETAILS

EMPLOYEE INFORMATION:

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

OTHER INJURED (IF APPLICABLE):

Name: _____

Home Address: _____
Street Address City State Zip Code

Contact Information: ( ) _____ ( ) _____
Primary Secondary

Date of Birth: _____

Date of Hire: _____

Branch: _____

Supervisor: _____

Date and Time Accident/Incident	Date and Time Reported
____/____/____ Month Day Year	____/____/____ Month Day Year
____ A.M. ____ P.M.	____ A.M. ____ P.M.

LOCATION OF INCIDENT/ACCIDENT

Project Name: _____

Client and Location: _____

or

Office Location: _____

INCIDENT TYPE: (Check All That Applies)

- ☐ **Personal Injury/Illness**
- ☐ **Vehicle Accident**
- ☐ **Property Damage**
- ☐ **Environmental Spill**
- ☐ **Other**

WITNESS INFORMATION

Name: _____

Contact Number: _____

Company: _____

WHAT HAPPENED TO THE INJURED PARTY: ☐ First Aid Administered ☐ Refused Treatment/Transport ☐ Transported to Hospital ☐ Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: _____ Phone: _____
Name Street Address City State Zip Code

SECTION B — PERSONAL INJURY

Cause of Injury: _____

Part of Body Injured: _____ Multiple Injuries: ☐ Y ☐ N

Was PPE worn when injured? : ☐ Y ☐ N What PPE was worn? _____

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

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GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION C — AUTO ACCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: _____

Department: _____

Driver's License Number: _____

DOB: ____/____/____ State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year: Color: _____

Owner: _____

Name of Other Driver: _____

Driver's License Number: _____

State: _____

Description of Vehicle: License Plate Number: _____

Make: _____ Model: _____ Year: _____ Color: _____

Insurance Carrier: _____

Policy Number: _____ Ph. Number: _____

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): _____

Cause of Damage(s): _____

Type of Chemical Released (if known): _____

Quantity of Chemical Released: _____

Spill Measures Employed: _____

SECTION E — NATURE OF ACCIDENT/INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

_____

_____

_____

_____

_____

_____

_____

_____

_____

I hereby certify that the above information is true and correct to my understanding of this accident/incident.

_____ _____

Employee/Preparer's Name **Date and Time**

GEI Consultants

Near Miss Report Form

Please complete this form and send it to your Branch Manager, HR and the Safety Team ***within 24 hours*** of the near miss.

NEAR MISS DETAILS

Employee Name: _____

Phone Number: _____

Branch: _____

Supervisor: _____

Date and Time Accident/Incident	Date and Time Reported	LOCATION OF NEAR MISS
_____/_____/_____ Month Day Year _____A.M._____P.M.	_____/_____/_____ Month Day Year _____ A.M._____P.M.	**Project Name:** _____ **Client and Location:** _____ **or** _____ **Office Location:** _____

WHAT HAPPENED?

(Please give a detailed description of what happened. Attach photos or a sketch, if applicable.)

_____

_____

_____

_____

_____

☐ **Photos were Taken**

WHAT WAS DONE?

(Please give a detailed description of what was done to prevent and incident from occurring.)

_____

_____

_____

_____

_____

_____

☐ **I have verbally contacted a member of the Safety Team and my Supervisor.**

_____ _____

Employee/Preparer's Name **Date and Time**

Project Safety Briefing Form

Project Number:	**Project Name:**
Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents that a project specific-briefing was conducted in accordance with the site-specific HASP and GEI's H&S policy. GEI personnel who perform work on site are required to attend this project briefing. Applicable health and safety SOPs and any additional hazards are also required to be reviewed during this briefing. Prior to the start of the project or upon the start of a new on-site project team member, this form must be completed. Please email this completed form to: *Health&SafetyCommittee@geiconsultants.com*

TOPICS COVERED (check all those covered):			
SOP HS-001 Biological Hazards		SOP HS-025 Manual Lifting	
SOP HS-002 Bloodborne Pathogens		SOP HS -26 Hazard Identification	
SOP HS-003 Container Management		SOP HS-27 Confined Space Entry for Sanitary Sewers	
SOP HS-004 Driver Safety		SOP HS-28 Safe Trailer Use	
SOP HS-005 Electrical Safety - Lockout/Tagout		SOP HS-29 Overtime and Fatigue Management	
SOP HS-006 Excavation/Trenching		Accident Reporting Procedures	
SOP HS-008a Hand Tools (Non-Powered)		Changes to the HASP	
SOP HS-008b Powered Hand Tools		Cold Stress	
SOP HS-009 Hazardous Substances Management		Confined Space	
SOP HS-010 Inclement Weather		Decon Procedures	
SOP HS-011 Ladders		Exposure Guidelines	
SOP HS-012 Noise Exposure		General PPE Usage	
SOP HS-013 Nuclear Density Gauge		Heat Stress	
SOP HS-014 Utility Markout		Hearing Conservation	
SOP HS-015 Respirator Fit Test		Lockout/Tagout	
SOP HS-016 Traffic Hazards		Personal Hygiene	
SOP HS-017 Water Safety		Respiratory Protection	
SOP HS-018 Working Around Heavy Equipment		Review of Hazard Evaluation	
SOP HS-019 Rail Safety		Site Control	
SOP HS-020 Aerial Lift		Site Emergency Procedures	
SOP HS-021 Mobile Equipment		Slips, Trips, Falls	
SOP HS-022 Aquatic Ecological Survey/Electrofishing		Other (Specify):	
SOP HS-023 Scaffolding		Other (Specify):	
SOP HS-024 Wilderness Safety		Other (Specify):	

Personnel Sign-in List	
Printed Name	**Signature**

GEI Consultants

Daily Safety Briefing and Site Visitor Sign-In

Project Number:	**Project Name:**
[1]Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the site specific HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, daily.

TOPICS COVERED (check all those covered):

- ☐ Accident Reporting Procedures
- ☐ Cellular Phone Charged w/Service
- ☐ Changes to the HASP
- ☐ Cold Stress
- ☐ Confined Space
- ☐ Decon Procedures
- ☐ Exposure Guidelines
- ☐ General PPE Usage
- ☐ Heat Stress
- ☐ Hearing Conservation
- ☐ Lockout/Tagout
- ☐ Personal Hygiene
- ☐ Respiratory Protection
- ☐ Review of Hazards
- ☐ Site Control
- ☐
- Emergency Procedures
- ☐ Slips, Trips, Falls
- ☐ Traffic Safety
- ☐ Other:
- ☐ Other:
- ☐ Other:
- ☐ Other:
- ☐ Other:
- Site
- ☐ Other:
- ☐ Other:
- ☐ Other:
- ☐ Other:

Daily Safety Topic Description:

Personnel Sign-in List

Printed Name	Signature	Company Name	Time-In	Time-Out

[1] This form is applicable for *only* 1 day of site activity.

Appendix E

GEI's Health and Safety SOPs

HS-001
HS-003
HS-006
HS-009
HS-010
HS-014
HS-016
HS-018
HS-019
HS-025

STANDARD OPERATING PROCEDURE

AR-005 Hydrogen Cyanide Work Zone Air Monitoring Procedures

1. Objective

Describe real-time monitoring of hydrogen cyanide gas during field activities.

2. Equipment

To monitor cyanide (as hydrogen cyanide gas), the GEI field representative should utilize a real time handheld meter in conjunction with the Dräger Chip Measuring System (CMS) during subsurface activities including subsurface excavations, borings and monitoring well installation, materials handling, and groundwater sampling in areas with confirmed or suspected cyanide impacts.

Continuous monitoring equipment includes the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems, and are available from rental equipment suppliers. Due to potential interference from sulfurs, hydrogen sulfide gas (H_2S) should also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real time meter.

3. Calibration

Prior to commencing work on-site, the real-time cyanide meter should be calibrated in accordance with the equipment manufacturer's specifications. If the meter is calibrated in the field, the daily calibration results should be recorded in the field notebook.

4. Execution

Cyanide will be monitored around the perimeter of the work zone on a regular basis. Continuous monitoring should be completed every fifteen minutes if sulfur odor or suspected purifier waste material (former MGP sites only) is encountered. Measurements should be monitored in the breathing zone and should be recorded into the field notebook or on an applicable form. In the event that hydrogen cyanide is detected, the GEI field representative should proceed as follows:

4.1. Action Level: HCN ≤1 ppm for 15-minute average using real time meter

- Run CMS Dräger tube.
- Continue monitoring with real time meter.
- Continue work if CMS Dräger tube for hydrogen cyanide reads <2 ppm.

4.2. Action Level: 1 ppm < HCN < 2ppm for 15-minute average using real time meter.

- Run CMS Dräger using hydrogen cyanide gas chip and confirm <2 ppm concentration.
- Continue monitoring with real time meter.
- Run CMS Dräger tube using sulfur dioxide, hydrogen sulfide phosphine chip to evaluate potential interference.
- Recalibrate the real time meter and continue to monitor the work zone.

4.3. Action Level: HCN 2 ppm on CMS Dräger tube

- Stop work and move (with continuous monitoring meter) at least 25 feet upwind from excavation or until continuous monitoring meter registers <1 ppm.
- Run CMS Dräger hydrogen cyanide chip and re-evaluate activities
- Continue monitoring with real time meter.
- Allow area to ventilate and continue to monitor while returning to the work zone.
- Do not move into an area when readings are >1 ppm without confirming with additional CMS Dräger measurement.
- May resume work if Dräger tube for cyanide reads <2 ppm.

5. Limitations

No air purifying respiratory protection is available for hydrogen cyanide gas.

The American Conference of Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Hydrogen Cyanide is 4.7 ppm.

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

7. Contacts

Brian Skelly
Ryan Hoffman

STANDARD OPERATING PROCEDURES

SOP No. HS-001 Biological Hazards

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the potential for GEI personnel to encounter biological hazards during field activities.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for contact with biological hazards such as animals, insects, plants, and sewage. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for encounters with biological hazards and the control methods to be implemented by GEI employees. These hazards must be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Mammals

During some site operations, animals such as stray or domesticated dogs or cats, raccoons, snakes, bears, rats, bats, etc. may be encountered. Employees should use discretion and attempt to avoid contact with animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed animal control technician.

1.3.1 Rabies

The rabies virus is transmitted through the bite of an infected animal or contact with saliva or brain/nervous system tissue of an infected animal. The rabies virus infects the central nervous system, causing disease in the brain. The early symptoms of rabies in people are fever, headache, and general weakness or discomfort. As the disease progresses, more specific symptoms appear and may include insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation (increase in saliva), difficulty swallowing, and hydrophobia (fear of water). Death usually occurs within days of the onset of these symptoms.

If you are bitten or think you may be exposed, wash any wounds immediately and thoroughly with soap and water. Then go to the hospital emergency room and notify the Project Manager and the People Safety Team. The doctor, possibly in consultation with the state or local health department, will decide if you need a rabies vaccination. Decisions to start series of vaccinations will be based on your type of exposure and the animal you were exposed to, as well as laboratory and surveillance information for the geographic area where the exposure occurred. If possible have someone document what type of animal it was, how it was behaving prior to the bite, what caused it to bite the

employee, and if it's not a domestic animal that would be easy to find again in the future, try to get animal control on site to capture it. An Incident Report Form must be completed and submitted, per GEI's Incident reporting procedures. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

1.4 Insects and Arachnids

Insects, including bees, wasps, hornets, mosquitoes, ticks, spiders, etc., may be present at a job site making the chance of a bite/sting possible. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life-threatening condition. Some insect bites can transmit diseases such as Lyme disease or a virus such as West Nile. The following is a list of preventive measures:

- Apply insect repellent prior to performing field work and as often as needed throughout the work shift.
- Wear proper personal protective equipment (PPE), including protective clothing (work boots, socks, and light colored clothing).
- Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many insects are most active (between dawn and dusk).
- When walking in wooded areas, avoid contact with bushes, tall grass, or brush as much as possible.
- Field personnel who have or may have insect allergies must have insect allergy medication onsite and must inform the Site Safety Officer (SSO) and the People and Safety Team of their particular allergy prior to commencing work.
- Field personnel should perform a self-check at the end of the day for ticks.

1.4.1 Tick-borne Diseases

Lyme Disease

Lyme disease is caused by infection from a deer tick that carries a spirochete (a bacterium). During the painless tick bite, the spirochete may be transmitted into the bloodstream, often after feeding on the host for 12 to 24 hours. The ticks that cause the disease are often no bigger than a poppy seed or a comma in newsprint. The peak months for human infection are from May to September.

Symptoms appear in three stages. First symptoms usually appear from 2 days to a few weeks after a person is bitten by an infected tick. Symptoms usually consist of a ring-like red rash on the skin where the tick was attached. The rash is often bulls-eye like with red around the edges and clear in the center. The rash may be warm, itchy, tender, and/or "doughy." This rash appears in only 60 to 80 percent of infected persons. An infected

person also has flu-like symptoms of a stiff neck, chills, fever, sore throat, headache, fatigue, and joint pain. These symptoms often disappear after a few weeks.

The second stage symptoms, which occur weeks to months later include meningitis, severe headache, drooping of the muscles on the face, called Bell's Palsy, encephalitis, numbness, withdrawal, and lethargy. These symptoms may last for several weeks to several months. Third stage symptoms, which occur months or years later include arthritis, heart problems, and loss of memory. The third stage symptoms may mimic multiple sclerosis and Alzheimer's disease.

When in areas that could harbor deer ticks, employees should wear light color clothing, and visually check themselves and check and be checked by another employee when coming from wooded or vegetated areas. If a GEI employee has a tick bite, the People and Safety Team and Project Manager must be contacted immediately. The employee will be offered the option for medical treatment by a physician, which typically involves antibiotics. An Incident Report form must be completed in compliance with the Incident Reporting procedures. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

If personnel feel sick or have signs similar to those mentioned above, the SSO and the People and Safety Team must be notified immediately.

Figure 1: From left to right, the deer tick adult female, adult male, nymph, and larva on a centimeter scale.

How to Remove a Tick

A tick can be removed from the skin by pulling gently at the head with tweezers. If tweezers are not available, use tissue paper or cloth to grasp the tick. It is important to grasp the tick as close to the site of attachment and use a firm steady pull to remove it. Wash hands immediately after with soap and water. The affected area should also be washed with soap and water, then disinfected with an antiseptic wipe, if available. All mouth parts must be removed from the skin. If the tick was removed by breaking off the

mouth parts, an irritation or infection may occur because the organism that is causing the disease can still enter the body through the skin.

Treatment for Lyme Disease

Treatment with antibiotics is effective and recovery is usually complete. For first stage symptoms, antibiotics are usually given orally. However, treatment for second and third stage symptoms is prolonged and recovery may take longer. Antibiotic treatment is usually provided intravenously for second and third stage Lyme disease.

Babesiosis

The deer tick can also cause Babesiosis, an infection of the parasite Babesia Microti. Symptoms of Baesiosis may not be evident, but may also include fever, fatigue and hemolytic anemia lasting from several days to several months. Babesiosis is most commonly diagnosed in the elderly or in individuals whose immune systems are compromised. If there are no signs or symptoms of Babesiosis, usually no treatment it needed. If an employee believes they might have Babesiosis they'll see a physician to be tested. Treatment usually consists of taking prescription medications for 7 to 10 days.

Ehrlichiosis

Ehrlichiosis is a tick-borne disease which can be caused by either of two different organisms. Human monocytic ehrlichiosis (HME) is caused by *Ehrlichia chaffeensis*, which is transmitted by the lone star tick (*Amblyomma americanum*). Human granulocytic anaplasmosis (HGA), previously known as human granulocytic ehrlichiosis (HGE), is caused by *Anaplasma phagocytophilia*, which is transmitted by the deer tick (*Ixodes scapularis*).

Ehrlichiosis is transmitted by the bite of infected ticks, including the deer tick and the lone star tick. The symptoms of HME and HGE are the same and usually include fever, muscle aches, weakness and headache. Patients may also experience confusion, nausea, vomiting and joint pain. Unlike Lyme disease or Rocky Mountain spotted fever, a rash is not common. Infection usually produces mild to moderately severe illness, with high fever and headache, but may occasionally be life-threatening or even fatal. Symptoms appear 1 to 3 weeks after the bite of an infected tick. However, not every exposure results in infection. For those that become infected a drug called Doxcycline will be prescribed.

Rocky Mountain Spotted Fever

Rocky Mountain spotted fever is a tick-borne disease caused by a rickettsia (a microbe that differs somewhat from bacteria and virus). In the eastern United States, children are infected most frequently, while in the western United States, disease incidence is highest among adult males. Disease incidence is directly related to exposure to tick-infested habitats or to infested pets. Rocky Mountain spotted fever is characterized by a sudden onset of moderate to high fever (which can last for 2-3 weeks), severe headache, fatigue, deep muscle pain, chills and rash. The rash begins on the legs or arms, may include the

soles of the feet or palms of the hands and may spread rapidly to the trunk or rest of the body. Symptoms usually appear within 2 weeks of the bite of an infected tick. Like Ehrlichiosis the prescription drug Doxcycline is the first line treatment option.

1.4.2 Mosquito-Borne Disease

West Nile Virus
West Nile Virus is a mosquito-borne infection transmitted through the bite of an infected mosquito. The symptoms of West Nile Virus can be asymptomatic (no symptoms) or in more serious cases can lead to West Nile Fever. West Nile Fever can include fever, headache, tiredness, body ache, an occasional rash on the trunk of the body, and swollen lymph glands, In severe cases, people have developed West Nile Encephalitis or Meningitis which symptoms include fever, headache, neck stiffness, tremors, coma, and in some cases death. The incubation period for the disease is usually 2 to 15 days. The symptoms can range from a few days to several weeks. Most mosquitoes are not infected and the chance of infection from a mosquito bite of an on-site employee is very small.

1.5 Repellants

The following precautions will be used to help reduce the risk of mosquito bites:

Reduce mosquito-breeding areas by making sure wheelbarrows, buckets, and other containers are turned upside down when not used so that they do not collect standing water. According to the Environmental Protection Agency (EPA), many mosquitoes can breed in pooled water that's minimal enough to fill a bottle cap.

Wear shoes, long pants with bottoms tucked into boots or socks, and a long-sleeved shirt when outdoors for long periods of time, or when many mosquitoes are most active (between dawn and dusk).

Use mosquito repellant according to the manufacturer's directions when outdoors for long periods of time and when mosquitoes are most active.

Centers for Disease Control and Prevention (CDC) evaluation of information contained in peer-reviewed scientific literature and data available from the EPA has identified several EPA-registered products that provide repellent activity sufficient to help people avoid the bites of disease carrying mosquitoes. Products containing these active ingredients typically provide reasonably long-lasting protection:

- **DEET** (Chemical Name: N,N-diethyl-m-toluamide or N,N-diethly-3-methyl-benzamide)
- **Picaridin** (KBR 3023, Chemical Name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester)

- **Oil of Lemon Eucalyptus** or **PMD** (Chemical Name: para-Menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus
- **IR3535** (Chemical Name: 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)
- **Permethrin** (3-Phenoxybenzyl (1RS)-cis,trans-3-(2,2-dichlorovinyl) -2,2-dimethylcyclopropanecarboxylate) **–** Permethrin kills ticks and can be used on clothing (but not skin)

The EPA characterizes the active ingredients DEET and Picaridin as "conventional repellents" and Oil of Lemon Eucalyptus, PMD, and IR3535 as "biopesticide repellents", which are derived from natural materials.

In general, higher concentrations of active ingredient provide longer duration of protection, regardless of the active ingredient, although concentrations above approximately 50 percent do not offer a marked increase in protection time. Products with less than 10 percent active ingredient may offer only limited protection, often from 1 to 2 hours. Products that offer sustained release or controlled release (micro-encapsulated) formulations, even with lower active ingredient concentrations, may provide longer protection times. Regardless of what product you use, if you start to get mosquito bites reapply the repellent according to the label instructions or remove yourself from the area with biting insects if possible.

Clothing and other products can be purchased pre-treated, or products can be treated using EPA-registered products. Permethrin is the only pesticide approved by the EPA for these uses. Permethrin binds tightly to the fabrics, resulting in little loss during washing and minimal transfer to the skin. Permethrin is poorly absorbed through the skin, although sunscreens and other products may increase the rate of skin absorption.

If you decide to use permethrin-treated clothing, consider these tips:

- Read the application instructions carefully and apply the product according to the label directions. Do not over-treat products.
- Permethrin treatments are only intended for use on fabrics; do not apply them directly to the skin or other items.
- Do not apply permethrin to clothing while it is being worn.
- Apply the product to clothing outdoors in well ventilated areas that are protected from wind.
- Hang treated fabrics outdoors and allow them to dry completely before wearing them.
- Wash permethrin treated clothing separately from other clothing items.

1.6 Poisonous Plants

The potential for contact with poisonous plants, such as poison ivy, oak, and sumac exists when performing fieldwork in wooded or boggy areas. Urushiol, an oily organic allergen found in plants, can cause an allergic reaction when in contact with the leaves or vines.

Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison ivy grows throughout much of North America, including all states east of the Rocky Mountains. It is normally found in wooded areas, especially along edge areas where the tree line breaks and allows sunshine to filter through. It also grows in exposed rocky areas, open fields, and disturbed areas.

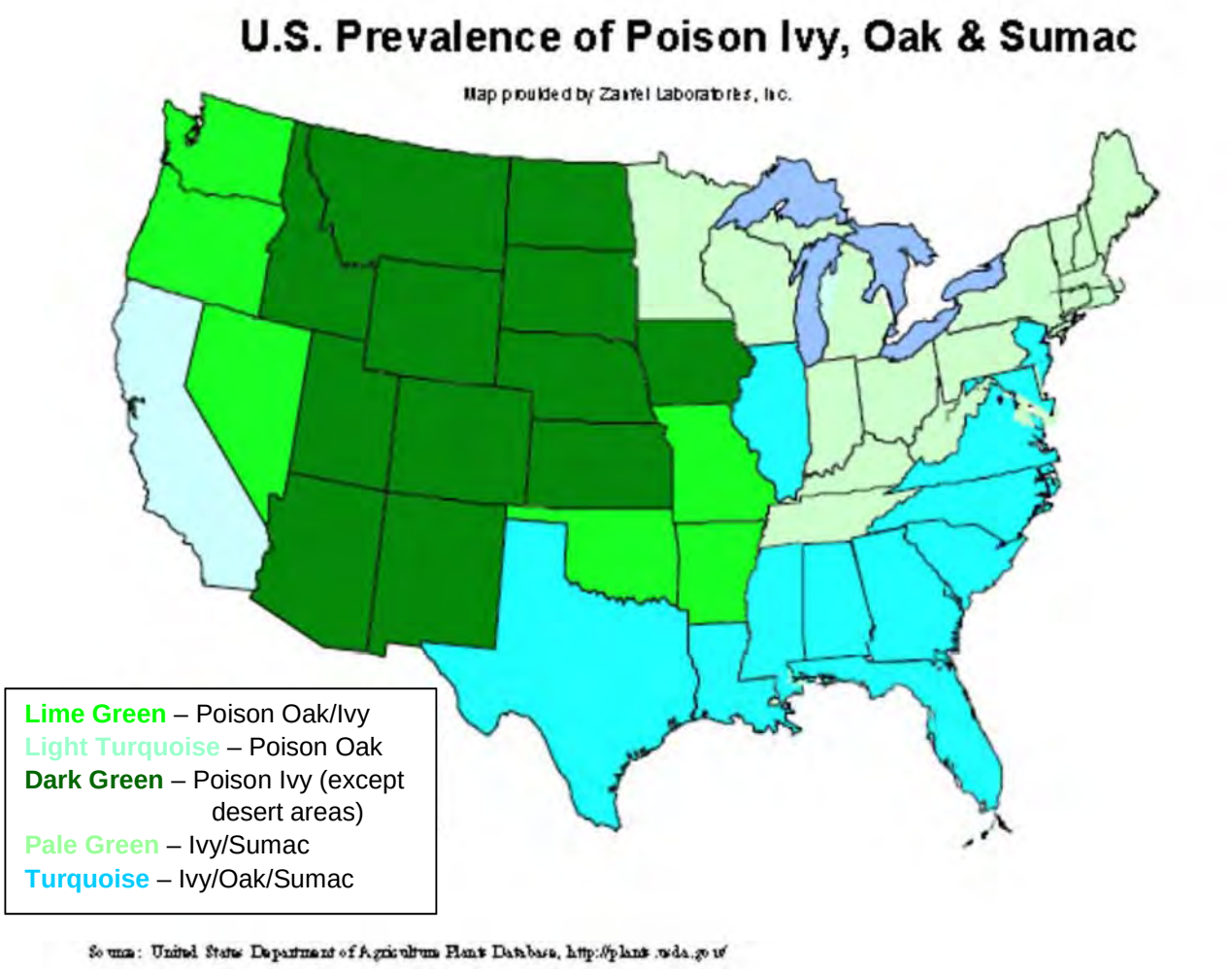
Poison oak can be present as a sparsely-branched shrub. Poison oak can grow anywhere in the United States with the exception of Hawaii, Alaska, and some southwest areas that have desert climates. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches.

Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety “down.” Poison sumac has white, “hairy” berry clusters. Poison sumac grows exclusively in very wet or flooded soils, usually in swamps and peat bogs, in the eastern United States.

Poison Ivy

Poison Oak

Poison Sumac



To prevent exposure to these poisonous plants:

- Wear proper PPE, including long sleeves, long pants, boots, and gloves.
- Barrier skin creams, such as lotion containing bentoquatum (Tecnu®), may offer some protection prevent the occurrence of exposure symptoms.
- Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. Employees with known allergies should identify themselves to the SSO or Project Manager prior to starting field work as a precautionary measure. If you believe you have contacted one of these plants:
    - Immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.
    - Contact the People and Safety Team and Project Manager immediately after caring for affected skin.

  - Wash exposed clothing separately in hot water with detergent.

- After use, clean tools, and soles of boots with rubbing alcohol or soap and lots of water. Urushiol can remain active on the surface of objects for up to 5 years.
- If a rash occurs, contact the People and Safety Team and complete and submit an Incident Report Form. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

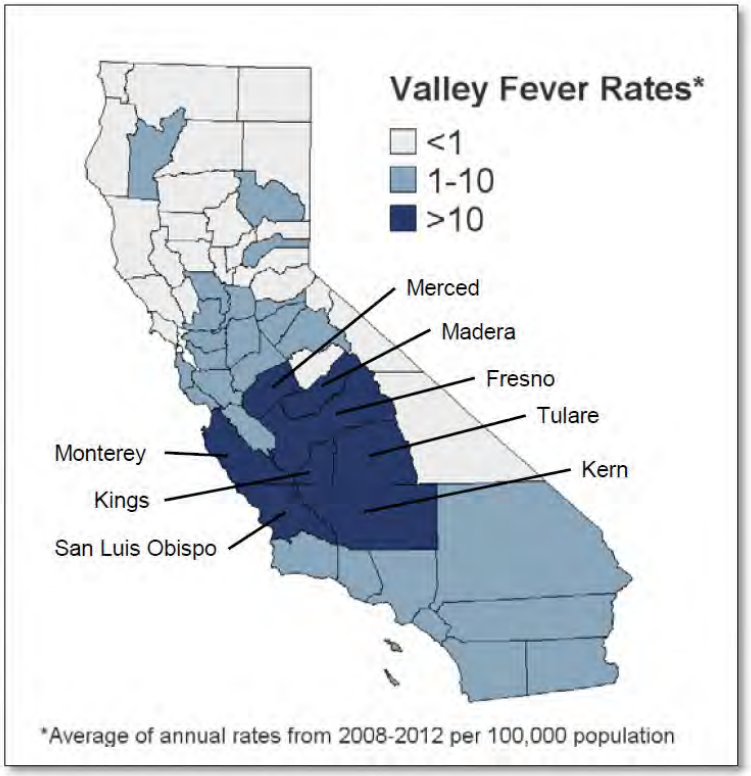
1.7 Sewage and Bacterial Impacted Sediments

Some project work may be conducted at sites that serve or have served as a combined sewer overflow and consequently may have received untreated sanitary sewage from numerous sources. Decomposed sewage can potentially be encountered within sites and their sediments. Sediments could contain soil and marine microorganisms, and bacterium associated with sewage. Many of these bacterium can cause illness through ingestion, direct contact, or the inhalation of a bio-aerosol possibly in the form of dust. Potential respiratory exposure to biological agents can also occur through the inhalation of aerosols produced during sediment handling activities. PPE as identified in the site-specific HASP will be worn to minimize potential exposures. Employees will follow the decontamination or disposal procedures identified in the HASP.

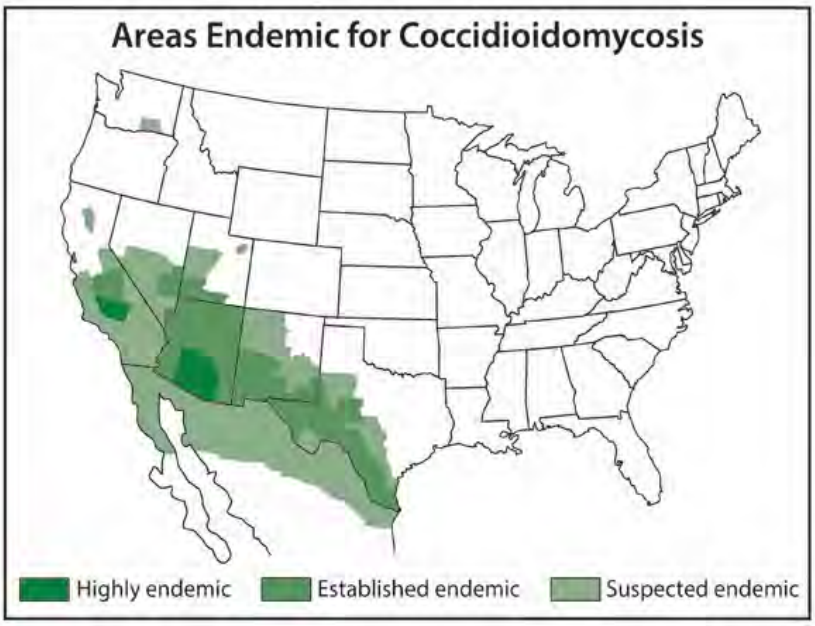
1.7.1 Fungal Spores in Soil – Valley Fever

Valley Fever is an illness that usually affects the lungs. It is caused by the fungus *Coccidioides immitis* that lives in the top 2 to 12 inches of soil in many parts of California. When fungal spores are present, any work activity that disturbs the soil, such as digging, grading, or other earth moving operations, or vehicle operation on dirt roads, can cause the spores to become airborne, therefore increasing the risk of Valley Fever. All employees on sites where the fungus is present, and who are exposed to dusty conditions and wind-blown dusts are at increased risk of becoming infected.

Valley Fever fungal spores are too small to be seen, and there is no reliable way to test the soil for spores before working in a particular place. Valley Fever can be found throughout the southwestern United States, parts of Mexico, and South America. Some California counties consistently have Valley Fever fungus present in the soil. In these regions Valley Fever is considered endemic. Health departments track the number of cases of Valley Fever illness that occur. This information is used to map illness rates as seen on the figures below from the Center of Disease Control Valley Fever Awareness website.



Rates of reported Valley Fever cases in California counties from 2008–2012. Darkest colored counties had the highest rates of Valley Fever.



When present, symptoms usually occur between 7 to 21 days after breathing in spores, and can include:

- Cough
- Fever
- Chest pain
- Headache
- Muscle aches
- Rash on upper trunk or extremities
- Joint pain in the knees or ankles
- Fatigue

Symptoms of Valley Fever can be mistaken for other diseases such as the flu (influenza) and TB (tuberculosis), so it is important for employees to obtain medical care for an accurate diagnosis and possible treatment.

While there is no vaccine to prevent Valley Fever, the following important steps must be taken in order to limit risk:

- Determine if the worksite is in an endemic area. Contact the local health department for more information about the risk in the county GEI is performing work that may disturb soils.
- Prepare work plans and work practices that reduce employee's exposure, which may include:
    - Provide air conditioned cabs with properly maintained dust filters for vehicles that generate heavy dust and make sure employees keep windows and vents closed.
    - Suspend work during heavy winds.
- When exposure to dust is unavoidable, National Institute for Occupational Safety and Health (NIOSH)-approved respiratory protection with particulate filters rated as N95, N99, N100, P100, or High Efficiency Particulate Air (HEPA) must be provided. The Project Manager must work with the Safety Team to develop and implement a respiratory protection program in accordance with California's Occupational Safety and Health Administration (Cal/OSHA's) Respiratory Protection standard (8 CCR 5144) for the project.
- Take measures to reduce transporting spores offsite, such as:
    - Clean tools, equipment, PPE, and vehicles before transporting offsite.
    - If employee's clothing is likely to be heavily contaminated with dust, provide coveralls and change rooms, and showers where possible.

1.8 Injury Reporting

If a GEI employee suffers an injury, bite, or sting on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.9 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.10 References

http://www.cdc.gov/ncidod/dvbid/westnile/index.htm
http://www.cdc.gov/ncidod/dvbid/westnile/qa/insect_repellent.htm
http://www.epa.gov/pesticides/health/mosquitoes/insectrp.htm
http://www.cdc.gov/niosh/topics/lyme/
Protecting Yourself from Ticks and Mosquitoes, NIOSH Fast Facts, Publication No. 2010-119
http://npic.orst.edu/pest/mosquito/ptc.html
http://www.cdc.gov/features/valley-fever-10-things/
https://www.cdph.ca.gov/HealthInfo/discond/Documents/VFGeneral.pdf
https://blog.epa.gov/blog/tag/mosquitoes/

1.11 Attachments

None

1.12 Contact

Health&SafetyTeam@geiconsultants.com

1.13 Review History

- June 2016
- June 2014
- November 2013
- October 2010

STANDARD OPERATING PROCEDURES

SOP NO. HS-003 Container Management

1.1 Objective

This Standard Operating Procedure (SOP) has been developed to minimize the potential for injuries to GEI employees performing container and drum handling and sampling, through proper use of engineering and administrative controls, personal protective equipment (PPE), and education.

1.2 General

This SOP is intended for use by employees engaged in work with the management of containers that may contain hazardous substances or contaminated media. The site-specific health and safety plan (HASP) should include a hazard assessment and control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

Hazardous substances and contaminated media will be handled, transported, labeled, and disposed of in accordance with this paragraph. Drums and containers will meet the appropriate United States Department of Transportation (DOT), Occupational Safety and Health Administration (OSHA), and Environmental Protection Agency (EPA) regulations for the wastes that they contain.

Site operations will be organized to minimize the amount of drum or container movement. Prior to movement of drums or containers, employees exposed to the transfer operation will be notified of the potential hazards associated with the contents of the drums or containers. Unlabeled drums and containers will be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L, shall be on hand and ready for use to control incipient fires.

DOT specified salvage drums or containers and suitable quantities of proper absorbent will be kept available and used in areas where spills, leaks, or ruptures may occur. Where spills may occur, a spill containment program, which may be part of the HASP, will be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

1.3 Opening Drums and Containers

The following procedures will be followed in areas where drums or containers are being opened:

- Employees not actually involved in opening drums or containers will be kept a safe distance from the drums or containers being opened.
- If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation will be placed between the employee and the drums or containers being opened to protect the employee in case of accidental release.
- GEI employees will not handle or attempt to open bulging containers. Employees will not stand upon or work from drums or containers. GEI will contract with a hazardous waste company to handle, manage, and dispose of a bulging drum.

1.4 Material Handling Equipment

Several types of equipment can be used to move drums: (1) a drum grappler attached to a hydraulic excavator; (2) a small front-end loader, which can be either loaded manually or equipped with a bucket sling; (3) a rough terrain forklift; (4) a roller conveyor equipped with solid rollers; and (5) drum carts designed specifically for drum handling. GEI employees will not operate heavy equipment to move drums. This will be handled by an authorized subcontractor.

The following procedures can be used to maximize worker safety during drum handling and movement:

- Train personnel in proper lifting and moving techniques to prevent back injuries.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface.
- Air condition the cabs of vehicles to increase operator efficiency; protect the operator with heavy splash shields.
- Supply operators with appropriate respiratory PPE when needed. Normally either a combination SCBA/SAR with the air tank fastened to the vehicle, or an airline respirator, and an escape SCBA are used because of the high potential hazards of drum handling. This improves operator efficiency and provides protection in case the operator must abandon the equipment.
- Have overpacks ready before any attempt is made to move drums.
- Before moving anything, determine the most appropriate sequence in which the various drums and other containers should be moved. For example, small

containers may have to be removed first to permit heavy equipment to enter and move the drums.

- Exercise extreme caution in handling drums that are not intact and tightly sealed.

- Ensure that operators have a clear view of the roadway when carrying drums. Where necessary, have ground workers available to guide the operator's motion.

1.5 Leaking, Open, and Deteriorated Drums

If a drum containing a liquid cannot be moved without rupture, immediately transfer its contents to a sound drum using a pump designed for transferring that liquid. Contract an approved vendor to immediately use an over pack container if the:

- Leaking drum contains sludge or semi-solids;

- Open drum contains liquid or solid waste;

- Deteriorated drum can be moved without rupture.

1.6 Radioactive Wastes

GEI does not routinely handle or manage radioactive waste. If required to do so for a project, procedures will be approved by the Corporate Health and Safety Officer (CHSO) and Regional Health and Safety Officer (RHSO).

1.7 Shock-Sensitive Wastes

GEI employees will not handle shock-sensitive waste. Shock-sensitive waste or chemicals may explode with friction, movement or heat. Some chemicals are shock-sensitive by nature-, others become shock-sensitive through drying, decomposition, or slow reactions with oxygen, nitrogen, or the container. Some chemicals that are, or can, become shock-sensitive will have that hazard noted in the safety data sheet (SDS).

- Drums and containers containing packaged laboratory wastes will be considered to contain shock-sensitive or explosive materials until they have been characterized. *Caution: Shipping of shock-sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Shippers will refer to 49 CFR 173.21 and 173.50.*

1.8 Laboratory Waste Packs

It is unlikely that GEI employees work in an environment where laboratory waste packs are used. However if one is found, do not handle or open it. Complete the incident reporting form to identify finding the pack and then work with the Project Manager to find the appropriate means of disposal.

1.9 Sampling of Drum and Container Contents

Sampling of containers and drums will be done in accordance with a site-specific sampling plan that will be developed in conjunction with a site-specific HASP.

1.10 Staging Areas

Drums and containers will be identified and classified prior to packaging for shipment. Drum or container staging areas will be kept to a minimum number as approved by the client to safely identify and classify materials and prepare them for transport. Staging areas will be provided with adequate access and egress routes. Bulking of hazardous wastes will be permitted only after a thorough characterization of the materials has been completed and approved by the Client. GEI employees will not sign manifests unless a written authorization agreement is in place with the Client.

1.11 Shipment and Training

Shipment of materials to off-site treatment, storage, or disposal facilities involves the entry of waste hauling vehicles into the site. U.S. Department of Transportation (DOT) regulations (49 CFR Parts 171-178) and EPA regulations (40 CFR Part 263) for shipment of wastes must be complied with. Employees managing hazardous waste on behalf of a client must complete annual RCRA training and triannual DOT hazardous materials training. Training must be current and a manifest agreement with the client must be in place before employees can sign hazardous waste manifests on behalf of a client.

1.12 Tank and Vault Procedures

GEI employees do not routinely sample vaults and tanks. Entry procedures will be coordinated and approved by the CHSO and RHSO.

1.13 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the

potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.14 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection and appropriate training must be current

1.15 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response (j) Handling of Drums and Containers

1.16 Attachment

None.

1.17 Contact

Health&SafetyTeam@geiconsultants.com

1.18 Review History

- June 2016
- May 2014
- November 2013
- October 2011
- Initial Version Date Unknown

STANDARD OPERATING PROCEDURES

SOP No. HS-006 Excavations and Trenches

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to highlight the hazards and safety procedures when work activities include excavations and/or trenches. The following guidelines will be followed when excavations or trenches are present on GEI projects.

1.2 General

This SOP is intended for use by employees engaged in work on project sites that include trenching and/or excavation operations. The site-specific health and safety plan (HASP) must include a hazard assessment for the project that identifies the potential for trenching and excavation hazards and the control methods to be implemented by GEI employees. These hazards must be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

An “excavation” is any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.

A “trench” (trench excavation) is a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet.

Do not enter a trench or excavation without consulting with the Project Manager, Corporate Health and Safety Officer (CHSO), or Regional Health and Safety Officer (RHSO).

1.2.1 Personal Protective Equipment

Employees will be provided with the personal protective equipment (PPE) necessary to help protect them from the hazards of work activities related to excavations and/or trenches. All employees will wear a hard hat, steel toe or composite toe boots, and safety glasses at a minimum. In addition, face shields, gloves, fall protection and hearing protection may be required. PPE must be maintained in good condition, kept clean and properly stored when not in use. More information regarding PPE is located in Section 6 of GEI’s Corporate Health and Safety Program.

1.3 Hazards

Hazards associated with excavations and trenches can include collapse, falls, falling objects, hazardous atmospheres, and incidents involving mobile equipment. One cubic yard of soil can weigh as much as a car.

1.4 Entry

GEI employees will not enter trenches or excavations that do not comply with OSHA 29 CFR 1926.650. If a project requires GEI employees to enter a trench or excavation, the trench or excavation must meet the following requirements described in the following sections.

Do not enter a trench or excavation without consulting with the Project Manager, Corporate Health and Safety Officer (CHSO), or Regional Health and Safety Officer (RHSO).

1.4.1 Competent Person

The excavation must be inspected prior to the start of each shift by a competent person who most likely will work for the contactor performing the work. The competent person is an individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to workers, soil types and protective systems required, and who is authorized to take prompt corrective measures to eliminate these hazards and conditions. GEI generally does not act as the competent person.

1.4.2 Soil Type

The competent person for the project will determine what the soil type is and what type of protective system will be implemented. The type of soil where the excavation or trench is being dug has significant influence on what type of protective system will need to be in place. There are four types of soil: stable rock, type A, type B, and type C. As you progress from stable rock to type C, the cohesive properties of the soil change the soil becomes less stable.

1.4.3 Protective System

A protective system is required for trenches or excavations greater than 5 feet in depth unless the excavation is made entirely in stable rock. In special situations the competent person may require a protection system for an excavation that is less than 5 feet deep. The competent person is responsible for assessing the soil type and the protective systems required for a specific trench when an excavation is less than 20 feet deep. If the excavation is greater than 20 feet in depth, the protection system requires a design by a registered professional engineer or based on tabulated data prepared and/or approved by a registered professional engineer.

The protective system will be designed based on soil type, depth of excavation, water level, loads adjacent to the excavation, changes in weather conditions, or other operations in the area. Protective systems can include sloping or benching of the sidewalls, shoring the sidewalls using an approved support system, or shielding workers with a trench box or other similar type of support.

The different types of protective systems include:

Benching is a method of protecting workers from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels of steps, usually with vertical or near vertical surfaces between levels. Benching cannot be done with Type C soil.

Sloping involves cutting back the trench wall at an angle inclined away from the excavation.

Shoring requires installing aluminum hydraulic or other types of support structures to prevent soil movement and cave-ins.

Shielding protects workers by using trench boxes or other types of supports to prevent soil cave-ins.

Designing a protective system can be complex because many factors must be considered: soil classification, depth of cut, water content of soil, changes caused by weather or climate, surcharge loads (e.g., spoil, other materials to be used in the trench) and other operations in the vicinity.

1.4.4 Access and Egress

Excavations and trenches greater than 4 feet in depth require a safe access and egress including ladders, steps, or ramps. These points of access and egress are to be no greater than 25 feet of lateral travel in any direction.

1.4.5 Atmospheric Hazards

Where oxygen deficiency (atmospheres containing less than 20.7% oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation will be tested before employees enter excavation.

1.5 Subcontractor Oversight

When GEI is overseeing excavation activities performed by a subcontractor, the following safety hazards should be monitored:

- Care must be taken not to create new hazards like narrow walkways along edges of an excavation.
- Heavy equipment must not be parked or working at the edge of the excavation.
- Spoils should not be stockpiled within 2 feet of the trench edges.
- Confirm with subcontractor that underground utilities have been located before any excavation or trenching activities begin (*refer to* SOP HS-014 Utility Mark-out).
- Confirm with the subcontractor that the excavation or trench has been tested for hazardous atmospheres before entering.
- Confirm with the subcontractor that the excavation or trench has been inspected by a competent person before each work shift and after any type of precipitation. If hazards are identified during this inspection, verify that the hazards are controlled prior to entering the trench or excavation.
- GEI employees will not work under raised or suspended loads.
- Excavations/trenches must be protected at the end of a work shift if they are to be left open. These trenches/excavations must be covered and a sign that reads "Hole" must be placed in a location that will notify anyone of the hazard. Or a secure barricade will need to be installed.

In circumstances where GEI employees are working on sites where a contractual agreement with the excavation contractor does not exist and we cannot confirm the above stated conditions, entry into trenches or excavations will not be conducted. Any safety concerns that arise should be communicated to the Project Manager and, if necessary, the client.

1.6 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened.

The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.7 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

Some states, including Massachusetts, require a trench permit prior to trenching or excavation activities. Verification of local requirements will be evaluated in the planning stage.

1.8 References

OSHA 29 CFR 1926.650 – Subpart P; *Excavations*
OSHA Construction eTool – http://www.osha.gov/SLTC/etools/construction/index.html
OSHA FactSheet Trenching and Excavation Safety – viewed on 9/13/2016
https://www.osha.gov/OshDoc/data_Hurricane_Facts/trench_excavation_fs.pdf

1.9 Attachments

None

1.10 Contact

Health&SafetyTeam@geiconsultants.com

1.11 Review History

- September 2016
- May 2014
- November 2013
- January 2011
- Initial Version Date Unknown

STANDARD OPERATING PROCEDURES

SOP NO. HS-009 Hazardous Substances Exposure Management

1.1 Objective

This Standard Operating Procedure (SOP) is intended to outline the steps GEI employees will take to identify potential hazards associated with exposure to hazardous substances, the risks associated with these hazards, and the proper controls to use to minimize exposure. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential of encountering a hazardous substance and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2 General

A hazardous substance is any substance that has one or more of the following intrinsic properties:

- Explosiveness
- Flammability
- Ability to oxidize
- Human toxicity (acute or chronic)
- Corrosiveness (to human tissue or metal)
- Ecotoxicity (with or without bioaccumulation)
- Capacity, on contact with air or water, to develop one or more of the above properties

1.3 Hazard Identification

An initial identification of hazards should be done based on a review of available documents including lists of chemicals used on site, analytical data from soil, surface water, groundwater, air, spill history, site history, equipment on site, maps, photos, and a preliminary survey.

Once hazardous substances are identified the regulated exposure limits need to be identified. Each substance may have a state/federal exposure value for each of the following (if applicable):

Action Level – An airborne level, typically one-half of the permissible exposure limit (PEL) designated in Occupational Safety and Health Administration's (OSHA's) substance-specific standards, 29 CFR 1910, Subpart Z, calculated as an

8-hour time weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Ceiling Limit – The exposure limit a worker's exposure may never exceed.

Sampling and Analytical Error – A statistical estimate of the uncertainty associated with a given exposure measurement.

Short-Term Exposure Limit (STEL) – The average exposure to a contaminant to which a worker may be exposed during a short time period (typically 15-30 minutes).

Time Weighted Average (TWA) – The average exposure to a contaminant over a given period of time, typically 8 hours.

1.4 Risk Identification

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances will be identified. GEI employees and GEI subcontractors who will be working on the site will be informed of risks that have been identified.

Risks to consider include, but are not limited to:

- Potential exposures exceeding the permissible exposure limits and published exposure levels
- Potential Immediately Dangerous to Life and Health (IDLH) concentrations
- Potential skin absorption and irritation sources
- Potential eye irritation sources
- Potential hazardous atmospheres, including oxygen deficiency and fire and explosion hazards

1.5 Engineering Controls, Work Practices, and Personal Protective Equipment for Employee Protection

Engineering controls, work practices, and personnel protective equipment (PPE) for substances regulated in OSHA Subpart G (Occupational Health and Environmental Control) and Subpart Z (Toxic and Hazardous Substances) will be implemented in to protect employees from exposure to hazardous substances and safety and health hazards.

1.5.1 Elimination/Substitution

The first control method should be to try and eliminate or substitute the hazards with a safer alternative. This is the most effective solution as shown is Figure 1 below. If you can remove the hazard than you no longer need to find a way to protect the employee

from it. Or you can substitute a different piece of equipment or chemical to use that doesn't pose the same hazard and doesn't create a new one.

1.5.2 Engineering Controls

Engineering controls implement physical change to the workplace, which eliminates/reduces the hazard on the job/task. Examples include:

- Change the process to minimize contact with hazardous chemicals
- Isolate or enclose the process
- Use of wet methods to reduce generation of dusts or other particulates
- General dilution ventilation
- Use of fume hoods

1.5.3 Administrative Controls (Work Practices)

Administrative controls establish efficient processes or procedures to help protect the employee. Examples of these are:

- Rotate job assignments
- Adjust work schedules so that workers are not overexposed to a hazardous chemical

1.5.4 Personal Protective Equipment

The use of PPE to reduce exposure to risk factors is the last line of defense. All other options should be exhausted before use of PPE. Examples of PPE are:

- Chemical protective clothing
- Respiratory protection
- Gloves
- Eye or hearing protection
- Steel toe boots

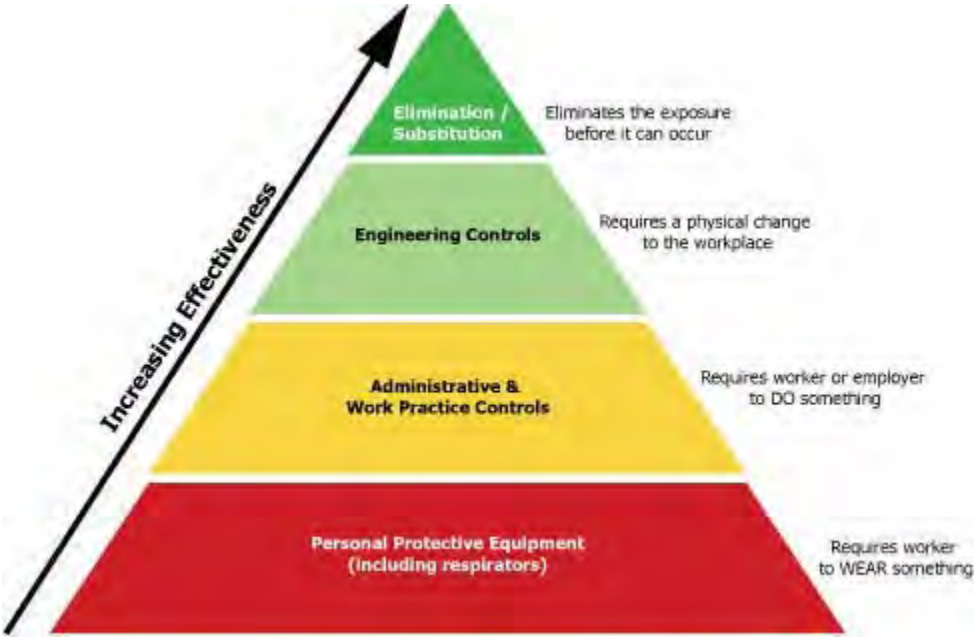


Figure 1: Hazard Mitigation Effectiveness Pyramid

1.5.5 Engineering Controls, Work Practices, and PPE for Substances Regulated in Subparts G and Subpart Z

Engineering controls and work practices will be instituted to reduce and maintain employee exposure at or below the PELs for substances regulated by 29 CFR Part 1910.

Engineering controls that may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices may include removing non-essential employees from potential exposure during opening of drums, wetting down dusty operations, and positioning employees upwind of potential hazards.

If engineering controls and work practices are not feasible, or not required, a reasonable combination of engineering controls, work practices, and PPE will be used to reduce and maintain at or below the PELs or dose limits for substances regulated by 29 CFR Part 1910, Subpart Z.

GEI will not implement a schedule of employee rotation as a means of compliance with PELs or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

The provisions of 29 CFR, subpart G, will be followed.

1.5.6 Engineering Controls, Work Practices, and Personal Protective Equipment for Substances Not Regulated in Subparts G and Subparts Z

An appropriate combination of engineering controls, work practices, and PPE will be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Subparts Z. GEI will use published literature and Safety Data Sheets (SDS) as a guide in making the determination of what level of protection is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

1.5.7 Decontamination Procedures

Decontamination procedures will be developed, communicated to employees, and implemented before employees or equipment enter areas on site where potential for exposure to hazardous substances exists. Procedures will be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

GEI employees leaving a contaminated area will be properly decontaminated; contaminated clothing and equipment leaving a contaminated area will be properly disposed of or decontaminated.

Decontamination procedures will be monitored by the site safety officer (SSO) to determine their effectiveness. When such procedures are found to be ineffective, the site safety officer will contact the Corporate Health and Safety Officer and appropriate steps will be taken to correct deficiencies.

Location

Decontamination will be performed in areas that will minimize the exposure to employees, equipment, and the environment.

Equipment and Solvents

Equipment and solvents used for decontamination will be decontaminated or disposed of properly.

Personal Protective Clothing and Equipment

Protective clothing and equipment will be decontaminated, cleaned, laundered, maintained, or replaced as needed to maintain their effectiveness.

Employees whose clothing comes in contact with hazardous substances will immediately remove that clothing and follow the directions on packaging or SDS sheet for how to properly clean the exposed area. The clothing will be disposed of or decontaminated before it is removed from the work zone.

Commercial Laundries or Cleaning Establishments
Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment will be informed of the potentially harmful effects of exposures to hazardous substances.

Showers and Changing Rooms
Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, these will be provided and meet the requirements of 29 CFR 1910.141 (Sanitation). If temperature conditions prevent the effective use of water, then other effective means for cleansing will be provided and used.

1.6 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health and Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.7 Limitations

None

1.8 References

OSHA 1910.120 Hazardous Waste Operations and Emergency Response
OSHA 1910 Subpart G Occupational Health and Environment Control
OSHA 1910 Subpart Z Toxic and Hazardous Substances
OSHA 1910.141 General Environmental Controls – Sanitation
http://www.business.govt.nz/worksafe/information-guidance/legal-framework/hsno-act-1996/defining-hazardous-substances/ (Viewed 7/8/2016)
https://www.osha.gov/SLTC/hazardoustoxicsubstances/ (Viewed 7/8/2016)
https://www.osha.gov/SLTC/hazardoustoxicsubstances/control.html (Viewed 7/11/2016)

1.9 Attachments

None

1.10 Contact

Health&SafetyTeam@geiconsultants.com

1.11 Review History

- July 2016
- May 2014
- November 2013
- August 2011 known as Hazard Identification and Management
- February 2011 known as HS-008 Contaminant Properties

STANDARD OPERATING PROCEDURES

SOP No. HS-010 Inclement Weather

1.1 Objective

This Standard Operating Procedure (SOP) is intended for use by employees engaged in work with the potential to be affected by inclement weather. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for working in inclement weather and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2 General

Employees should be aware of local weather conditions and monitor advisories issued by the National Weather Service and other local reporting services. Depending on location and season, storms are capable of producing heavy rain, floods, extreme temperatures, high wind conditions, lighting, tornados, and/or snowfall.

1.2.1 Heavy Rain

If working or driving in a rain storm, use extreme caution. When driving, turn your low beam lights on when the rainfall becomes heavy. Employees should be aware of the following:

- Heavy rain decreases visibility, especially when driving.
- Surfaces and tools become slippery.
- If you are working in the rain and your clothes become wet there is a risk of hypothermia when exposed to winds, even in warm temperatures.
- If the storms are going to produce thunder and/or lightning, leave the work area immediately and move to a safe area.
- Use your best judgment to determine if the rainfall becomes too heavy to continue working safely.

1.2.2 Lightning

Lightning can strike as far as 10 miles from the area where it is raining. That's approximately the distance you can hear thunder. **If you can hear thunder, you are within striking distance. Seek safe shelter immediately.** This can be within a building or vehicle. Wait 30 minutes after the last clap of thunder or flash of lightning before going outside again.

1.2.3 Flooding

Flooding may occur as a result of heavy rain in a short period of time. Flooding can be particularly acute in canyon areas where dry creek beds can turn into raging rivers from rainfall in distant or higher elevation areas. Be aware of this and your surroundings and move to a safe place if you begin to see signs that flooding may occur. Signs of potential flooding include sudden appearance of water in dry creek beds, increased water flow in rivers or streams, or quick rise in water levels.

Do not attempt to drive through areas or streets that are flooded. Seek alternate routes. Be particularly cautious at night when flooded areas are difficult to see. Urban flooding can stop traffic; increase the potential for traffic accidents; and can trap people in vehicles.

1.2.4 Extreme Temperatures

Work activities may take place in extreme heat or cold. Be prepared if these conditions are anticipated. Have the appropriate personal protective equipment (PPE) available; exercise proper fluid intake; and take breaks to prevent heat and cold stress. For more information about these conditions see the heat stress and cold stress programs found in GEI's Health and Safety Program.

1.2.5 High Winds, Tropical Storms, and Tornados

High Winds can be extremely dangerous. Appropriate measures will be taken to secure equipment and loose items when working in windy conditions. The project manager should be contacted about the weather conditions and, if necessary, work should be postponed.

Tropical storms are described as storms with sustained winds ranging from 39 to 73 miles per hour (mph) and hurricanes produce sustained winds that exceed 74 mph. When winds approach 40 mph (gale force winds) twigs begin to break off of trees and vehicles will veer off of the road. When winds approach 40 mph or the GEI employee feels unsafe based on the activities being performed, stop work and seek shelter as soon as possible. Blowing or falling debris and overhanging limbs/signs can be a significant hazard. If possible, avoid driving in these conditions; 70 percent of injuries during hurricanes are a result of vehicle accidents. Note that tall or elevated equipment will have manufacturer's safe operating wind speeds defined that could be less than 40 mph. The operator's manual should be consulted prior to operation of the equipment.

A tornado is a violent, dangerous, rotating column of air that is in contact with both the surface of the earth and a cumulonimbus cloud or, in rare cases, the base of a cumulus cloud. The Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure. Based on the Fujita Scale, or F-Scale, numbers begin at F0: 40-72 mph and go to F6: 319-379 mph (F6 is

generally theoretical). Nearly three-fourths of tornados are on the weak F0-F1 scale with just over two-thirds of deaths resulting from the violent F4-F5 tornados.

If a tornado is seen, stop work and seek shelter immediately. If a tornado siren is sounded move immediately to safety indoors and then move to a windowless interior space, basement, stairwell, or designated fall-out shelter. Windows should not be opened before an oncoming tornado. If there is no shelter available, seat belt yourself into your stationary vehicle or seek a depression or low spot on the land surface.

1.2.6 Snowfall and Ice Conditions

Working in the winter months may result in activities taking place during periods of snowfall or icy conditions. If you are working during or after snow has fallen, dress appropriately for the conditions. Snow and ice can cause working surfaces to become slippery. Clear snow and ice from work areas to prevent slip hazards. Use caution when performing snow or ice removal activities to prevent injuries. Driving in snowy and icy conditions is also hazardous. Reduce speed and use caution if you must drive in these conditions.

If the weather conditions deteriorate and you do not feel safe working in these conditions, stop work, move to a safe indoor location, and contact your project manager to let them know the weather, work conditions, and your location.

1.3 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.4 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection. Protection in extreme weather conditions can best be accomplished if the conditions are anticipated and actions are taken. Monitor local weather conditions prior to starting work.

1.5 References

Center for Disease Control and Prevention – Natural Disasters and Severe Weather
http://www.bt.cdc.gov/disasters/

National Lightning Safety Institute

NOAA, National Weather Service

Office of Climate, Water, and Weather Services

1.6 Attachment

None

1.7 Contact

Safety Team
Health&SafetyTeam@geiconsultants.com

1.8 Review History

- Previous revision dates were not documented
- May 2014
- July 2016

STANDARD OPERATING PROCEDURE

SOP HS-014 Utility Mark-out

1.1 Objective

This Standard Operating Procedure (SOP) provides guidance for utility mark-out procedures related to drilling, excavation, or other sub-surface or intrusive activities to avoid injury to GEI employees or property damage. This SOP is applicable when GEI is responsible for its operation or our subcontractor's operation for utility mark-out. A utility mark out is when paint, flags or other markers are put in place to identify the location of an underground utility.

Clients or local agencies may have additional requirements or procedures to mark out of utilities. If local utility mark-out procedures differ from those described within this SOP, applicable state or municipal regulations should be followed.

1.2 General

This SOP is intended for use by employees engaged in work with sub-surface or intrusive activities. The site-specific health and safety plan (HASP) should include a hazard assessment for the project that identifies the potential for subsurface hazards and the control methods to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.2.1 Contractor/GEI Responsibilities

- The contractor or GEI employee will pinpoint each exploration area with white paint, flags, or stakes. personal protection equipment (PPE), including eye protection when using spray paint will be worn.
- Exploration locations should be marked-out with sample identification number(s) and type of sample (e.g., boring, test-pit, or monitoring well).
- The contractor compiles information about the work areas on a request form specified by the state utility mark-out program and submits it. Work area location maps can be sent to the utility mark-out program to clarify locations.
- The mark-out program customer service representative will provide a mark-out ticket number and a list of utilities notified upon receipt of the request information. This information will be recorded on the GEI documentation form in Appendix B and/or in other project documents.
- If known, the contractor or GEI employee will also notify non-member utility operators (e.g., apartment complexes, commercial complexes, railroads with communication cables, etc.).

1.2.2 Utility Mark Outs

- Utility companies or their sub-contractors will only mark-out, or clear, utilities under their responsibility. Generally, this means that they will only mark-out utilities within the public right-of-way up to private property boundaries. Information needed to determine the location of utilities on private properties will be requested from the property owner. This may include available property drawings or as-built figures. If this information is not available, additional non-intrusive surveys of the property may be required by a private utility locator to find underground utilities by using techniques such as ground penetrating radar (GPR).
- American Public Works Association (APWA) Uniform Color Code For Marking Underground Utility Lines are:
    1. **White** – Proposed Excavation
    2. **Pink** – Temporary Survey Markings
    3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
    4. **Yellow** – Gas, Oil, Steam, Petroleum, and Gaseous Material
    5. **Orange** – Communications, Alarm, Signal Lines, Cables or Conduit
    6. **Blue** – Water
    7. **Purple** – Radioactive Materials
    8. **Green** – Sanitary and Storm Sewers and Drain Lines

1.2.3 Utility Mark Out Review

- Before the intrusive work activities begin, the contractor or GEI employee will verify that each utility company has completed a utility location for the work area or the location has been cleared by a private locator and record this on the mark-out request information sheet.
- A visual survey of the project area will be done prior to the start of intrusive activities. This visual inspection will be done to identify signs, manholes, utility boxes, or other evidence of an underground utility is present and has been considered.
- The contractor or GEI employee can begin work on the scheduled work date and time if the utility operators have responded, taking care to find and preserve markings that have been made.
- Completed clearance documentation will be located on the excavation site during excavation activities and kept in project files.

1.2.4 Excavations

- When excavating near a buried utility, observe the approximate location around that utility.
- If exposing a utility, proper support and protection must be provided so that the utility will not be damaged.
- If the excavation work requires significant spans of the utility to be exposed, it is the contractor's responsibility to support the infrastructure (to prevent sagging or collapse) as needed. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, provide proper backfill for utilities that have been exposed.
- Take care not to damage the conduit or protective coating of a utility. If the damage occurs, leave the damaged utility exposed and immediately call the utility owner.
- If a gas line is encountered, everyone will be evacuated according to the site evacuation procedures and the contractor must notify police, fire, and emergency personnel. No attempt should be made to tamper with or correct the damaged utility. All site personnel are to evacuate to the site's predetermined meeting point or a location a minimum of 300 feet away from the incident location.
- If the contractor needs to dig within the approximate location of a combustible, hazardous fluid, or gas line (natural gas, propane or gasoline), soft digging is required (hand digging, vacuum extraction) to a maximum depth of 5 feet. The approximate location is defined as 24 inches on either side of the designated center line of the utility if the diameter is not provided or 24 inches from each outside edge if the diameter is provided.

1.3 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification and/or the receipt of the Incident Report Form, RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.4 Limitations

- Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.
- Mark-out notification time usually does not include holidays. Make sure holidays are considered and mark-out time is scheduled accordingly. Under no circumstances are intrusive activities allowed to be performed prior to the required mark-out.
- Do not use white paint if precipitation is eminent. Consider using stakes if snow is predicted.

1.5 References

Reference the website for the "Call Before You Dig – 811" for the utility mark-out agency for the state you working in prior to site work. If you have issues locating the appropriate agency, contact the Safety Team for assistance.

1.6 Attachments

Attachment A – Standard Utility Color Codes

Attachment B – GEI Utility Clearance Documentation Form

1.7 Contact

Health&SafetyTeam@geiconsultants.com

1.8 Review History

- June 2016
- May 2014
- November 2013
- February 2011
- November 2010

ATTACHMENT A

COLOR CODE FOR UTILITY MARKING

(BASED ON 'THE AMERICAN PUBLIC WORKS ASSOCIATION' RECOMMENDATIONS AND THE ANSI STANDARD Z-53.1 FOR SAFETY COLORS)

UTILITY	COLOR
PROPOSED EXCAVATION	WHITE
ELECTRIC POWER LINES, CABLES, CONDUIT AND LIGHTING CABLES	RED
POTABLE WATER	BLUE
STEAM, CONDENSATE, GAS OR OIL COMPRESSED AIR	YELLOW
TELECOMMUNICATIONS, ALARM OR SIGNAL LINES, CABLES OR CONDUIT	ORANGE
TEMPORARY SURVEY MARKINGS	PINK
SEWER AND STORM DRAINS	GREEN
CHILLED WATER, RECLAIMED WATER, IRRIGATION AND SLURRY LINES	PURPLE
OTHER	LIGHT BLUE

ATTACHMENT B

Utility Clearance Documentation

Please print clearly. *For more room, use back of page.*

Client: _____

GEI Project Name & Number: _____

Site: _____

Excavation/Drilling Location ID: _____

Excavator/Driller: _____

GEI PM: _____ GEI Field Team Leader: _____

Utility Drawings Reviewed: _____

Provided By: _____ Reviewed By: _____

Utility Clearance Call Date: _____ Name of Utility: _____

Utility Clearance Call Date: _____ Name of Utility: _____

Utility Clearance Received from (utility & rep name): _____ Date: _____

Utility Clearance Received from (utility & rep name): _____ Date: _____

Company that completed clearance: _____ Date: _____

GEI Staff Responsible for Oversight: _____

Metal Detector Survey (yes/no): _____ Drilling Location Cleared by: _____

Contractor Name: _____ Company Name: _ Contractor Signature: _____

_____ Date: _____

GEI Staff Responsible for Oversight: _____

Private Location Clearance Required (yes/no): _____ Date: _____

Contractor Name: _____ Company Name: _____

Contractor Signature: _____ Date: _____

Methods used for utility location (i.e. GPR, electronic pipe location) _____

GEI Staff Responsible for Oversight: _____

Hand clearing Performed (yes/no): _____ Methods: _____ Date: _____

Contractor Name: _____ Company Name: _____

Contractor Signature: _____ Date: _____

GEI Staff Responsible for Oversight: _____

GEI Consultants, Inc. Representative (name & title): _____

GEI Consultants, Inc. Representative Signature: _____ Date: _____

Based upon the best available information, appropriate utility clearance procedures were performed for the invasive work specified. If client ordered site specific deviations from existing GEI utility clearance procedures, they are approved by the client signature below:

Client Representative (name & title): _____

Client Representative Signature: _____ Date: _____

Notes:

STANDARD OPERATING PROCEDURES

SOP No. HS-016 Traffic Hazard Management

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the potential for GEI personnel to encounter traffic hazards during field activities.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for traffic hazards. The site-specific health and safety plan (HASP) will include a hazard assessment for the project that identifies the potential for exposure to traffic hazards and the control methods to be implemented by GEI employees, including review or attainment of necessary permits, traffic control plans, and flagger/police detail requirements for the local jurisdiction. Routine checks of the work zone will be made to ensure there are adequate levels of protection. These hazards will be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Traffic Hazard Management

Traffic Hazard Management is the process of identifying and managing the potential risks associated with the movement of traffic through, around, or past a work area. This Traffic Hazard Management SOP is designed to assist employees in identifying and managing these hazards. Work areas should be as safe as possible. It is the responsibility of GEI employees to follow the Traffic Hazard Management SOP and adhere to these safety standards. Safety is not negotiable.

Under no circumstances are GEI employees permitted to commence work in a situation that the employee believes or knows their health and safety, or the health and safety of others, is at risk.

Major risk factors for work site Traffic Hazard Management include:

- The speed of traffic moving through a work site.
- The distance and clearance between moving traffic, workers, vehicles and equipment, and over-head power lines.
- Traffic volume and vehicle composition.
- Nature and conditions at the work site and approaches to the work site.

- Other factors such as the time of day, sight distance, weather, presence of pedestrians, or cyclists, and the type of work being carried out.
- Other hazards in proximity to the work site (e.g., power lines, open excavations) that may have conflicting safety management measures that need to be considered when developing the HASP.

1.4 Site Preparation

The following management measures will be considered whenever working in traffic areas. In addition, remain aware of the amount of traffic around the working area. The work space should be large enough for the job to be completed safely. Check permit, traffic control plans, and flagger/police detail requirements for the local jurisdiction. Perform routine checks of the work zone to make sure there are adequate levels of protection.

1.4.1 Traffic Barriers and Warning Signs

GEI employees will comply with the U.S. Department of Transportation's (DOT) Manual on Uniformed Traffic Control Devices (MUTCD) and/or state regulations for temporary traffic barriers (cones, barriers) and sign placement when required for working in traffic areas. Clearly define the work site by placing traffic barriers around the work space to indicate the space that is needed to safely perform the work. The traffic barrier will help make the work site more visible to other workers, pedestrians, cyclists, and moving vehicles. Place traffic barriers in such a way as to give yourself and equipment adequate space to work within the barriers. OSHA suggests placing the first warning sign at a distance calculated to be 4 to 8 times (in feet) the speed limit (in MPH).

1.4.2 Adequate Light

Requirements for night conditions and work areas with poor visibility are similar to day requirements. However there are a number of additional things to consider, such as visibility of the work site to advancing traffic and sufficient lighting. OSHA requires lighting for workers on foot and equipment operators to be at least 5-foot-candles or greater.

Visibility of the work area can be increased by employing the following measures:

- Using parked vehicles hazard and flashing lights.
- Wearing reflective personal protective equipment (PPE), such as a safety vest, in good condition.
- Providing adequate lighting to illuminate the work area with lights positioned so that there is no glare to approaching drivers.
- Placing reflective advance warning signs and traffic barriers so that they are visible to road users.

1.4.3 Distance from the Nearest Traffic Lane

Work areas located along roadsides will have a minimum clearance as defined by DOT's MUTCD and/or state or local DOT regulations for traffic barrier and sign placement.

1.4.4 PPE

The proper PPE, as outlined in the project HASP, will be worn when appropriate. The color/type of safety vest will comply with site regulations.

1.5 Equipment Operation

Vehicles and heavy equipment operators should use a spotter when possible if it is necessary to drive in reverse to reduce risk of collision with oncoming traffic. If it is necessary to drive against the flow of traffic make sure this area is within the work zone and properly blocked off from oncoming traffic.

1.6 Pedestrian Safety

When working near pedestrian traffic, a safe alternate pedestrian route will be established. Refer to local regulations when establishing pedestrian walkways.

1.7 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHSO will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.8 Limitations

Follow safety procedures as defined in the site-specific HASP, federal DOT, and local jurisdictions. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.9 References

DOT's Manual on Uniformed Traffic Control Devices (2009 Edition)

Hazard Exposure and Risk Assessment Matrix for Hurricane Response and Recovery Work: https://www.osha.gov/SLTC/etools/hurricane/work-zone.html

1.10 Attachments

None

1.11 Contact

Health&SafetyTeam@geiconsultants.com

1.12 Review History

- November 2016
- May 2014
- November 2013
- August 2011
- October 2010 Initially HS-027 Traffic Hazards

STANDARD OPERATING PROCEDURES

SOP No. HS-018 Working Around Heavy Equipment

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the physical hazards when working around heavy equipment.

1.2 General

This SOP is intended for use by employees engaged in work with the potential for working near heavy equipment. The project site-specific health and safety plan (HASP) should include a hazard assessment for working near heavy equipment to be implemented by GEI employees. These hazards should be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Heavy Equipment Precautions

Heavy equipment (e.g., excavators, backhoes, drill rigs, etc.), can present many physical hazards that can result in serious injury or death if the proper safety precautions are not followed. The following is a list of precautions to be aware of when working around heavy equipment:

- Wear appropriate personal protective equipment (PPE), including at a minimum reflective, high-visibility safety vest, hard hat, safety glasses, and steel/composite toe boots.
- Always keep your distance from moving equipment.
- Do not assume the operator knows where you are or where you are going.
- Make sure to make eye contact and receive acknowledgement of your presence with the operator.
- Avoid working near heavy equipment, but if unavoidable, communicate your location with the operators. If using hand signals, discuss the signals with the equipment operator prior to starting work.
- Watch for moving equipment. Construction sites can have a lot of activity and equipment may be moving in an unpredictable manner.
- Do not rely on back-up or other alarms. They may not be working or you may not hear them with the noise of other activities taking place in the area.
- Stay out of the swing radius of cranes, excavators, or other equipment that swings or rotates.
- Do not walk beside a moving vehicle, the vehicle may turn, slip, or the load may shift causing the vehicle to go off course.
- Do not ride on the outside of a moving equipment.

- Never walk under or stand too close to a load suspended by cranes or hoists.
- Do not walk behind a piece of equipment that is backing up without acknowledgment from the operator it is safe to proceed. If working next to heavy equipment is unavoidable, be aware of the hazards including pinch points and moving parts. Use a spotter to watch the work area for moving equipment.
- If necessary, ask the operator to stop equipment operation to perform your work tasks.
- Verify the location and operation of emergency shut-off devices on the equipment.
- Be aware of the fuels and chemicals associated with the equipment. Have a spill prevention and response plan in place that includes the appropriate containment materials (i.e., spill kit).
- Do not wear loose fitting clothing when working around moving equipment (i.e., drill rig augers).
- Do not operate heavy equipment.
- Do not use cellular telephones near operating equipment.

1.4 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.5 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.6 References

OSHA 29 CFR 1926.600 – Subpart O; Motor Vehicles, Mechanized Equipment, and Marine Operations.

www.toolboxtopics.com/Construction/ (Viewed 10/16)

Caterpillar Safety – http://safety.cat.com/ (Viewed 10/16)

1.7 Attachments

None

1.8 Contact

Health&SafetyTeam@geiconsultants.com

1.9 Review History

- October 2016
- May 2014
- November 2013
- August 2011
- October 2010

STANDARD OPERATING PROCEDURES

SOP No. HS-019 Railroad Safety Requirements

1.1 Objective

The objective of this Standard Operating Procedure (SOP) is to prevent or limit the hazards for GEI personnel associated with working on a site that has active rail lines.

1.2 General

This SOP is intended for use by employees engaged in work where an active rail line is used. The site-specific health and safety plan (HASP) will include a hazard assessment for working near active rail lines to be implemented by GEI employees. These hazards will be reviewed during the project safety briefing and documented on the Project Safety Briefing form found in the HASP and on the Safety page of the GEI intranet.

1.3 Rail Line Safety Practices

Railroad safety practices will be conducted in general accordance with client and railroad specific requirements. Safety requirements include:

- Stay alert around railroad tracks. The use of cellular/smart phones, headphones, or any other distractions that could prevent hearing an approaching train is strictly prohibited. When you are required to work around live tracks, stay alert to stay alive.
- Expect movement from on-track equipment, in either direction, at any time.
- Consider having a flagger on site.
- If available, have a train schedule on hand as a guide for potential train activity.
- Before approaching a track, look in both directions. Make sure it's safe to work near or to cross the track.
- Consider establishing hand signals as an added safety measure to inform others of an oncoming train.
- When walking on a project site, employees will only cross designated rail crossings where provided.
- If a designated crossing is not available, the general requirements for employees are:
    - Do not cross within 10 feet of the end of a parked rail car.
    - Never cross between uncoupled cars.
    - Stop, look, and listen prior to proceeding across the tracks.
    - Never step on rails.

- Never cross a track in front of oncoming rail traffic unless you are absolutely certain there is sufficient time and space to do so safely.
- Employees will never attempt to crawl under rail equipment.
- When on-track equipment is approaching, stay at least 30 feet from the track while the equipment is passing.
- Watch for protruding structures on passing equipment as well as other hazards.
- When rail traffic is approaching move away from the track, and warn co-workers to do the same.
- Never sit, walk, step, stand, or lay on rails; including other track components such as switch points, frogs, guard rails, derails, and wheel stops.
- Do not lean or climb on, or go under any on-track equipment unless your job requires it. Then do so only after all required safety procedures, such as lockout/tagout procedures have been put in place.
- Do not walk between two pieces of on-track equipment unless they are separated by at least 50 feet.
- Keep at least 25 feet from the end of standing trains, cars, or locomotives. This will allow time to react safely to any movement of the equipment.
- Avoid being trapped between on-track equipment passing on adjacent tracks. It is the responsibility of the employee to be aware of the ever-present hazards associated with working around tracks. Use good judgment and common sense in dealing with these hazards. Keeping alert at all times on the job will protect you and your co-workers from the various hazards of working on the rails.
- Employees must maintain awareness of potential pinch points and avoid working in these areas.
- Be aware if the track has a “third rail” or any overhead lines when working around electrified train equipment.
- Any approaching train is always closer, and moving faster, than you think.
- Trains have the right of way 100% of the time over emergency vehicles, cars, police, and pedestrians.
- Employees must not ride on rail equipment except when authorized and in the performance of duty.
- Do not operate switches or other railroad equipment unless trained to do so and in the performance of duty.

- Employees must follow and observe all Federal Railway Administration (FRA) Regulations applicable to their operations.
- Employees must keep premises and work areas subject to their control neat and clean.
- No steel tape or chain is to be allowed to cross or touch the rails without permission of the designated railroad employee.
- Employees must wear suitable personal protective equipment (PPE): clothing, safety equipment, and footwear to perform their duties safely. ANSI-compliant high visibility vests are to be worn at all times. Working in shorts is prohibited. Shirts must cover shoulders, upper arms, back, and abdomen. Performing work in oily, greasy, torn, lose, or frayed clothing is not permitted.
- When practicable, equipment or material that would obstruct the view of the track must be left at least 100 feet from highway grade crossings.

Employees will obtain permission from the client before performing work within 25 feet of any railroad track. If written permission is not obtained, verbal permission will be recorded in the GEI field book documenting name, title, and contact information of the client representative granting permission.

1.4 Training Requirements

If a railroad safety training class is available for the associated rail line company, it should be taken prior to the start of work. Complete any client-specific training and background checks as applicable.

1.5 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or supervisor/project manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.6 Limitations

Follow safety procedures as defined in the site-specific HASP. Appropriate PPE must be worn correctly to provide the intended level of protection.

1.7 References

http://www.safetyservicescompany.com/industry-category/construction/railroad-track-safety/

http://www.csatf.org/pdf/28RAILROADS.pdf

http://oli.org/education-resources/saftey-tips/safety-tips-and-facts/

Norfolk Southern Operating Guidelines for Contractors, April 19, 2010.

1.8 Attachments

None

1.9 Contact

Health&SafetyTeam@geiconsultants.com

1.10 Review History

- November 2016
- November 2015
- May 2014
- November 2013
- June 2012

STANDARD OPERATING PROCEDURES

SOP No. HS-025 Manual Lifting

1.1 Objective

The purpose of this Standard Operating Procedure (SOP) is to identify and reduce potential work-related musculoskeletal disorder (WMSD) hazards. The SOP is intended to comply with state regulations and safe work practices developed by the Occupational Safety and Health Administration (OSHA). Modifications to meet these requirements will be made to this program as changing laws or regulations dictate.

1.2 General

Lifting heavy items is one of the leading causes of injury in the workplace. Overexertion and cumulative trauma when lifting are significant factors for injuries. When employees use smart lifting practices and work in their "power zone", they are less likely to suffer from back sprains, muscle pulls, wrist/elbow/spinal and other injuries caused by lifting heavy objects. Common things to consider prior to lifting an object are: weight of the object, awkward postures, high-frequency and long duration lifting, inadequate handholds, and physical/environmental factors.

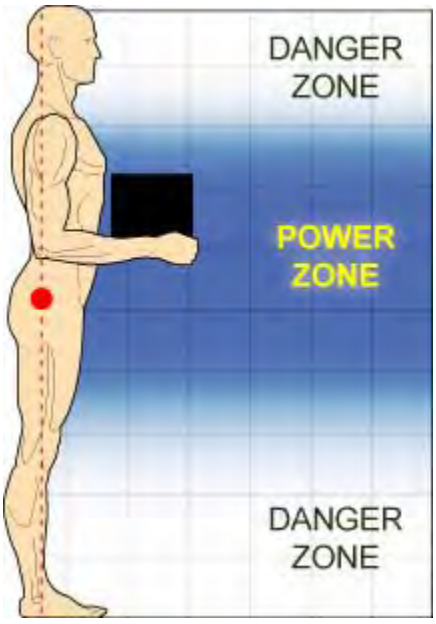


Figure 1: Lifting Power Zone

1.3 Safe Lifting Guidelines

The following safe lifting guidelines will be followed by employees involved in manual lifting activities:

- Before manual lifting is performed, a hazard assessment must be completed. The assessment must consider size, bulk, and weight of the object(s), if mechanical lifting equipment is required, if two-man lift is required, whether vision is obscured while carrying and the walking surface and path where the object is to be carried.
- Get a co-worker to help if equipment or other item is too heavy to lift.
- If possible, use powered equipment instead of manually lifting heavy materials. Lifting equipment such as dollies, hand trucks, lift-assist devices, jacks, or carts can be provided for employees.
- Reduce lifts from shoulder height and from floor height by repositioning the shelf or bin to closer to the power zone.
- Make sure walkways are clear of tripping hazards before moving materials.
- Use your legs and keep your back in a natural position while lifting. Keep the load close to your torso.

- Test the load to be lifted to estimate its weight, size, and bulk and to determine the proper lifting method.
- Do not twist while carrying a load. Instead, shift your feet and take small steps in the direction you want to turn.
- Make sure there are appropriately marked and sufficiently safe clearances for aisles and at loading docks or passageways where mechanical-handling equipment is used.
- Properly stack loose or unboxed materials which might fall from a pile by blocking, interlocking, or limiting the height of the pile to prevent falling hazards.
- Bags, containers, bundles, etc. should be stored in tiers that are stacked, blocked, interlocked, and limited in height so that they are stable and secure to prevent sliding or collapse.

- Storage areas should be kept free from accumulation of materials that could lead to tripping, fire, or explosion.
- Work methods and stations should be designed to minimize the distance between the person and the object being handled.

Supervisors should periodically evaluate work areas and employees' work techniques to assess the potential for and prevention of injuries. New operations should be evaluated to engineer out hazards before work processes are implemented.

1.4 Regulations

OSHA does not have a standard which sets limits on how much a person may lift or carry. They do however state that lifting loads heavier than about 50 pounds will increase the risk of injury.

The National Institute for Occupational Safety and Health (NIOSH) has developed a mathematical model that helps predict the risk of injury based on the weight being lifted and other criteria. The NIOSH model is based on previous medical research into the compressive forces needed to cause damage to bones and ligaments of the back. The mathematical model is incorporated in the *Applications Manual for the Revised NIOSH Lifting Equation*, which can be found on the NIOSH website (http://www.cdc.gov/niosh/docs/94-110/). It should be noted, however, that this NIOSH document provides only voluntary guidelines.

If there is a situation that arises where an employee is required to perform manual lifting on a reoccurring basis, the NIOSH Lifting Equation will be used to determine the appropriate weight that employee can safely lift. The lifting equation establishes a maximum load of 50 pounds for employees that are less likely to have to lift something, and don’t have to do any long distance travel or maneuvering of the item. This 50 pounds is then adjusted to account for:

- how often the employee is lifting
- twisting the back during lifting
- the vertical distance the load is lifted
- the distance of the load from the body
- the distance the employee must move while lifting the load
- how easy it is to hold onto the load

GEI uses 50 pounds as a standard. However each individual should not attempt to carry loads heavier than they can safely manage.

1.5 Training

Training will include general principles of ergonomics, correct manual lifting techniques to avoid musculoskeletal injuries, recognition of hazards and injuries, procedures for reporting hazardous conditions, and methods and procedures for early reporting of injuries.

1.6 Lifting Assistance

If employees are assigned a task that involves repetitive lifting and carrying of equipment the Safety Team and Project Manager should be contacted to conduct an ergonomic evaluation. The task should be discussed to determine if there is an alternative method that can be used. The alternative method should institute an engineering or administrative control to reduce/limit the amount of lifting that is required of the employee. Some examples include providing smaller containers to reduce the weight of what needs to be lifted; providing a device that helps carry awkwardly-shaped objects easier; or using a winch, fork lift, or other device to lift the item(s) for the employee.

1.7 Injury Reporting

Injuries experienced during manual lifting activities should receive prompt medical attention. If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health and Safety Officer.

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the Regional Health & Safety Officer (RHSO) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health & Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future musculoskeletal injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.8 Limitations

Follow safety procedures for manual lifting.

1.9 References

OSHA Technical Manual (OTM), Section VII: Chapter 1 - Back Disorders and Injuries
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=29936 (Viewed 7/12/2016)
https://www.osha.gov/SLTC/etools/electricalcontractors/materials/heavy.html (Viewed 7/12/2016)

1.10 Attachments

None

1.11 Contact

Health&SafetyTeam@geiconsultants.com

1.12 Review History

- July 2016
- August 2014

STANDARD OPERATING PROCEDURES

SOP NO. HS-026 Hazard Identification and Management

1.1 Objective

This Standard Operating Procedure (SOP) is intended to outline the steps GEI employees will take to identify potential hazards on site, the risks associated with these hazards, and the proper engineering controls, work practices, and personal protective equipment (PPE) to use to minimize the associated risks.

1.2 Hazard Identification

Establishing proper work procedures by conducting a job hazard analysis will should be performed for all projects involving field work. An initial identification of hazards will be completed based on past and current property usage of the site, what tasks are required to perform the job, what equipment is needed to complete the assigned tasks, what hazards are in the working area etc.

The site-specific health and safety plan (HASP) will include a hazard assessment for the project that identifies the potential hazards and how to alleviate the hazard. These hazards will be reviewed in the project safety briefing and documented on the Project Safety Briefing form, found on the Safety page of the GEI intranet.

1.3 Risk Assessment

A risk assessment will be performed for all aspects of field work. This analysis is to determine the quantitative or qualitative value of risk related to a tangible situation and a recognized hazard. Identification, studies, and monitoring of any hazard to determine its potential, origin, characteristics, and behavior are examples of what could be included and performed during a risk assessment. The assessment will increase awareness of workplace hazards and provide an opportunity to identify and control workplace hazards.

1.3.1 Assessment Guidelines

It is necessary to consider certain general guidelines for assessing the foot, head, eye and face, and hand hazard situations that exist in an occupational operation or process, and to match the protective devices to the particular hazard.

Assessments should be conducted:

- Prior to starting any work at the site
- As conditions change
- Workplace layout changes
- Environmental changes
- Process changes

- Yearly or other pre-determined interval

1.3.2 Hazard Sources

Some examples of hazard sources include but are not limited to:

- Items, materials, or machinery in motion
- Extreme temperatures
- Chemical exposures
- Harmful dust
- Light radiation
- Falling objects or potential from dropping objects
- Sharp objects
- Rolling or pinching objects
- Layout of workplace and location of co-workers
- Electrical hazards
- Noise exposures
- Confined spaces
- Working near or on water
- Fall hazards
- Traffic or other activities taking place on the site
- Air quality issues

1.4 Prevention – Control Methods

Control methods should be considered in the following hierarchy:

- Elimination
- Substitution
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

1.4.1 Elimination and Substitution

Elimination and substitution, while most effective at reducing hazards, also tend to be the most difficult to implement in an existing process. If the process is still at the design or development stage, elimination and substitution of hazards may be inexpensive and

simple to implement. For an existing process, major changes in equipment and procedures may be required to eliminate or substitute for a hazard. Employees should work with the Safety Team to find solutions.

1.4.2 Engineering Controls

Engineering controls are used to remove a hazard or place a barrier between the work and the hazard. It's implemented to control the hazard at the source. Examples may include machine guards, sound deading/dampening panels, traffic barriers, guardrails, and shields.

1.4.3 Administrative Controls

Administrative controls change the work procedures such as programs, schedules, and supervision to reduce employee exposure to hazards. The controls are frequently used with existing processes where hazards are not particularly well controlled. Examples of administrative controls are requiring frequent breaks or implementing a specific method to perform a task.

1.4.4 Personal Protective Equipment Selection

To select the proper PPE, the potential hazards must be known. The protective equipment selected must ensure a level of protection *greater than* the minimum required in order to help protect employees. The user must be supplied with a properly fitting protective device and given instructions on care and use. Users must be aware of all warning labels for and limitation of the PPE. Employees must be aware that the PPE does not eliminate the hazard.

1.4.5 Hazard Re-Assessment

As necessary, the workplace should be re-assessed for hazards by identifying and evaluating new equipment and processes, reviewing accident records, and re-evaluating the suitability of previously selected PPE. Re-assessment should occur at a defined regular schedule interval.

1.5 Job Safety Analysis

A job safety analysis (JSA) sometimes referred to as a job hazard analysis (JHA) or an activity hazard analysis (AHA) is the breaking down of any method or procedure into its component parts to determine the hazards connected with each key step and the requirements for performing it safely.

When a JSA is being created, make sure it isn't too general where the resulting information is not enough to assess the hazard and select proper controls, and be careful not to add unnecessary steps.

1.6 Injury Reporting

If a GEI employee suffers an injury on the job that is not life threating, call Medcor Triage at 1-800-775-5866 to speak with a medical professional. Then, immediately report the injury to the Supervisor/Project Manager and Regional Health & Safety Officer (RHSO).

After verbal notification has been made, an Incident Report Form is to be completed by the employee and/or Supervisor/Project Manager and submitted to the People & Safety Team immediately following care of the incident. This form is available on the Safety App (smart phones) and on the Safety page on the GEI intranet.

Upon notification from a Branch or Office Manager, Human Resources, and/or the receipt of the Incident Report Form, the RHS) will conduct an investigation and evaluation on what happened and how and why it happened. The Corporate Health and Safety Officer (CHSO) will then recommend (as necessary) engineering controls, personal protection equipment, training or other appropriate measures to minimize the potential for future injuries. The CHSO/RHSO may develop educational information based on lessons learned for distribution to GEI employees.

1.7 Limitations

Limitations may arise on a project specific basis and will be addressed as they arise.

1.8 Attachments

None.

1.9 References

Risk Analytics, LLC Hazard Assessment Training Program, January 2011

1.10 Contact

Health&SafetyTeam@geiconsultants.com

1.11 Review History

- November 2016
- June 2015