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Site Characterization Work Plan Bath Former MGP Site

Bath, New York
ACO Index #R1-20200304-60
Site # 851036

Submitted to:

Bath Electric, Gas & Water Systems
7 South Avenue
Bath, New York 14810

Submitted by:

GEI Consultants, Inc., P.C.
1301 Trumansburg Road, Suite N
Ithaca, NY 14850
607-216-8955

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Bruce D. Coulombe, P.G.
Project Manager

Joseph M. Simone P.E.
Senior Consultant

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Abbreviations and Acronyms

ACGIH	American Conference of Government Industrial Hygienists
ACO	Administrative Order on Consent
AOC	Area of Contamination
BEGWS	Bath Electric, Gas and Water Systems
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CAMP	Community Air Monitoring Plan
CERCLA	EPA Comprehensive Environmental Response, Compensation, & Liability Act
CHSS	Corporate Health and Safety Specialist
COC	Chain-of-Custody
DER	Division of Environmental Remediation
DNAPL	Dense Non-Aqueous Phase Liquid
DUSR	Data Usability Summary Report
ECL	New York State Environmental Conservation Law
EDR	Environmental Data Resources
ELAP	New York State Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
FOIL	Freedom of Information Law
FSAP	Field Sampling and Analytical Plan
FWRIA	Fish and Wildlife Resources Impacts Analysis
GEI	GEI Consultants, Inc., P.C.
HASP	Health and Safety Plan
HSA	Hollow-Stem Auger
IDA	Industrial Development Agency
IDW	Investigation-Derived Waste
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid
MGP	Manufactured Gas Plant
MNA	Monitored Natural Attenuation
MS/MSD	Matrix Spike/ Matrix Spike Duplicate
NAPL	Non-Aqueous Phase Liquid
NAVD88	North American Vertical Datum of 1988
NTU	Nephelometric Turbidity Units
NYSASP	New York State Analytical Services Protocols
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation reduction potential
OSHA	Occupational Health & Safety Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photo-Ionization Detector
PM-10	Particulate Matter Less than 10 Micrometers in Diameter (Respirable Particulates)
PPE	Personal Protective Equipment

PRP	Potential Responsible Party
PSC	New York State Public Service Commission
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSCO	Recommended Soil Cleanup Objectives
SC	Site Characterization
SCGs	Standards, Criteria Or Guidance
SCOs	Soil Cleanup Objectives
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TIC	Tentatively Identified Compound
USCS	Unified Soil Classification System
U.S. DOT	United States Department of Transportaion
UST	Underground Storage Tank
VOC	Volatile Organic Compound

Measurements

cf	Cubic foot
I.D.	Inner Diameter
msl	Mean Sea Level
NTUs	Nephelometric Turbidity Units
OD	Outer Diameter
ppm	Parts per Million
ug/m ³	Micrograms per Cubic Meter

1. Introduction

On behalf of our client, Bath Electric, Gas and Water Systems (BEGWS), GEI Consultants, Inc., P.C. (GEI) has prepared this Site Characterization (SC) Work Plan for the Bath Former Manufactured Gas Plant (MGP) site located in the Town of Bath, Steuben County, New York. Figure 1 shows the location of the Bath Former MGP site. BEGWS and the New York State Department of Environmental Conservation (NYSDEC) have entered into an Administrative Order on Consent (ACO) and administrative settlement #R1-20200304-60 to evaluate environmental conditions at the Bath Former MGP. This Work Plan has been prepared and will be submitted to the NYSDEC and the New York State Department of Health (NYSDOH) for review and approval as a requirement of the ACO. Implementation of the scope of work described in this plan is intended to generate sufficient data to complete the SC. The Work Plan has been prepared in accordance with the document entitled, “NYSDEC Technical Guidance for Site Investigation and Remediation (DER-10),” issued May 3, 2010 [NYSDEC, 2010].

The purpose of this Work Plan is to describe the methods and procedures to be implemented in performing a site characterization of the former MGP site. This Work Plan includes the following components:

- A brief site history of the Bath Former MGP.
- The scope of work for a site characterization of the Bath Former MGP site.

Appendices to the Work Plan include the following:

- Historical information is included as Appendix A.
- A Community Air Monitoring Plan (CAMP) is included as Appendix B.
- A Site-Specific Health and Safety Plan (HASP) is included as Appendix C.
- Standard Operating Procedures (SOPs) are included as Appendix D.
- A Field Sampling Analysis Plan (FSAP) is included as Appendix E.
- A Quality Assurance Project Plan (QAPP) is included as Appendix F.
- A Non-Aqueous Phase Liquid (NAPL) Contingency Plan is included as Appendix G.

2. Site Background

2.1 Site Location and Description

2.1.1 Site Layout and Cultural Features

The Bath Former MGP site is located at the east end of Murray Avenue on the southeast side of Village of Bath, Steuben County NY (Figure 1). The site is on the edge of the commercial/industrial area. It is bounded by commercial properties and Murray Avenue to the north, the former Babcock Ladder factory to the east, vacant land and a junkyard to the west, and by the former Erie-Lackawanna Railroad (now B&H Rail Corporation) to the south of the site (Figure 2). Just south of the railroad is Interstate Route 86 and beyond that the Cohocton River. The site is zoned as “Light Industrial.”

The site is owned by the Village of Bath with dimensions of approximately 110- to 140-feet-wide by 220- to 265-feet-long. The site currently operates as a BEGWS facility for storage of electric and gas equipment and supplies. A small one-story natural gas meter and regulator station building owned by Corning Natural Gas is located at the southwest corner of the site. Current site features consist of a gas regulator, stored electrical transformers, and various other equipment storage areas. The tax map information for the site and for adjacent properties of interest described in this work plan is shown in Table 1.

2.1.2 Surface Geology

Surficial soils are described as outwash sand and gravel (New York State Geological Survey, 1988). In the vicinity of the site, these soils overlay lacustrine silt and fine sand (USGS, 1984). Based on the history of use for the site and the surrounding area it is expected that some amount of filling or disturbance of the native surface soils has occurred.

2.1.3 Subsurface Geology

Bedrock is the Gardeau Formation shale and siltstone (Roricks Glen Shale) (New York State Geological Survey, 1970). Based on available data, depth to bedrock is anticipated at least 200 feet below grade.

2.1.4 Surface Water

The site is generally flat and does not have any surface water features present. The Cohocton River is located 380 feet to the southwest of the site, flowing from northwest to southeast.

2.1.5 Local and Regional Hydrogeology

There are several wells that were identified in the EDR Report located within one mile of the site (EDR, 2015). Among these are seven inactive USGS water wells, two inactive water supply wells, three plugged and abandoned former oil/gas wells, and two active small quantity water supply wells. The still active water supply wells are listed as Oldfield Court, serving a population of 40 and the Holland-American Motel, serving a population of 25 (EPA well database, 2015). There are also four active BEGWS water supply wells located within the Village of Bath limits (Figure 3). These Bath water supply wells are each over eighty feet in depth and pump from aquifers located near the Cohocton River (BEGWS, 2014). Groundwater elevation data are not available for these wells, but local groundwater flow would appear to be toward the Cohocton River and regionally to the southeast, based on topography (EDR, 2015). Note that the nearest active water supply well to the site is located 1,900 feet hydraulically up-gradient of the site.

2.2 Site History

The history of the Bath Former MGP site and surrounding area was developed through the review of available historic Sanborn Fire Insurance (Sanborn) maps and the Browns Directory of American Gas Companies (Browns Directory), as well as historical photographs and documents obtained from sources on the Internet, and documents provided by the Bath Historical Association (see Appendix A). A summary of the known events in the history of the site is presented in Table 2.

2.2.1 MGP History

The first gas plant located in Bath was at the corner of Pine and West William Streets and reportedly made gas from distilling pine knots (Barker and Wheeler, 1942). This MGP was erected around 1854, with little remaining except for short sections of cast iron main in the vicinity of Liberty Street and Pulteney Square.

From the available sources, the MGP was built by “The Gass Company” in 1883, consisting of a red brick building with two 3-foot cast iron retorts and a gas holder (The Heritage of Bath, NY, 1793-1993). The plant began operation October 10, 1883. The name was changed to the Bath Gas Co. in 1890 (Brown’s Directory) and merged with a local electric company in 1900 to form the Bath Electric and Gas Light Company. In 1911, the plant was extensively re-built and converted to water gas equipment and a second gas holder was also erected (Barker and Wheeler, 1942). The plant then had capacity of 50,000 cu. ft.: a main gas holder of 30,000 cu. ft. and a relief holder of 20,000 cu. ft. (Brown’s Directory). In 1920, the Village of Bath purchased the gas operations and later changed the name of the company to the Bath Gas Plant in 1921 (The Heritage of Bath, NY). In 1922, the name was again changed to the Bath Electric and Gas System. Undated photos show the plant with a gas

holder and the plant building that housed the retorts adjacent to the railroad tracks (Appendix A).

Natural gas was discovered nearby in 1930 and the Village subsequently entered into an agreement with the Southern Tier Gas Company to supply the Village with natural gas (The Heritage of Bath, NY). On December 26, 1932, the Village switched from carbureted water gas to natural gas (Advocate, 1932). The gas holders at the site were used to store natural gas, but gas was no longer being produced at the site. In 1936, the Village took over the local water works company, and they became the Bath Electric, Gas and Water Systems (The Heritage of Bath, NY).

A 1941 plant drawing still shows the two gas holders, purifiers, tar washer, oil storage tank and coal storage on the plant property (Barker and Wheeler, 1942). The 1948 Sanborn map indicates that the plant building was used for storage. The circular gas holders (or their foundations) are still visible on a 1955 aerial photo but are no longer visible on a 1964 aerial photo. The outer structure of the MGP building was still visible on aerial photos up through 1968. There is no documentation available on when the last above ground MGP structures were removed.

2.2.2 Post MGP History

The site has been used as a natural gas regulation site since the Village started purchasing natural gas from the Southern Tier Gas Company in 1935. The previous MGP plant property is still owned by BEGWS and is used for electrical transformer and equipment storage.

2.3 Previous Investigations

In 1941, Barker and Wheeler Engineers performed an inventory and cost evaluation of the Municipal Gas Utility for the Village of Bath. There has been no previous environmental investigation of the site. The map of site features from this report has been used in the preparation of the figures in this work plan.

2.4 Adjacent Properties

2.4.1 Village of Bath

The property adjacent to the west side of the former MGP plant, that is now also owned by the Village, was previously owned by the Standard Oil Company of New York (SOCONY). The premises were originally conveyed by Andrew Crook to Standard Oil Company of New York in 1896. There was a second parcel that was conveyed by Ferdinand Murray to Standard Oil in 1916. The 1930 Sanborn Map indicates that Standard Oil had two gasoline tanks and two oil tanks on the property but were no longer shown on the 1948 Sanborn map. SOCONY-Vacuum Oil Company then transferred the property to John Burns in 1941 who sold it to the Steuben Rural Electric Cooperative in 1942. Steuben Rural Electric then sold

the property to the Southern Tier Gas Corporation in 1958, who sold it to Corning Natural Gas Corporation in 1982. Corning Natural Gas then sold the property to the Village of Bath in 1984. These properties are both owned by the Village of Bath and are used by BEGWS for the natural gas transmission line and electrical support.

2.4.2 Babcock Ladder

The former Babcock Ladder factory has been located adjacent to the east of the site since at least 1915, according to the Sanborn maps and a building was on the property since 1905 according to the Steuben County tax records. Babcock produced wooden ladders. The property was purchased by the Steuben Industrial Development Agency (IDA) approximately in 2000, and then leased back the business. The facility was subsequently closed, and the property is currently leased by Clark Specialty Company, commercial/industrial fabrication company.

The facility is listed in the New York Spills database for a spill on June 9, 2010 of “brownish black drops and strings of oil” at a depth of approximately 6 feet below grade in an excavation for a water line 50 feet north of the railroad tracks and 100 yards east of the building (EDR Report, July 2015). The EDR Report indicates a Phase II Investigation was conducted for this spill. Approximately 500 tons of impacted soil were disposed of at the Steuben County landfill and two wells were installed. No sheen was observed on the water at the southwest corner of the Babcock Ladder property. Two USTs on the Babcock Ladder property were identified during the Phase II investigation. They each had oil/water mixtures in the tanks which were pumped out prior to tank removal. Sidewall samples collected during removal met Commercial standards. A Soil and Groundwater Management Plan was drafted, and the spill was closed on December 17, 2014.

2.4.3 B&H Railroad

The B&H Railroad Corporation is the owner of the property abutting the south side of the site. This was formerly the Erie-Lackawanna Railroad. A single track currently is located on this property. The Sanborn maps show that previously up to three tracks were present on this property. To the south of this property was an additional railroad property with six tracks owned by the Delaware, Lackawanna and Western Railroad, which is now the location of Interstate Route 86.

3. Summary of Record Search

GEI completed a search of environmental records for the Bath Former MGP site on behalf of BEGWS as part of the preparation of the SC Work Plan. The environmental records search review was prepared in general accordance with requirements established within the ACO.

3.1 Records Search Scope of Work

The record search report for the Bath Former MGP site included the review or evaluation of the following:

- Environmental data and information currently available.
- History and description of site including nature of operations.
- Identity of other potential responsible parties (PRPs) for releases of hazardous waste.

The site history and current site conditions are discussed above within Section 2.2.

To evaluate the environmental data, potentially hazardous waste storage, and PRPs, GEI relied upon information from EDR (EDR, 2015), a commercially available environmental database search dated July 2015, available Sanborn maps from 1915 until 1948, and the Browns Directory of American Gas companies.

3.2 Records of Materials Handling, Storage Processes, and Waste Generation

A search of the NYSDEC spill incidents and environmental site remediation databases was conducted, Sanborn maps were reviewed, and an EDR Radius Map with GeoCheck® Report was reviewed. Records of materials handling, storage processes, and waste generation were not identified for the site.

3.3 Possible Subsurface Structures

It is unknown if any Bath Former MGP foundations are present at the site. Subsurface investigations and/or remote sensing methods would be required to evaluate whether any subsurface structures are still present. The location of the former buildings and holders are shown on Figure 2. Based upon experience at other former MGPs, it is likely that foundations are still present at the site.

No other records of possible subsurface structures or product lines were identified through the NYSDEC database search, Sanborn maps or the EDR Radius Report. Active natural gas lines are present on the site and are shown on Figure 2.

3.4 Environmental Records Search

The EDR Radius Map with GeoCheck® Report ordered by GEI was reviewed to search the NYSDEC spill incidents and environmental site remediation databases. No environmental records information or known discharges on the site were identified based on the records search, aside from the presence of the former MGP. No current or former storage of petroleum or hazardous waste on the site was identified by the records search. The adjacent property, previously owned by Standard Oil Company of New York, and now owned by the Village of Bath, did include petroleum storage when it was an active facility. These tanks are shown on the 1915 and 1930 Sanborn maps.

The target property was not listed in any of the databases searched by EDR. There was a spill reported at adjacent property Babcock Ladder Company in 2001, and it was closed in 2004. This spill was discussed in Section 2.4.2 above.

3.5 Identity of Other PRPs

Sanborn maps were used to identify other PRPs. These businesses that are on site or abutting the site have a potential to have impacted the subsurface soil or groundwater on site.

The Standard Oil Company of New York adjacent to the former MGP has potential for petroleum impacts.

The former Babcock Ladder Company, now owned by the Steuben IDA, adjacent to the former MGP on the east side has potential from petroleum or wood finishing products.

4. Scope of Work

The scope of work addresses field investigation tasks that will provide a better understanding of potential soil and groundwater impacts related to the operation of the Bath Former MGP site. The type, number, and depth of samples were developed based on a review of historic information.

The subsurface investigation of the site will be performed in phases, in order to address the issues of potential concern in a sequential manner that allows the BEGWS to budget and conduct the site investigation in a cost-effective manner. This work plan provides descriptions of a suite of procedures that may be employed during the site investigation; however, for the first phase only the initial soil boring program will be conducted. Descriptions of test pit and monitoring well installation procedures, groundwater sampling, and other investigation elements are provided for reference should they be employed during subsequent phases.

By performing a soil-boring investigation BEGWS will quickly and cost-effectively accomplish the following:

- Identification of whether soil or gross groundwater impacts are present associated with the former MGP, and whether these impacts are likely to be a significant threat to human health and the environment.
- If impacts are present, the investigation results will be reviewed with the NYSDEC and the scope of work for a second phase of the investigations will be proposed in a letter work plan.

The initial scope of work includes the following tasks:

- Records search,
- Site utility survey and mark-out and mobilization activities.
- Initial field investigation sampling by direct-push borings and targeted soil analysis.
- Qualitative Human Health Exposure Assessment.
- Survey of sample point locations.
- Quality assurance/quality control (QA/QC) and data validation.
- Preliminary SC Report preparation.

A Fish and Wildlife Resources Impact Analyses (FWRIA) will not be performed as part of the SC due to the site's urban setting. The location, depth, magnitude, and possible extent of the impacts relative to overlying or nearby buildings will be used to determine if soil vapor is of concern.

Surface soil sampling will not be performed during the initial field investigation unless indications of impact are observed, although none have been found during site visits to-date. The site is fully fenced-off and only workers for BEGWS or Corning Natural Gas have access, therefore there is no risk from surface soil to the general public.

Monitoring wells will not be installed during the initial field investigation. Based on the observations from the soil borings (depth to groundwater, groundwater condition) a recommendation will be made to NYSDEC regarding the number and location of wells to be installed during a subsequent phase of the SC investigation. If non-aqueous phase liquid (NAPL) is observed in any of the soil borings, temporary wells may be installed during this initial phase of investigation.

Descriptions of each proposed work activity are provided separately below.

4.1 Records Search

A records search was performed by GEI, and the results presented in Section 2 of this Work Plan and in a site history prepared in fulfillment of Exhibit B of the AOC.

4.2 Field Investigation Preparation and Mobilization Activities

Upon approval of the Work Plan by the NYSDEC and authorization from BEGWS, GEI will mobilize to the site to implement the sampling program. The initial field mobilization will include the following items to be completed prior to the commencement of the field SC activities:

- Conduct Dig Safely New York mark-out.
- Establish with BEGWS the location for a temporary decontamination area.
- Establish a temporary waste storage area and make arrangements with BEGWS for the removal of investigation-derived wastes (IDW). Note that direct-push sampling methods will be used to the extent possible to minimize the volume of waste soil generated by the sampling program.

4.2.1 Site Access

Since the Village of Bath owns the site property, additional access agreements are assumed to not be needed at this time.

4.2.2 Utility Location

The approximate locations of the proposed sampling locations shall also be identified and marked in the field prior to commencement of field activities. Each test pit, soil boring, or monitoring well location will be marked by GEI with white paint, stakes, or flagging prior to intrusive activities. The earthwork and drilling subcontractor will provide the investigation sample locations to the utility clearance organization (Dig Safely New York) to identify potential utility conflicts at the site. GEI will also request that the current property owner and holder of any rights-of-way provide the utility plans for on-site utilities. A private utility locator will also be contracted to locate buried utilities, if needed.

The gas line at the site is accessed from the Corning Natural Gas Corp property. It enters from the south to the building on site and proceeds through a regular to the north. This is located parallel to the western site boundary. This area will be well marked and kept clear during investigation activities. Note that BEGWS and Corning Natural Gas will work closely with GEI to identify the locations of active gas lines and to establish safety protocols for the subsurface investigation.

4.3 Field Investigation Sampling and Analysis

This section discusses the procedures for test pit, soil boring, and groundwater monitoring well sampling and analysis activities. As described above, only soil borings will be performed during the initial site investigation phase. Table 3 presents the general rationale and proposed sampling and analysis for each investigation point. The proposed sample locations are shown on Figure 4. In addition, air monitoring, and later well installation and groundwater sampling procedures to be implemented are discussed. Sampling procedures and methods are detailed within the Standard Operating Procedures in Appendix D. The Field Sampling and Analysis Plan (FSAP) is presented as Appendix E.

The proposed analyses, analytical methods, and QA/QC samples are discussed under each of the following subsections for test pits, surface soil, soil borings, and monitoring well sampling procedures and are also provided within the QAPP (Appendix F). Subsection 4.7 discusses laboratory data deliverables and data validation procedures.

4.3.1 Test Pit Excavation

Test pits (test trenches) will not be excavated during the initial site investigation. During a subsequent mobilization test pits may be excavated in the footprint of former MGP features to assess the presence of foundations, and to determine the presence of MGP-related residuals inside of, and outside of any foundations identified. The number and type of samples from test pits will be based on the purpose of the investigation and will be obtained according to the Field Sampling Plan. The test pits will be excavated with a backhoe or

excavator by BEGWS staff working with GEI. The excavated areas will be graded and restored as appropriate to match existing conditions, following test pit excavation.

The surface soil is mapped as sand and gravel according to the State geologic maps, but a detailed soil profile has not yet been developed. If NAPL is encountered in an excavation into the overburden unit, the excavation will be stopped to prevent the possible migration of NAPL into deeper soil.

If former MGP structures are encountered by the test pits, additional excavation may be performed to define the lateral limits of the structures, their depths, and their contents. Expansion of the test pit work will be determined by the limits of the utility clearance, the degree to which any impacted soil can be managed, and the degree to which volatile organic compounds (VOCs) and odors can be controlled.

4.3.2 Soil Borings

A total of twelve soil borings are proposed at the site. The proposed soil boring and well locations are shown on Figure 4. Table 3 presents summary information regarding the boring and wells, including the sample identification, sample location or rationale, and the types of analyses to be performed. Additional borings may be performed if needed to delineate the lateral extent and depth of any areas of impact which may be found at the site.

If utilities cannot be confirmed at a particular location, then that soil boring location will be cleared using a hand auger to a depth of 5 feet, or 1 foot below the estimated depth of any nearby known utility. The subsurface borings will be advanced by either a direct-push (Geoprobe™) drilling rig equipped with discrete-interval Macro-Core™ samplers, or by a conventional hollow-stem auger (HSA) drill rig equipped with 2-inch diameter split-spoon samplers. Either method will allow for continuous soil samples to be taken from the ground surface to the bottom of the borehole for both field characterization (PID screening and observations) and for the collection of samples for the chemical analyses.

Initially, a direct-push boring will be attempted at each location shown on Figure 4. The 4-foot-long sampling barrel will be equipped with a mechanism to obtain discrete samples of soil (e.g., a closed-piston Macro-Core™) to ensure maximum recovery and maintain the integrity of the soil interval. If this sampling method does not successfully obtain the required soil samples at a given location, or if the direct-push tools encounter refusal above the target sampling depths, HSA drilling and split-spoon sampling will be used as an alternative. Drilling equipment (rods and macro-core sampler) will be decontaminated between each sample location. Soil cuttings and decontamination fluids will be collected in 55-gallon United States Department of Transportation (U.S. DOT)-approved steel drums for temporary on-site storage, testing, and ultimate disposal by BEGWS.

The soil samples obtained by either method will be logged by a geologist who will record the following:

- The presence of fill material or subsurface structures.
- The nature of each geologic unit encountered with Unified Soil Classification System (USCS) classification.
- Observations regarding moisture content.
- The results of PID readings.
- Visual and olfactory observations regarding the presence of MGP-related residuals or other impacts.

A limited number of soil samples for analytical testing will be obtained during the initial site investigation according to the sampling rationale described below. The selection of soil intervals for laboratory analysis will be made by the field geologist based on the field conditions encountered. The purpose of the samples will be to assess the extent of MGP impacts and risks to receptors. If free-phase NAPL is encountered, a sample of the associated soil will NOT be collected for laboratory analysis. The limits of the NAPL will be noted in the boring log, and a laboratory sample will be obtained from the first soil interval below the impacted zone which does not exhibit apparent NAPL contamination. If impacts are not encountered, a sample will be collected from the 1-foot interval immediately below the water table. Samples will be collected into laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under chain-of-custody (COC) as described in the SOPs and QAPP (Appendix C and D, respectively). Each soil sample will be sampled for:

- TCL VOCs by EPA Method 5035 + 10 TICs.
- TCL SVOCs by EPA Method 8270D mod + 20 TICs.
- TAL metals by EPA Method 6000/ 7000 series.
- Total cyanide by EPA Method 9012B.
- Polychlorinated biphenyls (PCBs) by EPA Method 8082.

Soil borings will terminate at approximately 10 feet below the water table or 10 feet below the last visual or olfactory signs of impact for the purpose of vertical delineation. A minimum of two soil borings will continue to the top of the first confining unit, anticipated to be lacustrine silt. SB-3 and SB-10, both downgradient of gas holder locations, have been assigned to be the deep borings. If dense non-aqueous phase liquid (DNAPL) is observed in either soil boring, then a temporary well may be installed with a 2-foot sump set within the confining unit. If DNAPL is encountered, potential remobilization and downward migration will be limited by following the NAPL Contingency Plan (Appendix G).

Following the collection of subsurface soil samples, each subsurface soil boring will be abandoned by tremie grouting the boring from the bottom of the boring to the ground surface,

except for any borings to be used for temporary groundwater monitoring wells. The area around the soil borings will be restored as necessary.

Each sampling implement will be decontaminated in accordance with decontamination procedures described in the SOPs (Appendix D). QA/QC procedures are detailed within the QAPP located in Appendix F. However, for the initial field screening investigation a limited quality control program will be followed to prioritize the analysis of field samples. QA/QC samples will include one trip blank for VOC analysis, and one matrix spike/matrix spike duplicate (MS/MSD) pair. The QC samples will be completed at a frequency of one set of samples for each 20 field samples. An approved New York State Environmental Laboratory Approval Program (ELAP) laboratory will perform the analyses. One trip blank will be included per shipment of samples to the laboratory.

4.3.3 Monitoring Well Installation

Monitoring wells, including an upgradient well, will be installed during a later phase of work during the SC to define the extent of any NAPL or groundwater impact. Installation of permanent monitoring wells will allow determination of groundwater flow directions and will allow subsequent rounds of groundwater sampling to be performed if necessary. Each monitoring well will be installed in general accordance with procedures described below and within the SOPs (Appendix D).

The number of permanent monitoring wells and their locations will be dependent on the findings of the SC investigation. A minimum of three water table wells will be installed (one upgradient, one down gradient and one within the site) in order to assess the direction of groundwater flow. A minimum of one intermediate well will be installed at the top of the confining layer, if it is encountered at the site. If DNAPL impacts are found at the top of a the confining layer then additional intermediate and deep monitoring wells will be considered to define the depth and lateral extent of impacts. If necessary, offsite wells will be installed to define the extent of groundwater impact.

The boring for each permanent monitoring well will be drilled using 4¼-inch inner diameter. HSAs. Each well will be constructed as a water table monitoring well using a 2-inch inner diameter Schedule 40 PVC flush-joint threaded riser with 10-foot long, 0.020-inch slotted screened section and a 2-foot long DNAPL sump. Note, however, that actual well depth and construction will depend on site conditions encountered, such as thickness of the saturated zone, observed stratigraphy, and the presence, location, and thickness of NAPL, if any. Chemically inert silica sand will be backfilled to 1 to 2 feet above the top of the screen. A bentonite seal will be placed above the screen and sand pack. Where possible, the bentonite seal will be a minimum of 24-inches thick, except in those instances where the top of the well screen is in close proximity to the ground surface. The remainder of the annular space will be filled with a bentonite cement grout up to the ground surface. The grout will be tremied from the bottom up to the top. The grout will be allowed to set for a minimum of 48 hours

prior to developing the monitoring wells. The top of the casing will be finished using flush-mount casings with keyed-alike locks. A concrete surface pad will be sloped to channel water away from the well casing. Final well locations and construction details will be discussed with the NYSDEC as the field work progresses.

The monitoring wells will be surveyed for location and elevation of the reference point on the well casing.

4.3.4 Air Monitoring

A Community Air Monitoring Program (CAMP) will be implemented at the site during intrusive field activities. VOCs and respirable particulates (PM-10) will be monitored upwind and downwind of each soil boring or monitoring well location on a continuous basis. When working within 20 feet of an occupied structure, additional monitoring measures will be performed as specified by NYSDOH guidance (which has been incorporated into the site-specific CAMP for this project). Work zone air monitoring will be performed by GEI for VOCs, as required by the HASP. Work will be stopped if the threshold for any analyte is exceeded due to site-related activities. The site health and safety officer will assess the site conditions and monitoring results and will take any corrective actions needed to bring the air quality into compliance with the CAMP or HASP. If corrective measures cannot achieve the air quality targets, the work will be stopped and the Project Manager and BEGWS will be notified. The NYSDEC and NYSDOH project managers will also be notified of CAMP exceedances and corrective measures that are taken.

The equipment will be calibrated at least daily or in accordance with manufacturers' recommendations. The proposed CAMP is presented in Appendix B, and additional monitoring details are included in the HASP in Appendix C.

Odor monitoring will be performed during the excavation of the test pits and the subsurface soil boring tasks. Odor controls such as covering excavated soil with plastic may be used, as necessary.

4.3.5 Waste Disposal Sampling

Two representative samples of the IDW will be collected from the waste containers during the investigation and analyzed for full Resource Conservation and Recovery Act (RCRA) Hazardous Characteristics testing for waste profiling purposes. One sample will be obtained from the liquid wastes, and one from the solid wastes. Samples will be collected into laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under COC as described in the SOPs and QAPP (Appendix C and D, respectively). Each disposal sample media will be sampled for parameters to meet the requirements of the approved disposal facilities. The anticipated analyses to be performed include the following; however, the final list of analyses may be modified depending on the waste facility requirements:

- TCLP ZHE Extraction – EPA Method 1311
- TCLP VOC – EPA Method 8260C
- TCLP SVOC – EPA Method 8270D
- TCLP ICP Metals – EPA Method 6010B (Mercury 7470A)
- Corrosivity – EPA SW-846 Chapter 7
- Ignitability – EPA SW-846 Method 1010
- Reactive Cyanide – EPA SW-846 Chapter 7
- Reactive Sulfide – EPA SW-846 Chapter 7

4.3.6 Well Development

New monitoring wells will be developed not sooner than 48 hours after their installation to evacuate fine-grained sediments that may have accumulated within the well during installation.

Development of the newly installed monitoring wells will be performed by alternately surging and pumping for a maximum of one hour, or until the turbidity of the development water is less than 50 nephelometric turbidity units (NTUs), or until a maximum of 10 well volumes have been removed in accordance with the SOPs (Appendix D). A field turbidity meter will be used to monitor NTU levels. Groundwater sampling will not be completed for at least two weeks following the development of the permanent monitoring wells to allow groundwater conditions in the surrounding formation to stabilize.

4.3.7 Groundwater Sampling

Groundwater samples will be obtained for laboratory analysis from a three temporary sampling points during the initial phase of the SC Investigation: one shallow upgradient location, and both deep boring locations. The shallow boring sample will be obtained from the base of the boring. The two deep borings will be sampled at the top of the underlying confining layer, if present. If not present, the deep borings will be sampled at the bottom sampling interval.

Permanent monitoring wells will be sampled at a minimum of two weeks following completion of development. Prior to sampling, a synoptic round of groundwater level measurements will be recorded for each of the monitoring wells.

Each monitoring well will be purged and sampled utilizing low flow groundwater sampling procedures. Samples will be collected when measured field parameters have stabilized according to the requirements in the SOPs (Appendix D). Samples will be collected into

laboratory-preserved bottles, chilled with ice, and submitted to the laboratory under COC as described in the SOPs (Appendix D) and QAPP (Appendix F).

Groundwater will be sampled for:

- Target Compound List (TCL) VOCs by EPA Method 8260C
- TCL SVOCs, including 1,4-dioxane by EPA Method 8270D
- TAL metals by EPA Method 6000/ 7000 series (field-filtered and unfiltered if turbidity is not below 50 NTU)
- Total cyanide by EPA Method 9012B
- PCBs by EPA Method 8082
- Pesticides by EPA Method 8081B
- PFAS by EPA Method 537 Modified (NYSDEC compound list)

If NAPL accumulation is present in a well, then no groundwater sample will be collected for laboratory analysis. If NAPL is found to accumulate in a well, then the NAPL will be bailed or pumped from the well, the volume of tar will be recorded, and the recovery rate of the NAPL will be assessed through periodic measurements with an oil/water interface probe. If present, a sample of the accumulated light non-aqueous phase liquid (LNAPL) or DNAPL may be analyzed for hydrocarbon fingerprinting and/or disposal characteristics if requested by BEGWS. All NAPL removed from a well will be containerized for disposal. DNAPL measurements will be collected immediately following the removal of the DNAPL from a well, within one hour, and at the end of the sampling event before demobilization from the site.

QA/QC procedures are detailed within the QAPP located in Appendix F. QA/QC samples will include one blind duplicate groundwater sample, a MS/MSD sample, and an equipment rinsate blank sample. An approved New York State ELAP laboratory will perform the analyses. One trip blank for VOC analysis will be included per shipment of samples to the laboratory.

4.3.8 Surface Soil Sampling

Surface soil samples will be obtained during a subsequent phase of the site investigation. The final number and location of surface soil samples will be selected after the initial investigation, to target areas which have the greatest potential surface impact and/or where contact is most likely with site users (staff of the BEGWS or Corning Natural Gas).

Surface soil samples will be obtained at a minimum of five locations at the site, from the top two inches of the soil (with the vegetation layer removed, if present). Each sample will be analyzed according to the soil analysis list presented above in Section 4.3.2.

4.3.9 Soil Vapor Sampling

Soil vapor sampling will be performed during a subsequent phase of the site investigation, after the presence of MGP-related impacts are confirmed, the limits and concentration of VOCs in soil and groundwater at the site, the location of NAPL in the subsurface is identified, the direction of groundwater flow, and the relationship between any off-site occupied site structures and the VOC impacts will be discussed with the agencies. The protocols will be consistent with the NYSDOH document entitled “Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York,” dated October 2006 [NYSDOH, 2006].

Note that soil vapor investigation plan must take into account the potential for vapor contributions from the former Babcock Ladder factory to the east, and the former Standard Oil property to the west of the site. The current operations at the former Babcock property will be evaluated during the initial site investigation to determine a) which structures are currently occupied, and b) what materials are in use that may have VOCs which could have an impact on soil vapor or ambient air.

A minimum of three soil vapor samples will be obtained, along with an ambient air background sample. The samples will be collected using 6-liter SUMMA cannisters, and analyzed for VOC compounds by EPA Method TO-15.

4.3.10 Site Restoration

The former MGP site is unpaved and able to support truck-mounted drilling rigs. Site restoration will consist of ensuring that the soil boring locations are backfilled to the ground surface with suitable material to prevent hazards to BEGWS workers who may access the site.

4.4 Survey and Sample Point Location

Each of the completed SC boring locations including any subsequent test pits, surface soil samples, soil boring locations or monitoring wells, will be surveyed by a BEGWS surveyor. The elevation of each monitoring well will be determined to ± 0.01 foot. All horizontal locations will be referenced to the appropriate New York State Plane NAD83 coordinate system and all vertical data to the North American Vertical Datum (NAVD 88), per NYSDEC requirements. The results of the survey will be used by GEI to create a base map for the site.

4.5 Decontamination

Drilling equipment (i.e., drilling rods, auger, casing, samplers) will be decontaminated between each sample location. The decontamination will be performed on a decontamination pad which will be constructed at the beginning of the field activities. All decontamination wash-water will be containerized in a bulk storage tank or 55-gallon U.S. DOT-approved drums.

Sampling equipment used for sample collection (e.g., stainless steel split spoons, sample spoons, and hand trowels) will be decontaminated prior to use and reuse, or disposable sampling equipment will be used. All decontamination liquids will be collected and contained in 55-gallon U.S. DOT-approved steel drums for temporary on-site storage and ultimate disposal by BEGWS.

4.6 IDW Management

Soil cuttings and fluids generated during the installation of soil borings and monitoring wells will be collected in a bulk water tank, or in 55-gallon U.S. DOT-approved drums and transported to a temporary waste storage area on the site in preparation for disposal by BEGWS (see SOPs in Appendix D).

BEGWS will arrange for disposal of the IDW. GEI will support this process by properly labeling and storing all waste containers, by collecting and analyzing two waste profile samples, and assisting BEGWS in the profiling of the waste materials for disposal. GEI may provide other support services if requested by BEGWS.

4.7 QA/QC and Data Validation

An approved New York State ELAP laboratory will provide New York State Category B data deliverables. The data will be validated in accordance with New York State Analytical Service Protocols (NYSASP) protocols, dated July 2005. The data validator will prepare a Data Usability Summary Report (DUSR) summarizing the adequacy of the analytical data obtained from the laboratory and discussing any pertinent data excursions or limitations on the use of the data. The DUSR will be submitted along with SC data. The QAPP is in Appendix F.

Using standardized sample collection and decontamination procedures, the quality of the samples during field collection can be assured. The data validation process will ensure that the data collected and reported by the laboratory are of sufficient quality that management decisions regarding the degree and extent of potential impacts can be reliably made. The data validation will evaluate whether the required quantitation limit has been achieved for each sample analyzed, and will evaluate the precision, accuracy, and completeness of the data. The data validator will use the duplicate samples, the MS/MSD samples, the trip

blanks, and the equipment rinsate blank samples, as well as laboratory calibration blanks, spikes, and other standards to assess the quality of the data obtained. Any deviations from the required level of sample quality will be called out in the DUSRs prepared by the data validator and these deviations will be taken into consideration when using the data to explain site conditions.

4.8 Other Potential SC Activities

Additional tasks may be recommended if the SC finds that extensive impacts are present at the site. These additional tasks may include forensic analysis or an additional search and review of historical information.

Forensic chemical evaluation or analysis may be called for in the event that the SC finds impacts migrating onto the site from upgradient or other locations, such as the former Standard Oil Company of New York property. Likewise, if impacts are found on site which are not consistent with known types of MGP-related residuals, forensic analysis may be conducted.

5. SC Report Preparation

A preliminary SC report will be prepared for submittal to NYSDEC which will include the following:

- A table summarizing the location, depth, and nature of NAPL impacts, if any, observed in the soil boring and test pits.
- A tabulation of site soil analytical data, with required comparisons to NYSDEC standards (Industrial and Unrestricted).
- Soil boring logs.
- Figures showing the present and historic site features, and soil conditions.
- Geologic cross-sections.
- Site photographs.
- Recommendations for additional investigation, if warranted.

6. Schedule

GEI anticipates that the initial investigation can be completed in two days of field work, depending on weather and drilling conditions. GEI will notify NYSDEC at least seven days prior to the anticipated start date of the site characterization field program.

The anticipated order and schedule for the field work is as follows:

- Utility mark-out by BEGWS (1 week prior to mobilization).
- Soil boring drilling (2 days).
- Analysis of soil and water samples will be performed on a standard turn-around basis. Data validation will be performed on each analytical data set following receipt of the data packages from the laboratory. Data report preparation will be completed following completion of the DUSR and incorporation of the validated analytical results into final data tables and figures.
- Submit draft data report to BEGWS within one month after validation of the laboratory analytical data is complete.
- Submit data report to NYSDEC within two weeks following completion of the review of the report by BEGWS.

7. References

Advocate, 1932.

Barker and Wheeler Engineers, 1942. Municipal Gas Utility, Village of Bath, New York, Inventory and Original Cost February 1, 1941, Additions and Retirements February 1, 1941 to November 1, 1941.

BEGWS, 2014. Bath Electric, Gas & Water Systems Annual Drinking Water Quality Report for 2014.

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EPA, 2015. EPA well database, 2015.

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

New York State Geological Survey, 1988. Surficial Geologic Map of New York, Niagara Sheet.

New York State Geological Survey, 1970. Bedrock Geologic Map of New York, Niagara Sheet.

United States Geological Survey (USGS), 1984. Geohydrology of the Valley-Fill Aquifer in the Bath Area, Lower Cohocton River, Steuben County, New York.

Tables

Table 1
Property Ownership Information
Bath Former MGP Site
Bath Electric, Gas and Water Systems
Bath, New York

On-Site Properties			
Owner	Tax ID 159.17-01-020.000	Parcel Address	5 Murray Avenue
	Bath Municipal Corp	Occupant/Land Use	Gas Measuring Station
Off-Site Properties			
Owner	Tax ID 159.17-01-019.000	Parcel Address	5 Murray Avenue
	Village of Bath	Occupant/Land Use	Electric and Gas Facility
Owner	Tax ID 159.17-01-007.000	Parcel Address	35 Delaware Avenue
	Steuben Industrial Development Agency	Occupant/Land Use	Babcock Ladder Company

Table 2
Site History Summary
Bath Former MGP Site
Bath Electric, Gas and Water Systems
Bath, New York

Date	Observation/Activity	Data Source
1859	The Gass Company was granted rights to lay pipes for gas, but work is delayed until 1877 due to Civil War. Gas supplied for street lighting.	The Heritage of Bath, NY, 1793-1993
1883	The Gass Company built plant on Crooks Lane (now Murray Avenue), consisting of a red brick building with two 30-foot cast iron retorts. Coke and oil were delivered by rail, which was adjacent to the property. A gas holder was also present. Supplied gas through cast iron pipes throughout the Village. Plant began operation October 10, 1883.	The Heritage of Bath, NY, 1793-1993
1887	Earliest listing in Brown's Directory showing the Bath Gas Light Co. with coal process	Brown's Directory
1890	Name changed to Bath Gas Co., indicated they ran 87 public lights and had annual output of 5,000,000 cu.ft.	Brown's Directory
1900	The Gass company merged with local electric company to form the Bath Electric and Gas Light Company.	The Heritage of Bath, NY, 1793-1993
1901	Listed as Bath Electric and Gas Light Co., consolidated with Electric Co. on August 1, 1900.	Brown's Directory
1911	Building was extensively re-built and water gas equipment was installed, main holder erected.	Municipal Gas Utility, 1942, Barker & Wheeler
1912	Lowe's process use is indicated for first time.	Brown's Directory
1913	Total capacity of 50,000 cu.ft.: gas holder 30,000 cu.ft. and relief holder 20,000 cu.ft.	Brown's Directory
1915	Bath Electric Light and Gas Company Gas Plant shows 2 gasometers, 15,000 gallon capacity fuel oil tank, retorts, and notes "1 man constantly on duty". Standard Oil Co. located on adjacent property to west with 2 iron oil tanks.	Sanborn
1920	The Village of Bath purchased the gas operations of the Bath Electric and Gas Light Company.	The Heritage of Bath, NY, 1793-1993
1921	Name changed to Bath Gas Plant and shown as municipal plant.	Brown's Directory
1922	Name changed to Bath Electric and Gas System.	Brown's Directory
1930	Village entered into service agreement for Southern Tier Gas Company to build natural gas pipeline to supply the Village.	The Heritage of Bath, NY, 1793-1993
1930	Bath Electric Light and Gas Company Gas Plant shows same equipment as the 1915 Sanborn, with addition of 2 small gasometers adjacent to building. Standard Oil Co. still shows 2 oil tanks and now has 2 large circular structures both labeled "G.T.", likely gas tanks. The property west of this is labeled Colonial Beacon Oil Co. and has an oil tank, one round structure labeled "G.T." and one rectangular structure labeled "G.T.".	Sanborn
1932	The MGP was used until 1932. The Village switched to natural gas on December 26, 1932.	Advocate, December 22, 1932.
1933	Production listed as carbureted water gas for 11 months and natural gas for one month.	Brown's Directory
1934	Named changed to Bath Electric and Gas System, no longer listed under MGP sites but under natural gas companies.	Brown's Directory
1935	Natural gas being purchased from Southern Tier Gas Corp.	Brown's Directory
1936	Village took over the local water works company as well and merged the utilities into the Bath Electric, Gas and Water Systems (BEGWS).	The Heritage of Bath, NY, 1793-1993
1940	Name changed to Bath Electric, Gas and Water System.	Brown's Directory
1941	Gas Plant – General Plan map shows 2 gas holders (one 31,000 cu. ft. and one 19,500 cu.ft.), purifiers, tar washer, oil storage tank, and coal storage.	Municipal Gas Utility, Bath, NY Gas Plant – General Plan
1948	Bath Electric Light and Gas and Water System Company Gas Plant shows same equipment as 1930 Sanborn, but the retorts are no longer shown in the building interior, and the area is labeled as storage. The Standard Oil Co. property is now Steuben Rural Electric Co-Op Field office and the oil and gas tanks have been removed. The Colonial Beacon Oil Co. also had oil tank and round gas tank removed.	Sanborn
1955	Circular gas holders and MGP plant building still visible on aerial photo.	1955 air photo
1964	Circular gas holders appear to be removed, but MGP building still visible.	1964 air photo
Up to 1965	BEGWS shown as purchasing natural gas from Southern Tier Gas Co. and has no gas operations.	Brown's Directory
1968	MGP building still visible on aerial photo.	1968 air photo

Notes:

Brown's – Brown's Directory of American Gas Companies

cf – cubic foot

Sanborn – Sanborn Fire Insurance Map

Table 3
Site Characterization Sample Summary and Rationale
Bath Former MGP Site
Bath, New York

Type of Sampling	Location	Rationale	Number of Samples+	Target Completion Depth*	Laboratory Analyses+
Soil Sampling					
Soil Boring SB-1	Northwest Area	Evaluate site conditions	TBD	20 feet bgs or below base of gas Gas Holder A foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-2	Gas Holder A	Assess whether the gas holder foundation is present and its contents or the condition of site soils	TBD	Floor of buried holder foundation, or 20 feet bgs if holder no longer present	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-3 and deep temporary monitoring well (TM-1)	Gas Holder A, downgradient / drip box	Assess conditions on the downgradient side of Holder A at the former location of the drip box	Soil samples TBD Groundwater per Work Plan (see Note 1 below)	Top of confining layer or 30 feet - well screened at top of confining layer or from 25-30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-4	Southwest Area	Assess site conditions	TBD	20 feet bgs or below depth of Gas Holder A foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-5 and shallow temporary monitoring well (TM-3)	Oil Tank and Cooling Tower Area	Assess conditions adjacent to former oil tank and cooling tower locations	Soil samples TBD Groundwater per Work Plan (see Note 1 below)	20 feet bgs or below base of Gas Holder A or gas building foundation - well screened across water table	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-6	Coal storage area	Assess site conditions at coal storage area and downgradient of gas production building	TBD	20 feet bgs or below base of Gas Holder A or gas building foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-7	Gas Production Area	Assess building location/foundation and site conditions below former water gas production equipment	TBD	20 feet bgs or below base of Gas Holder A or gas building foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-8	Gas Production Area	Assess building location/foundation and site conditions below former gas processing/washing area	TBD	20 feet bgs or below base of Gas Holder A or gas building foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-9	Gas Purifiers	Assess soil conditions at gas purifiers	TBD	20 feet bgs or below base of Gas Holder A or gas building foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-10 and deep temporary monitoring well (TM-2)	Gas Holder B	Assess conditions down gradient of gas holder B at location of drip box	Soil samples TBD Groundwater per Work Plan (see Note 1 below)	Top of confining layer or 30 feet - well screened at top of confining layer or from 25-30 feet	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-11	Gas Holder B	Assess whether the gas holder foundation is present and condition of site soils beneath (assumes above-grade holder construction)	TBD	20 feet bgs or below Gas Holder A foundation	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs
Soil Boring SB-12	Gas Holder A	Evaluate the construction, depth, and potential contents of outer foundation for gas holder bell	TBD	Floor of buried holder foundation, or 20 feet bgs if holder no longer present	TCL VOCs + TICs TCL SVOCs + TICs TAL Metals + Cyanide PCBs

Notes:

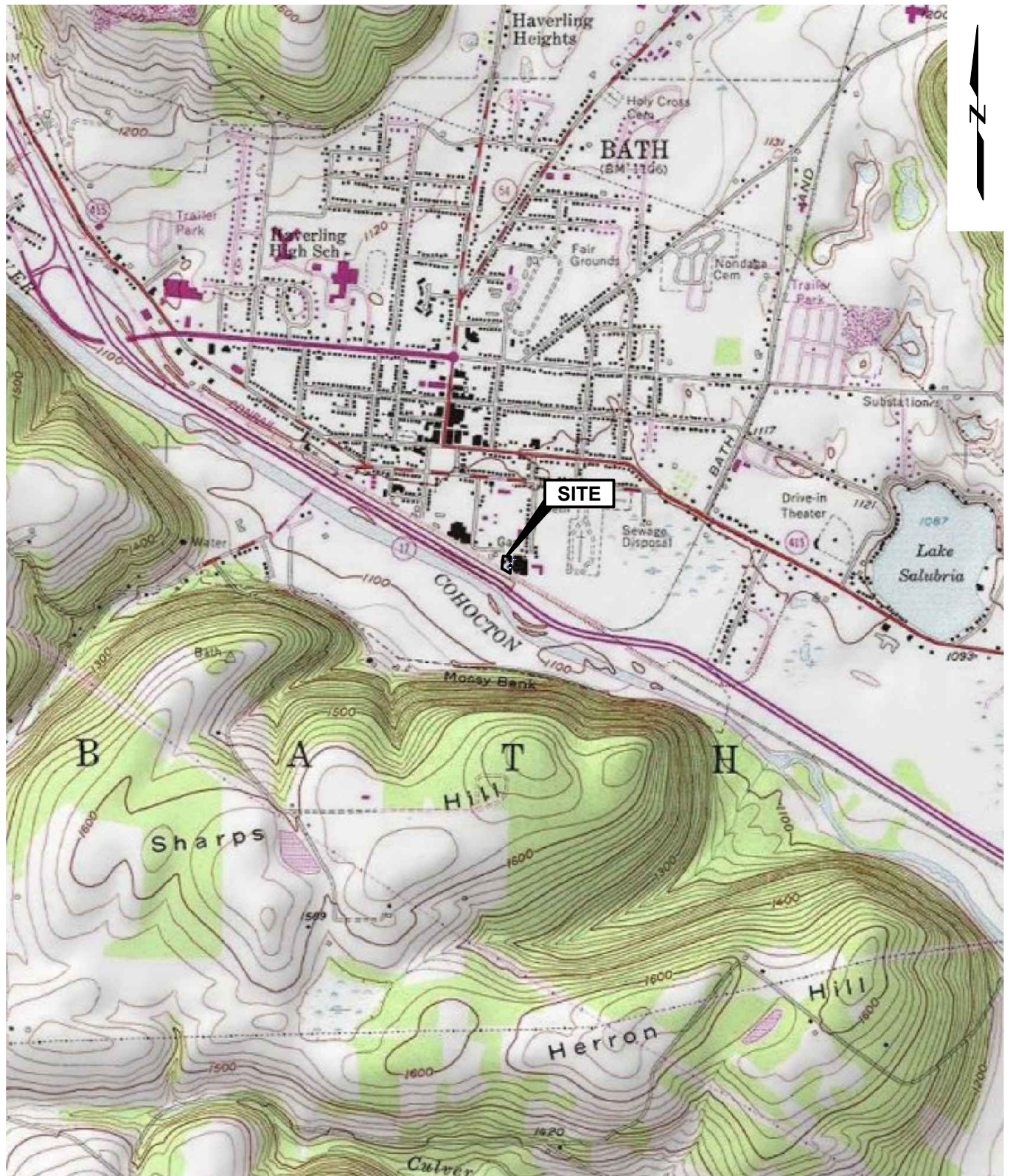
- * Borings will be advanced to the deepest level described, as determined by site conditions.
- + The locations of soil samples will be selected in the field based on the conditions encountered.

Table 3
Site Characterization Sample Summary and Rationale
Bath Former MGP Site
Bath, New York

Type of Sampling	Location	Rationale	Number of Samples+	Target Completion Depth*	Laboratory Analyses+
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Note 1: Groundwater analyses from temporary wells will include: TCL VOCs and SVOCs, TAL metals, total cyanide, PCBs, pesticides, and PFAS (see Work Plan for methods)

Figures



SOURCE:

USGS TOPOGRAPHIC MAP © 2013 NATIONAL GEOGRAPHIC SOCIETY ACCESSED VIA ARCGIS ONLINE.

Site Characterization Work Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York

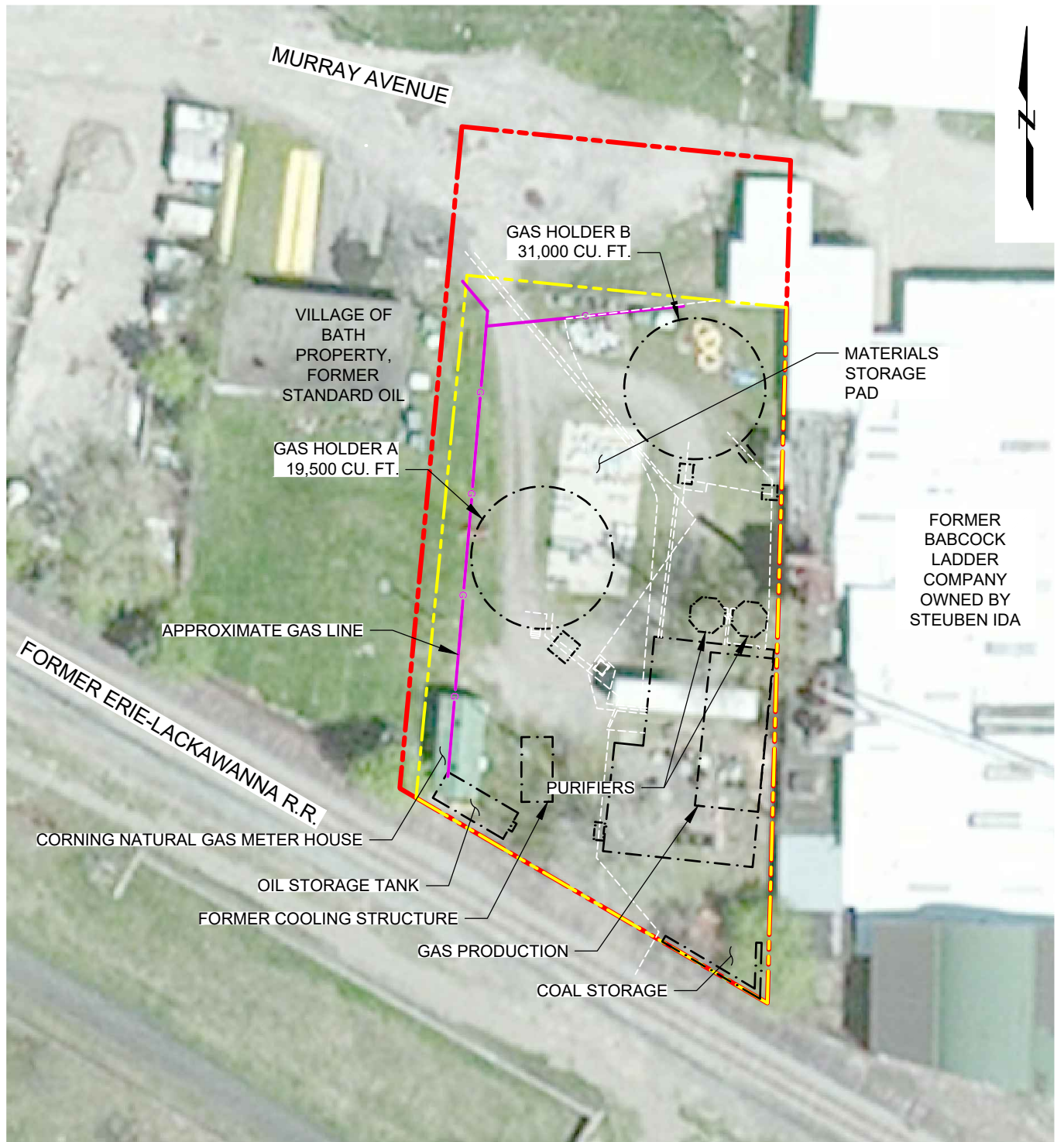


Project 1804919

SITE LOCATION MAP

October 2022

Fig. 1



SOURCES:

1. TAX MAP: VILLAGE OF BATH, MAP SECTION 159.17, PREPARED BY REAL PROPERTY TAX SERVICE AGENCY, REVISED DATE: 4/25/2014, SCALE" 1" = 100 FT.
2. HISTORIC STRUCTURES FROM: GAS PLANT - GENERAL PLAN, MUNICIPAL GAS UTILITY, BATH, NEW YORK PREPARED BY BARKER & WHEELER ENGINEERS, DATE: 11/1/41, SCALE: 1" = 8 FT.
3. STEUBEN COUNTY NEW YORK REAL PROPERTY PARCEL VIEWER (<https://snygis.maps.arcgis.com/apps/webappviewer/index.html?id=a9d84237ea8346f2a526e1f4d4534537>) ACCESSED ON 7/29/2015.
4. AERIAL PHOTOGRAPH: BING MAPS © 2008 MICROSOFT CORP. ACCESSED VIA ARCGIS ONLINE ON 7/29/2015.

LEGEND:

	HISTORIC MGP STRUCTURE
	HISTORIC PIPING
	HISTORIC MGP PROPERTY BOUNDARY
	CURRENT PROPERTY BOUNDARY

Site Characterization Work Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York

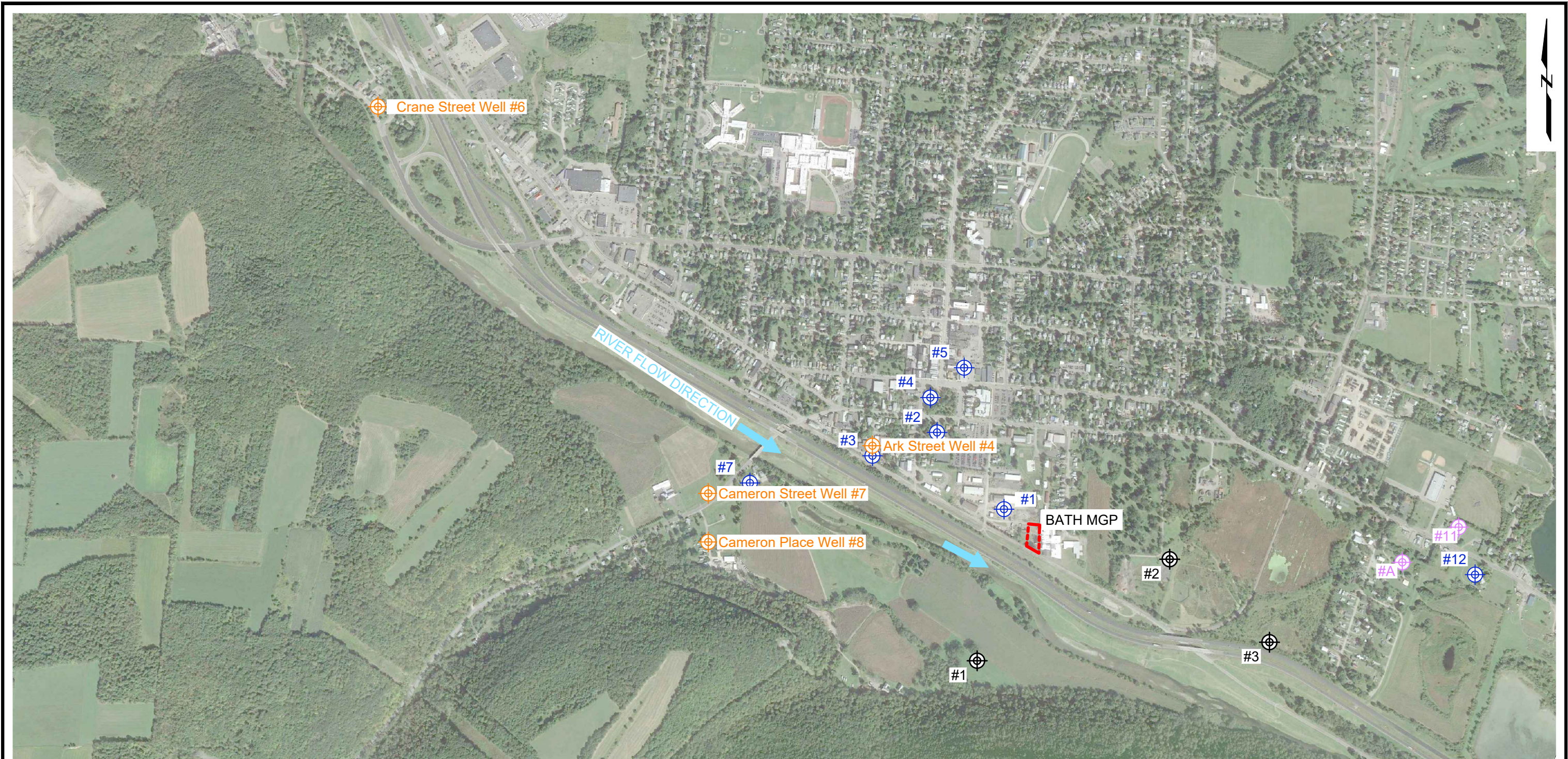


Project 1804919

SITE PLAN AND
HISTORICAL FEATURES

October 2022

Fig. 2



0 1000 2000

SCALE: 1" = 1000'

SOURCES:
1. AERIAL PHOTOGRAPH: GOOGLE MAPS
ACCESSSED VIA GOOGLE EARTH ON 9/01/2015.

COLOR LEGEND

- ⊗ Inactive water supply wells
- ⊗ Active small quantity water supply Well
- ⊗ Inactive USGS Water Wells
- ⊗ Plugged and Abandoned former Oil/Gas Well
- ⊗ Public Water Supply Wells

Site Characterization Work Plan Bath Former MGP Site Bath, New York	 GEI Consultants	WATER WELLS
Bath Electric, Gas and Water Systems Bath, New York	Project 1804919	October 2022 Fig. 3

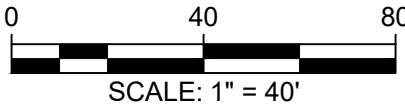


LEGEND:

- HISTORIC STRUCTURE
- HISTORIC PIPING
- HISTORIC MGP PROPERTY BOUNDARY
- CURRENT PROPERTY BOUNDARY
- PROPOSED BORING
- SHALLOW TEMPORARY WELL
- DEEP TEMPORARY WELL

SOURCES:

- TAX MAP: VILLAGE OF BATH, MAP SECTION 159.17, PREPARED BY REAL PROPERTY TAX SERVICE AGENCY, REVISED DATE: 4/25/2014, SCALE" 1" = 100 FT.
- HISTORIC STRUCTURES FROM: GAS PLANT - GENERAL PLAN, MUNICIPAL GAS UTILITY, BATH, NEW YORK PREPARED BY BARKER & WHEELER ENGINEERS, DATE: 11/1/41, SCALE: 1" = 8 FT.
- STEBEN COUNTY NEW YORK REAL PROPERTY PARCEL VIEWER (<https://snygis.maps.arcgis.com/apps/webappviewer/index.html?id=a9d84237ea8346f2a526e1f4d4534537>) ACCESSED ON 7/29/2015.
- AERIAL PHOTOGRAPH: BING MAPS © 2008 MICROSOFT CORP. ACCESSED VIA ARCGIS ONLINE ON 7/29/2015.



Site Characterization Work Plan Bath Former MGP Site Bath, New York		PROPOSED SAMPLING LOCATIONS	
Bath Electric, Gas and Water Systems Bath, New York		Project 1804919	October 2022
			Fig. 4

Appendix A

Historical Information

- Photographs
- Maps
- Sanborns

Village of Bath Public Utilities

The Village of Bath has been able to point with pride to its utility service. The Bath Electric, Gas, and Water System (BEGWS) has evolved into a highly efficient and economical utility service which serves the residents well.

The Gass Company

As early as 1859 the Gass Company was granted the right and privilege of laying pipes beneath the streets to convey gas for commercial, domestic, and street lighting. Construction was delayed by the Civil War until 1877 when The Gass Company began to exercise its 1859 village rights and furnished gas for several street lights. The plant for making gas by boiling pine knots was located at the northeast corner of William at Pine Street. The pipes were hollowed out logs.

In 1883 The Gass Company finished building its plant on Crooks Lane (now Murray Avenue); a red brick building housed two 30-foot high cast iron retorts. These were charged, at the second story level, with coke and oil delivered to the plant by rail freight. A gas holder and other equipment were used for the distribution of this gas in cast iron pipes throughout the village. The plant began continuous operations on October 10, 1883.

In 1887 Mr. Frank A. Hinds was granted the right to lay pipes beneath the streets for the conveyance of a water supply adequate for domestic uses and fire protection. This resulted in the construction of cast iron water mains in the streets, the establishment of a water well field and construction of a 350,000 gallon riveted wrought iron storage tank south of the river above Cameron Turnpike (Cameron Street).

Bath Electric Illuminating and Power Company

In 1892 the Bath Electric Illuminating and Power Company was organized to furnish commercial and domestic electric service to the village. A coal fired

Text for this section is adapted from the unpublished "History of Bath Public Utilities," an extensive work by Brooks Lapp, former director of the Bath utilities.



At one time, offices of the Bath Electric and Gas Light Co. were located on the ground level of the Nichols House hotel on E. Steuben Street.
From the collection of John Stratton

steam generation plant was built on Ark Street at South Avenue. The following year an electric generation plant was completed. It featured a two-story building enclosing a tall coal fired steam boiler which supplied low pressure steam to electric generators located in an adjoining building. The new company agreed to provide, operate, and maintain 43 electric arc street lights under contract with the village trustees and to make electric service available for both commercial and domestic purposes. This plant was purchased by the village in 1914 and operated until it was replaced by diesel generators in 1933. It was demolished in July 1992. While commercial and domestic building gas lighting and lights for village streets were important portions of The Gass Company business, the electric arc street lights soon replaced The Gass Company gas street lights. However, the company did compete to retain its commercial and domestic gas building lighting business.

Bath Electric and Gas Light Company

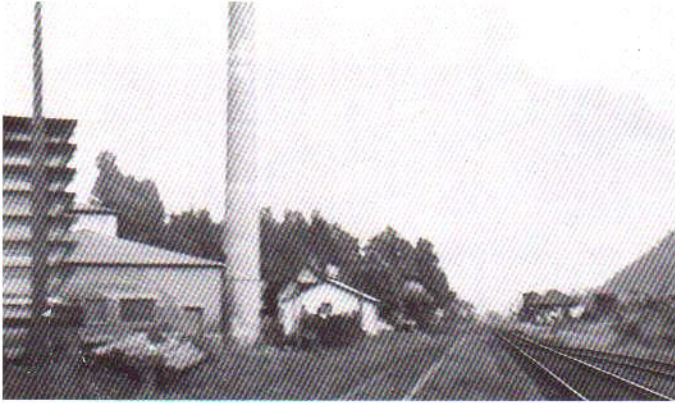
By 1900 many businesses and homes converted their gas lighting to the safer electric lights. During this year the two competing utility companies merged under the name of the Bath Electric and Gas Light Company. Unfortunately, new

capital investments, required primarily for electric service expansion, failed to materialize and the quality of both gas and electric service from the company gradually deteriorated.

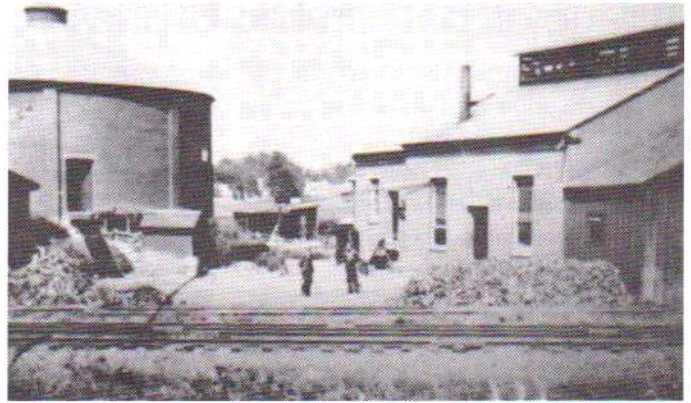
In 1913 The Bath Electric and Gas Light Company sought, without success, to sell its electric operations. Both service and reliability had deteriorated to an alarming degree. To protect the supply of electricity to the existing customers of the company, and as an alternative to bankruptcy, the New York State Public Service Commission issued a certificate of convenience and necessity to the trustees of the Village of Bath. The following year, the village residents approved a \$50,000 bond issue to purchase the electric facilities portion of the Bath Electric and Gas Light Company and to establish a municipal electric system.

In 1915 the village hired Mr. Frank Nollett as the first superintendent. Under his direction improvements were made at the steam generation plant on Ark Street and on the distribution pole lines. On July 1, 1915, the municipal operation of commercial and residential service, and the attendant street lights, was assumed. Under municipal operation other system investments and improvements were made and additional commercial and domestic electric service was

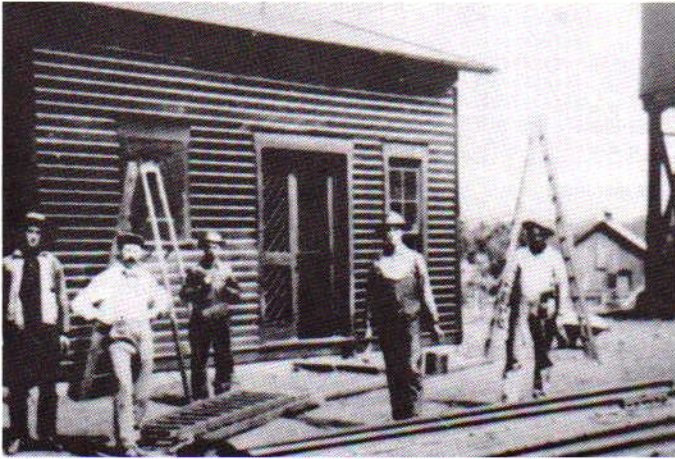
The Old Gas Plant on Murray Avenue



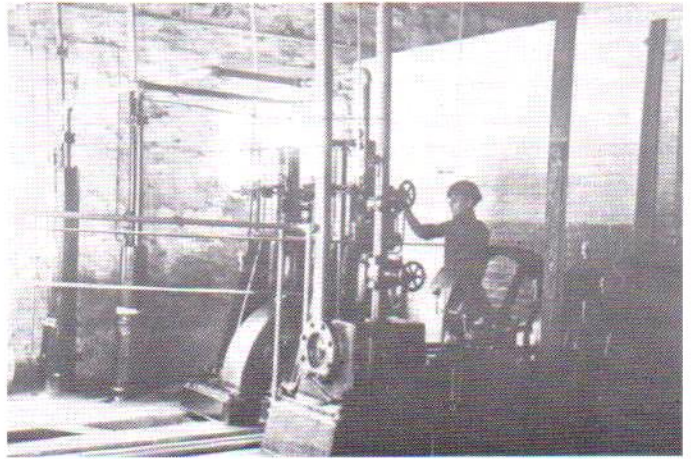
From the Steuben County Historian's collection



From the collection of Gary & Ruth Waldo



From the collection of Gary & Ruth Waldo



From the collection of Gary & Ruth Waldo

made available October 1, 1915. In 1916 the mayor and the board of trustees appointed a three-man board of light commission.

During this time period the gas operations of the Bath Electric and Gas Light Company had also become under capitalized and the company sought to cease operations. In 1920 under condi-

tions similar to those in 1913 to 1914, the village purchased the gas operations of the Bath Electric and Gas Light Company. A municipal gas system was established with operating responsibility being vested in the board of light commission for administration with the municipal electric department. Ten years later, natural gas was discovered in Rathbone

and Woodhull. The village entered into a service agreement that made it possible for Southern Tier Gas Company to build a natural gas pipeline from those supply areas to the village.

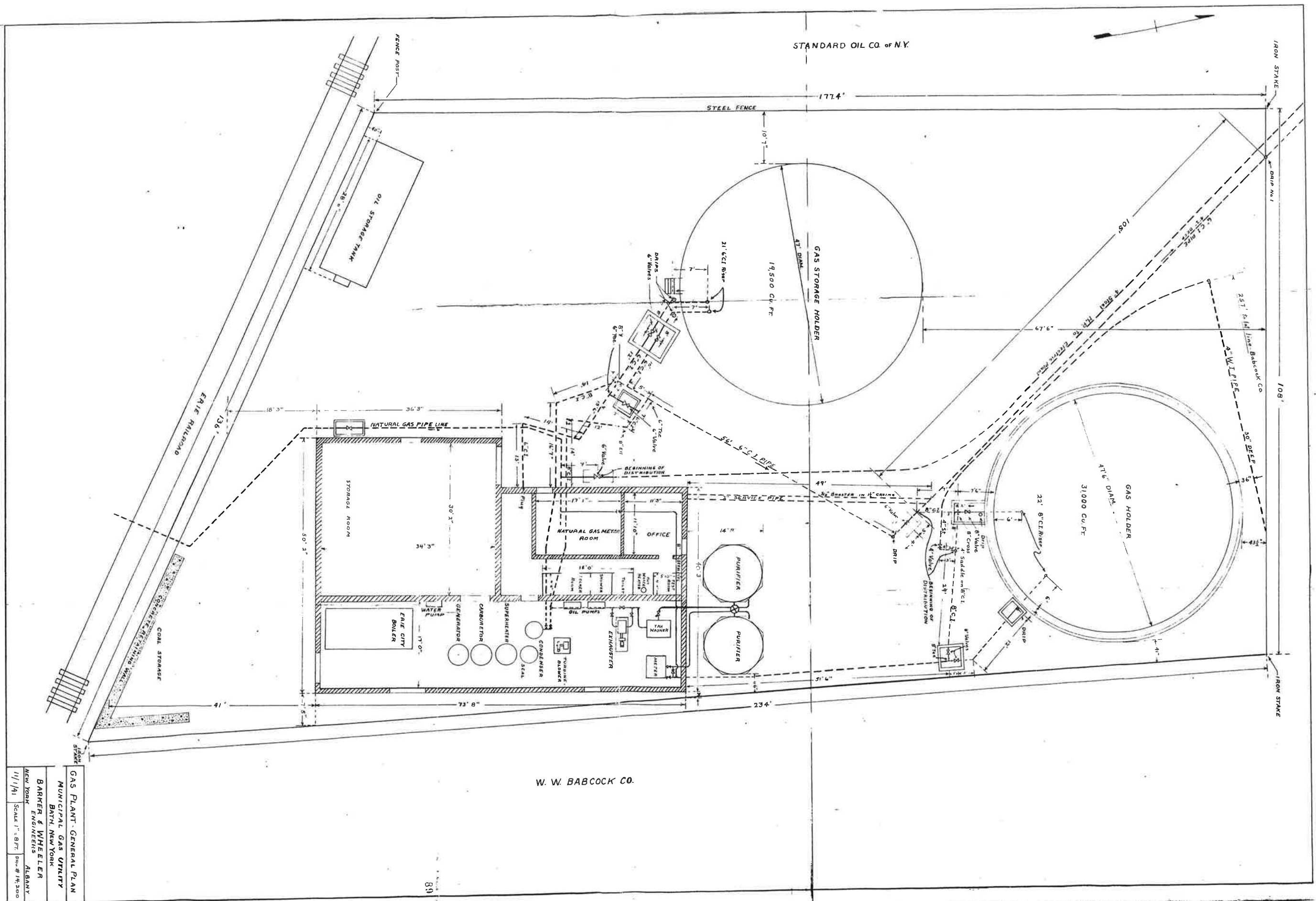
The Bath Water Works Company

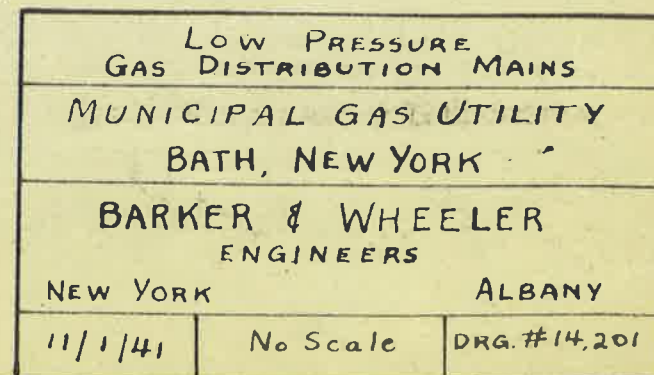
In 1934 the Bath Water Works Company, successor to the Frank A. Hinds (1887) Water Company, told the village that it was unable to supply the volume of water for fire protection required in its agreement with the village. The following year a village referendum approved the sale of village bonds to purchase the properties of the Bath Water Works Company and to construct sanitary and storm sewers. The sanitary sewer system construction, operation, and maintenance was turned over to the board of lighting commission for administration with the gas and electric in 1936. The commissioners elected to do business as the Bath Electric, Gas and Water Systems (BEGWS).



The Bath Water Works, located at the site of the former Cook's Pond.

From the collection of John Stratton





Bath MGP

5 Murray Avenue
Bath, NY 14810

Inquiry Number: 4344202.3
July 05, 2015

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7/05/15

Site Name:

Bath MGP
5 Murray Avenue
Bath, NY 14810

Client Name:

GEI Consultants, Inc
1301 Trumansburg Road
Ithaca, NY 14850



EDR Inquiry # 4344202.3

Contact: Jerry Peake

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Cross Street:
P.O. # NA
Project: Bath MGP
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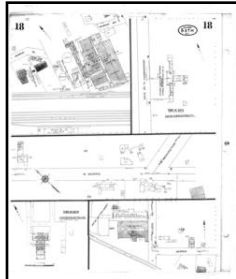
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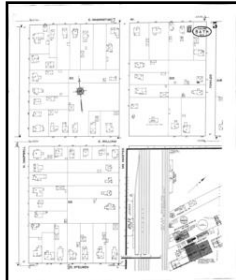
Volume 1, Sheet 18

1930 Source Sheets



Volume 1, Sheet 18

1915 Source Sheets



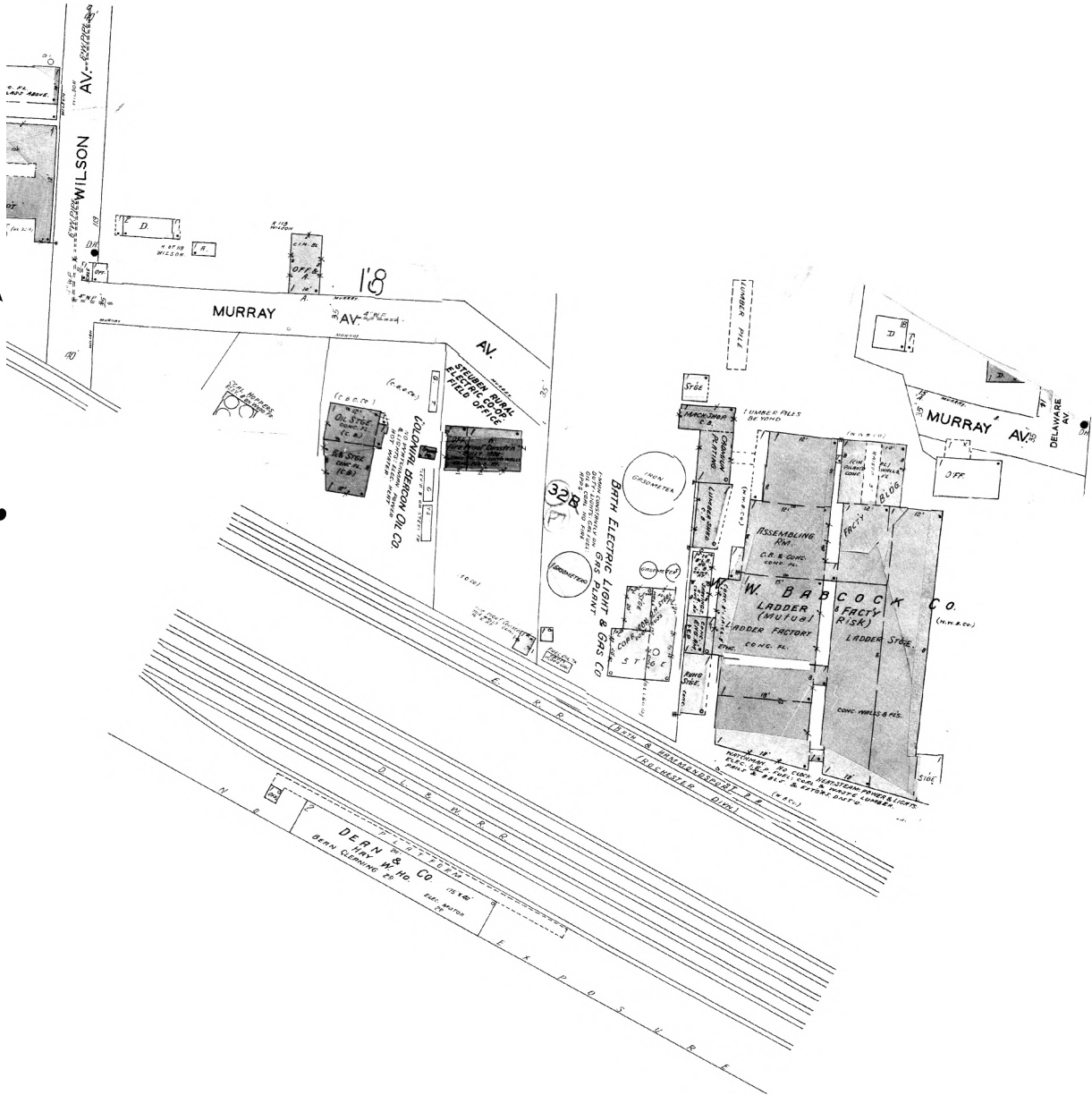
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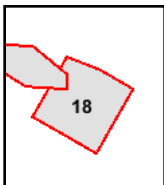
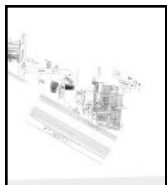
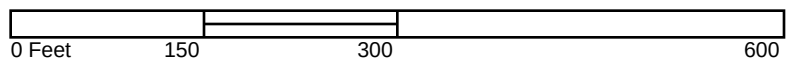
9A91-4470-BDFE



Site Name: Bath MGP
 Address: 5 Murray Avenue
 City, ST, ZIP: Bath NY 14810
 Client: GEI Consultants, Inc
 EDR Inquiry: 4344202.3
 Order Date: 7/5/2015 11:26:00 PM
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Address: 5 Murray Avenue

City, ST, ZIP: Bath NY 14810

Client: GEI Consultants, Inc

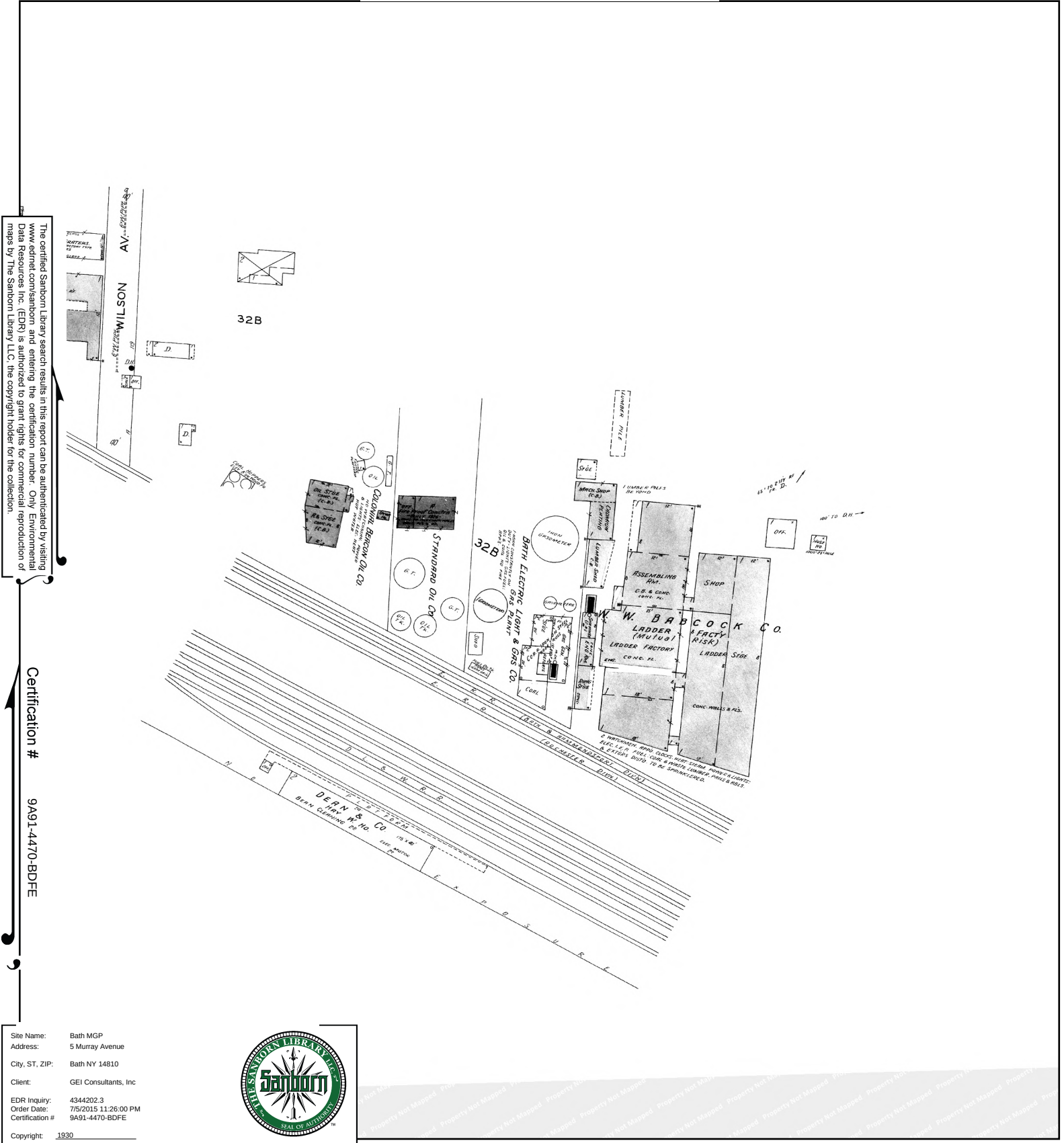
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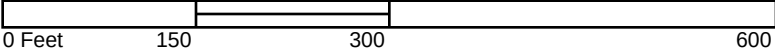
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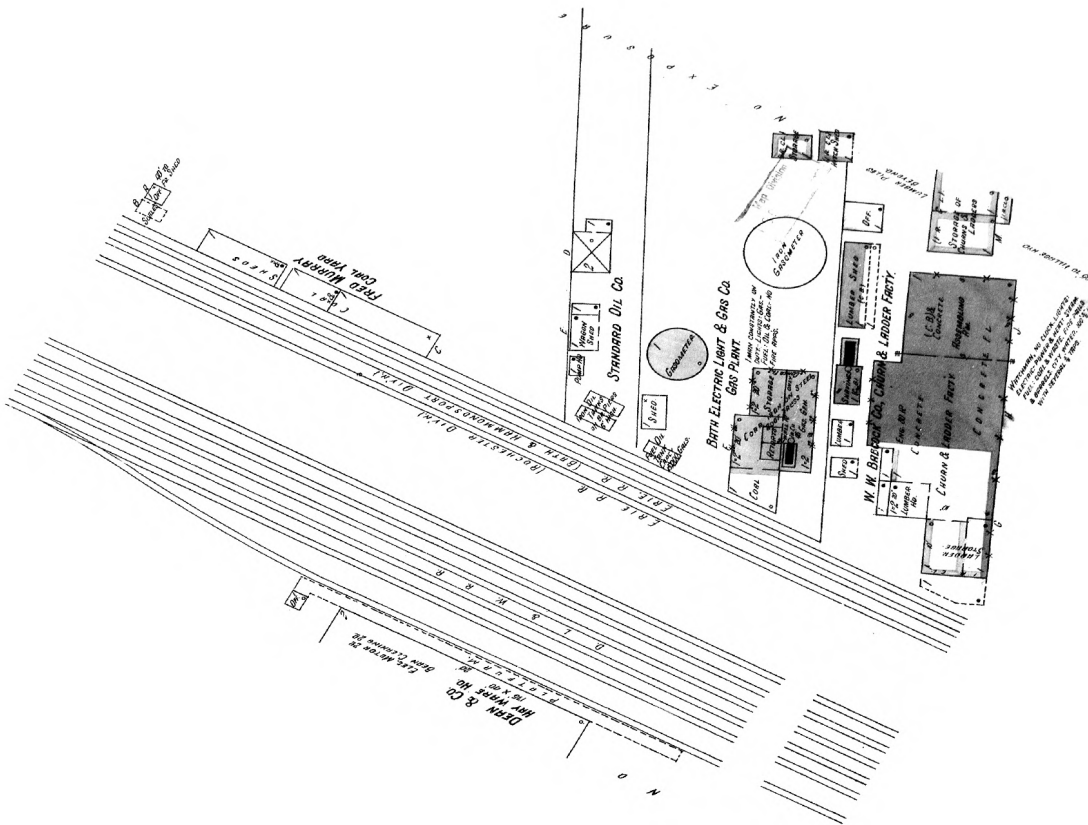


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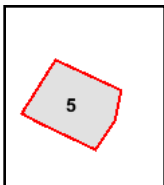
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Client: GEI Consultants, Inc
EDR Inquiry: 4344202.3
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Appendix B

Community Air Monitoring Plan



Consulting
Engineers and
Scientists

Appendix B

Community Air Monitoring Plan

Bath Former MGP Site

Bath, New York
NYSDEC Site # 851036

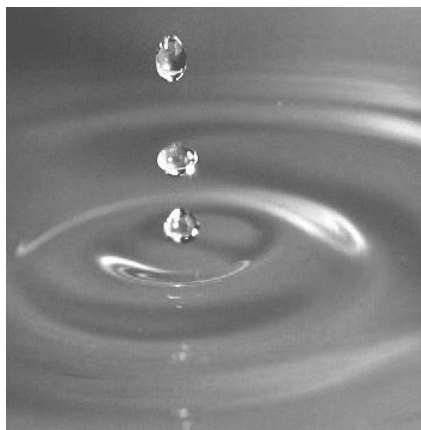
Submitted to:

New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233-7014

Submitted by:

GEI Consultants, Inc., P.C.
1301 Trumansburg Road, Suite N
Ithaca, NY 14850
607-216-8955

October 2022
Project # 1804919



Bruce Coulombe, P.G.
Project Manager

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A. Community Air Monitoring Daily Data Sheet	
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Abbreviations and Acronyms

BEGWS	Bath Electric, Gas & Water Systems
CAMP	Community Air Monitoring Plan
CHSO	Corporate Health and Safety Officer
COC	Constituents of Concern
GEI	GEI Consultants, Inc., P.C.
HASP	Health and Safety Plan
MGP	Manufactured Gas Plant
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbons
PID	Photoionization Detector
PM	Project Manager
ppm	Parts per Million
SC	Site Characterization
SVOC	Semi-Volatile Organic Compounds
VOC	Volatile Organic Compounds
$\mu\text{g}/\text{m}^3$	Micrograms per cubic meter

1. Introduction

This document presents the Community Air Monitoring Plan (CAMP) that will be implemented during the Site Characterization (SC) of the Bath electric, Gas & Water Systems (BEGWS) Former Manufactured Gas Plant (MGP) site, located in the Village of Bath, New York. A CAMP is required by the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH) at sites where ground-intrusive activities may result in airborne release of contaminants. Towards that end, community air monitoring will be performed for total volatile organic compound vapors (VOCs), and for particulates (dust).

The Bath Former MGP site is located at the east end of Murray Avenue in the Village of Bath, New York (Figure 1). The Site is owned by the Village of Bath and is being evaluated by BEGWS under a Consent Order with the NYSDEC. It is located on edge of a commercial area, bordering the former Erie-Lackawanna Railroad. The Site is currently defined as measuring approximately 110 to 140 by 220 to 265 feet located at 5 Murray Avenue (Figure 2).

This CAMP specifically applies to the SC work for the Bath Former MGP site. The SC field work is scheduled to be performed in early 2016, as described in the document “*Site Characterization Work Plan, Bath Former MGP Site, Bath, New York*,” dated August 2015 (attached). The SC field work involves installing soil borings and monitoring wells, and excavating test pits. Community air monitoring will be performed during the excavation and backfilling of the test pits and drilling of soil borings and monitoring wells.

The objectives of this CAMP are to:

- Ensure that the airborne concentrations of constituents of concern (COC) are minimized to protect the community;
- Provide an early warning system so that potential emissions can be controlled on site at the source; and
- Measure and document the concentrations of airborne COC to confirm compliance with the specified limits.

This CAMP is a companion document to GEI Consultants, Inc. P.C.’s (GEI) site-specific Health and Safety Plan (HASP). The HASP is a separate document and is directed primarily toward protection of on-site workers within the designated work zones.

2. Air Monitoring Equipment, Methods, and Action Levels

This section provides instructions for conducting the CAMP. Discussed are the COC to be monitored, the equipment to be used, where sampling is to be performed, and the action limits. For the Bath MGP site, community air monitoring will be performed for total VOCs and particulates (dust) during the excavation and backfilling of test pits and drilling of soil borings and monitoring wells.

In addition to the community air monitoring, work/exclusion zone monitoring will be performed during work activities where impacted soil or groundwater may be encountered. The exclusion zone air monitoring requirements, equipment, and action levels are described in the site-specific HASP for this project. Note, however, that the work zone air monitoring and the community air monitoring are conducted as part of the overall site control program. When work zone VOC or particulate readings are found to exceed the downwind CAMP limits, the field staff will check the upwind and downwind air monitoring instruments to assess whether control measures will be required.

2.1 Monitoring Locations

Two community air monitoring locations will be established at the start of each workday – one upwind of the work area, and one downwind of the work area/exclusion zone. The purpose of the upwind station will be to determine the background concentration of VOCs and particulates at the worksite. The downwind monitoring station will be used to assess compliance with the NYSDEC/NYSDOH specified action limits for VOCs and particulates. The upwind VOC and dust measurements will be subtracted from the downwind measurements in order to compare the downwind instrument readings to the CAMP action levels.

The location of each monitoring station will be noted on the ***Community Air Monitoring Daily Data Sheet*** (Daily Data Sheet) [Attachment A]. The locations of the instruments may be changed during the day to adapt to changing wind directions. Each location will be noted on the Data Sheet, along with the start and stop time at each location. Field personnel will be prepared to move the equipment to multiple locations in the event that there is little wind, if the wind direction changes frequently, or if there is a change to the location of the most sensitive downwind receptor location.

If necessary, precautions to minimize the release of VOCs and particulates will be taken at the work zone, and engineering or work controls used to protect the downwind receptor. These controls for minimizing releases from the work zone are discussed in Section 3.

2.2 Air Monitoring Equipment

The monitoring instruments will be calibrated at the start of each workday, and again during the day if the performance of an instrument is in question. The time and method of calibration will be noted on the Daily Data Sheet. Both the photoionization detectors (PIDs) and particulate meters will be mounted on a tripod in a vented protective case, and programmed to record 15-minute averages. A monitoring technician will check the instrumentation at each of these locations regularly during the work-day to ensure that they are operating properly.

2.2.1 VOC Monitoring Equipment

VOC monitoring will be performed using PIDs (RAE Systems MiniRAE™ or equivalent) equipped with a 10.2 or 10.6 eV bulb. The instruments will be set to record 15-minute running average concentrations. The PIDs will be equipped with an audible alarm to indicate an exceedance of the action level of 5 parts per million (ppm) total VOCs.

2.2.2 Particulate (Dust) Monitoring Equipment

Particulate monitoring will be performed using meters set to measure 10 micron and finer particulates (PM-10). Particulates will be monitored using an MIE DataRAM DR-2000I, TSI DustTrak™, or equivalent, which is capable of measuring PM-10. The equipment used will be set to record 15-minute running average concentrations, for comparison to the action levels.

In addition to the instrument readings, fugitive dust migration will be visually assessed during all work activities, and the observations recorded. Per NYSDEC requirements, visible dust migration will not be allowed. If visible dust is observed to be migrating from the work zone, the work will be stopped and dust control measures implemented.

2.3 Monitoring Action Levels and Responses

The action levels and responses for VOCs and particulates are presented in Table 1.

Table 1. Air Monitoring Response Levels and Actions

VOCs	
Response Level	Actions
>1 ppm at the wall of an occupied structure or at an air intake	Check the indoor air concentration and compare with background measurements taken previously
>10 ppm above background for 15-minute average	- Use Sensidyne detector tube for naphthalene or zNose® to verify if concentration is naphthalene. No respiratory protection is required if naphthalene is not present. - Continue monitoring, especially inside of occupied structures - If VOC levels decrease (per instantaneous readings) below 10 ppm over background, work activities can resume
10 – 50 ppm	No respiratory protection is required if benzene or naphthalene is not present.
50 – 100 ppm	Stop work, withdrawal from work area, institute engineering controls, if levels persist, upgrade to Level C.
> 100 ppm	Stop work, withdraw from work area, notify Project Manager (PM) and Corporate Health and Safety Officer (CHSO).
Particulates	
Response Level	Actions
>100 micrograms per liter ($\mu\text{g}/\text{m}^3$) above background for 15-minute average or visual dust observed leaving the site	- Apply dust suppression - Continue monitoring - Continue work if downwind PM-10 particulate levels are $<150 \mu\text{g}/\text{m}^3$ above upwind levels and no visual dust leaving site
>150 $\mu\text{g}/\text{m}^3$ above background for 15-minute average	- Stop work - Re-evaluate activities - Continue monitoring - Continue work if downwind PM-10 particulate levels are $<150 \mu\text{g}/\text{m}^3$ above upwind levels and no visual dust leaving site
Sources:	
- NYSDOH Community Air Monitoring Plan, December 2009, as published in NYSDEC DER-10, Appendix 1A, 2010. - Fugitive Dust and Particulate Monitoring, NYSDEC DER-10, Appendix 1B, 2010. - Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures, NYSDOH.	

All data will be downloaded to a computer on a daily basis and saved for review. The data will be provided to the NYSDEC and/or the NYSDOH upon request at any stage of the project.

If VOC or particulate action levels are observed to be exceeded during the work day, the event, the source and corrective actions taken will be recorded on the Daily Data Sheet and reported to on-site NYSDEC and NYSDOH representative. If an on-site representative is not present, NYSDEC and NYSDOH will be notified immediately following the event either by phone or email. The event will also be noted in the daily report to the NYSDEC and NYSDOH project manager within one business day.

Table 2. Emergency Contacts and Telephone Numbers

Fire, Police, Ambulance		911
NYSDEC Contact	Gerry Pratt, P.G. NYSDEC Project Manager Division of Environmental Remediation, Remedial Bureau C 625 Broadway, 12th Floor Albany, NY 12233-7014	(518) 402-9667 (office) TBD (cell) gerald.pratt@dec.ny.gov
NYSDOH Contact	Renata E. Ockerby NYSDOH Project Manager Bureau of Environmental Exposure Investigation Corning Tower; Room 1787 Albany, NY 12237	bee@hegplth.ny.gov
GEI Contacts	Bruce Coulombe – Project Manager and Field Team Leader	(607) 793-3426 (cell) bcoulombe@geiconsultants.com
BEGWS Contact	Erin B. Bonacci – Director of Municipal Utilities	(607) 664-9103 (office) (716) 998-9794 (cell) ebonacci@begws.com

2.4 Odor Monitoring

The field investigation personnel will record observations of odors generated during the implementation of the Work Plan. When odors attributable to the exposing of impacted media are generated in the work area during intrusive activities such as soil borings or excavation of test pits, observations will also be made at the downwind limit of the MGP site. The observations will be made to assess the potential for significant odors reaching on-site receptors or being transmitted off site. The downwind odor monitoring will be performed in conjunction with the PID and dust monitoring program described in this CAMP.

Upon detection of odors at the site perimeter, site controls, starting in the work area, will be implemented. The site controls described in Section 3 will be used to assist with odor mitigation. Note that the goal of the Odor Mitigation Plan is to minimize and to prevent, where practicable, the off-site migration of odors. Due to the short distances between any work area at the site and the on-site receptors property line, site controls will be implemented proactively when odors are detected in the breathing zone at any work area.

There are no action levels specified for odors. In the event that odors persist at the downwind receptors or property line after control measures are carried-out, the odor conditions will be discussed with the BEGWS and NYSDEC project managers.

3. Control Procedures

This section outlines the procedures to be used to control VOCs, odors, and particulates that may be generated during the SC field activities. The investigation program will be conducted using one principal SC technique that may generate odors: subsurface soil borings and test pit excavations. The remainder of this section is intended to provide site managers, representatives of NYSDEC and NYSDOH, and the public with information summarizing typical odor control options, and to provide some guidance for their implementation. A description of potential sources of odors and methods to be used for odor control are presented in the following sections.

3.1 Potential Sources of Odors and VOCs

Generally, the residuals encountered at former MGP sites are well defined. They are related to residual coal tar-like materials and petroleum, and principally contain VOCs, polycyclic aromatic hydrocarbons (PAHs), and a number of inorganic constituents, including metal-complexed cyanide compounds, and metals. Constituents of MGP tar or petroleum products can produce odor emissions during investigation activities when they are unearthed during backhoe test pits and soil borings. When this occurs, VOCs and light-end semi-volatile organic compounds (SVOCs) can volatilize into the ambient air. Some MGP residuals can cause distinctive odors that are similar to mothballs, roofing tar, or asphalt driveway sealer. It is important to note that the CAMP will provide for continual monitoring of VOCs and particulates during the field work to monitor for any potential release of constituents which may exceed the exposure limits for downwind receptors.

3.2 General Site Controls

Several general excavation or drilling procedure site controls that will be implemented include:

- Every effort will be made to minimize the amount of time that impacted material is exposed to ambient air at the site.
- Drill cuttings from the hollow-stem auger borings will be containerized as soon as possible during completion of each soil boring.
- For the test pit excavations, it may be possible to move some amount of soil around within the footprint of the test pit excavation in order to minimize the amount of soil removal and subsequent stockpiling of impacted soil at the ground surface. The use of in-excavation stockpiling of test pit soil will be evaluated on a case-by-case basis, and will only be performed with the approval of the NYSDEC field representative,

and will be completed only if it does not impede the collection of subsurface soils or the full delineation of the subsurface features being investigated.

- Loading of excavated debris or soil that has been found by the site manager to be unsuitable material to return to test pits may generate VOCs and odors. Every effort will be made to complete this work as quickly as possible and to keep these materials covered at all times.
- Meteorological conditions are also a factor in the generation and migration of odors. Some site activities may be limited to times when specific meteorological conditions prevail, such as when winds are blowing away from a specific receptor.

3.3 Secondary Site Controls

If substantial VOCs or odors still present an issue following implementation of the above procedures, secondary controls will be enacted. The site manager will work through the applicable list of secondary controls until the perimeter odor issues are resolved. The site manager will work closely with BEGWS and the NYSDEC during this task. Final selection of controls will be dependent on field conditions encountered. Secondary controls include the following:

- For stockpiled impacted soil, temporary tarps or polyethylene covers will be used to control odors, VOCs, and dust.
- Water may be sprayed onto dry soils to minimize the generation of dust.
- The placement of portable barriers close to small active source areas (test pits) can elevate the discharge point of emissions to facilitate dispersion and minimize the effect on downwind receptors. The barriers can be constructed using materials such as plastic “Jersey barriers”, or fence poles and visual barrier fabric/plastic. The barriers are placed as temporary two or three-sided structures around active test pit or other intrusive investigation areas, oriented such that the barriers are placed on the upwind and downwind sides of the source. If only one side of the source can be accessed, then the barrier should be placed on the downwind side.
- Two agents that can be sprayed over impacted soil have been determined to be effective in controlling emissions. They include odor suppressant solution (BioSolve™), and hydro mulch. These agents may be used where tarps cannot be effectively deployed over the source material, or where tarps are ineffective in controlling odors:
 - BioSolve™ can provide immediate, localized control of odor emissions.
 - Hydromulch - Although it is unlikely that it will be necessary, modified hydromulch slurry may be used to cover inactive sources for extended periods of time (up to several days). The hydromulch, typically cellulose fibers

(HydroSeal®), is modified by mixing a tackifier (glue) with the mulch and water to form a slurry. It is applied using a standard hydroseed applicator to a thickness of ¼ inch. The material forms a sticky, cohesive, and somewhat flexible cover. Reapplication may be necessary if the applied layer becomes desiccated or begins to crack.

3.4 Building Controls

Controls for minimizing the impacts to occupied buildings include deferral of work to times when building occupants are not present or at a minimum.

4. Documentation and Reporting

The attached Daily Data Sheet will be filled out each day to record all of the details of the CAMP work. The form will be used to record the following information:

- Date and weather, with significant changes noted which may affect the positioning of the meters or recording of the data;
- Calibration results for the instruments;
- Locations of the upwind and downwind monitoring stations, and any changes made to the locations during the day to adjust for changing work locations or wind directions; and
- Any significant readings made during the day, such as exceedances which occur and their causes.

Additional information will be noted in the project fieldbook(s), as necessary.

The electronic measurements from the PIDs and dust meters will be downloaded each day, reviewed, and archived. Exceedances of the action levels, if any, and the actions to be taken to mitigate the situations, will be discussed immediately with the on-site representatives, or reported within one business day to the NYSDEC project manager (if on-site NYSDEC oversight is not provided). The results of the daily CAMP monitoring will also be discussed in the daily written report to the NYSDEC project manager. Summaries of all air monitoring data will be provided to the NYSDEC or the NYSDOH upon request.

CAMP odor monitoring results will be recorded in the field log book and/or the Daily Data Sheet, and will also be available for review by the state agencies.

ATTACHMENT A

Community Air Monitoring Daily Data Sheet

Community Air Monitoring Daily Data Sheet

Date:								
Site:					Project Number:			
Weather:								
Monitoring Start Time:					End Time:			
Monitoring Station Location	Time (24 hour)	CAMP PID (ppm)	CAMP Particulate (mg/m3)	Wind Direction	Work Zone PID (ppm)	Work Zone Particulate (mg/m3)	Activity	Comments
Notes:								
INSTRUMENT INFORMATION								
PID Model:					Serial Number:		Calibration:	
PID Model:					Serial Number:		Calibration:	
Dust meter model:					Serial Number:		Calibration:	
Dust meter model:					Serial Number:		Calibration:	
Notes for Map on Reverse Side:								
Circle Work Area. Show start and end times if there are multiple work areas.								
↗ wind direction				U Upwind Station		D Downwind Station		

Monitoring Completed By (print and sign): _____

Appendix C

Health and Safety Plan [to be provided under separate cover]

Appendix D

Standard Operating Procedures

- PM-001 Public Utility Markout
- RE-001 Site Reconnaissance
- FD-001 Field Notebook
- FD-002 Field Observation Report
- FD-003 Sampling Handling and Chain-of-Custody
- FD-004 Photo Documentation
- DM-002 Hollow-Stem Auger
- DM-006 GeoProbe™ Direct-Push Boring
- DM-007 Monitoring Well Construction and Installation
- DM-009 Monitoring Well Development
- SC-002 Sample Handling
- SC-003 Investigation Derived Waste
- SC-004 Head Space VOC Screening
- SM-001 Soil Sampling Including Split-Spoon
- SM-003 Soil Classification
- SM-004 Test Pit Excavation
- GW-001 Water Level and NAPL Measurement
- GW-003 Low Flow (Low Stress) Groundwater Sampling
- AR-002 Suspended Particulate Matter in Ambient Air Using the MIE DataRam™
- Real-Time Aerosol Monitor (Portable)
- QA-001 Equipment Decontamination
- QA-002 Field and Laboratory Quality Control Procedures

STANDARD OPERATING PROCEDURE

PM-001 Utility Markout and Clearance

1. Objective

Describe typical utility markout/clearance procedures prior to and during excavation. All markout procedures should be performed in accordance with local and state regulations.

Many states, by law, require that utility companies are notified before excavation begins. Actual procedures and requirements differ by state. City/state government may have additional requirements for utility markout procedures. Check the requirements in the locality before beginning. Also check with the GEI project manager to determine whether it is most appropriate for GEI or the drilling/excavation subcontractor to handle mark out and clearance.

2. Execution

Public Utility Markouts

- The drilling/excavation locations should be marked with white paint, stakes, or flags.
- The contractor should call the appropriate one call communication network for the state the work is being conducted in. Refer to the Reference section in this SOP for contact information. Contractors shall provide all necessary information to the one call system. Sample location maps may be provided to clarify sampling locations. The contractor shall provide GEI with the utility clearance ticket number.
- If necessary, contact the municipalities or other utility owners to mark their water, sewer, or other lines if they do not belong to the one call system. The contractor should keep a record of these calls.
- Utility plans, if available, should be obtained from the property owner or municipal offices.
- Prior to excavation, a visual check should be made that all utilities companies and municipalities have marked their locations. This includes looking for signs that a utility exists, and verifying that the markings agree with a visual check. If they do not, contact the appropriate utility to remark their locations.
- Utilities will generally only markout and clear utilities in roadways or other public property up to the property boundary. Owners of fiber optic cables, natural gas pipelines, and other high hazard utilities will often markout on private property if requested. The contractor should request this. See section on private utility clearance below.
- Public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation should adopt the American Public Works Association (APWA) Uniform Color Code using ANSI standard Z535.1 Safety Colors for temporary marking and utility identification, as follow:

The APWA Uniform Color Code

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 & Gaseous Material
5. **Orange** – Communications, Alarm or Signal Lines, Cables or Conduit
6. **Blue** – Potable Water
7. **Purple** – Reclaimed Water, Irrigation and Slurry Lines
8. **Green** – Sewers and Drain Lines

However, not all organization do use these colors. Make sure the color scheme is understood.

- The excavator/contractor and consultant begins work on the scheduled work date and time (if all the facility operators have responded) taking care to find and preserve any markings that have been made.
- If markings may be disturbed during work, establish offset marks to create reference points for the underground utilities. Take photographs of the markings before starting work.
- When digging near a buried utility, the excavator/contractor and consultant should be aware of their proximity to the utility and use caution.
- If there is uncertainty about the accuracy of the markings or there are too many utilities in a given location to excavate or drill safely, consideration should be given to hand-digging the first few feet, vacuum excavation, or use of a utility location company as detailed below in Private Utility Markouts.
- Some clients may require hand or vacuum clearance to a minimum depth. Check with the GEI project manager.
- If exposing a utility, the excavator/contractor should provide proper support and protection for the utility to prevent damage. Contact the utility operator for support, guidance, or assistance.
- When the excavation is complete, the excavator/contractor should provide proper backfill for any utilities that have been exposed.

Private Utility Markouts

- Utility markouts on private property should follow the steps outlined above in public utility markouts with the additions below.
- If work is conducted on private property where public utilities may not provide markouts and the property owner cannot provide accurate utility plans, it is

recommended to use a company to determine the utility locations using one or more of the following technologies:

- i. 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 tracewire, or by an induced current via radio waves.
 - ii. Sewer Sonde: For non-metallic lines where internal access is possible (such as clean-out ports in a sewer), a beacon or 'sonde' that emits a signal to the 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 a simple sonde.
 - iii. 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. GPR should be considered for high risk utilities (e.g. PVC natural gas lines without trace wire) where line-of-sight project from site entry point to a kiosk or other building is uncertain.
- Utility markout on private property should include clearance for other types of underground structures such as underground storage tanks, septic systems, utility or access tunnels, and in-ground irrigation systems.

3. Limitations

- Markout notification time usually does not include holidays. Make sure holidays are considered and markout time is scheduled accordingly. Do not conduct excavation or drilling prior to the required wait time. Do not mark excavation locations using spray paint if it is raining or snowing enough so that the paint markings will be washed away. Consider using long stakes instead of paint if snow is predicted. Excavations within the tolerance zone should be performed with non-powered hand tools until the marked utility is exposed. The tolerance zone may be determined by the utilities, law or codes.
- When excavating close to an underground utility, it is good practice for the contractor/excavator to have a spotter assist and guide the machine operator.
- Take care not to damage the conduit or protective coating of a utility. If the excavator/contractor damages this, leave the damaged utility exposed and immediately call the utility owner.
- If contact to a gas utility occurs, notify police, fire, and emergency personnel, and evacuate employees and general public. No attempt should be made to tamper with or correct the damaged utility.

4. References

Connecticut

Name: Call-Before-You-Dig (CBYD)
Telephone: 1-800-922-4455
Website: www.cbyd.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

Massachusetts, Maine, New Hampshire, Rhode Island and Vermont

Name: Dig Safe
Telephone: 1-888-DIG-SAFE or 811
Website: www.digsafe.com
Wait time after notification:
 MA, ME, NH, and RI: 3 business days (excluding holidays)
 VT: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York State

Name: Dig Safely New York
Telephone: 1-800-962-7962
Website: www.digsafelynewyork.com
Wait time after notification: 2 business days (excluding holidays)
Expiration of markout: 30 days

New York City/Long Island

Name: New York City One Call Center
Telephone: 1-800-272-4480
Website: www.nycli1calldsi.com
Wait time after notification: 2 to 10 days (excluding holidays)
Expiration of markout: 30 days

New Jersey

Name: New Jersey One Call
Telephone: 1-800-272-1000
Website: www.nj1-call.org
Wait time after notification: 2 business days
Expiration of markout: 45 days

5. Attachment

Attachment A – Standard Utility Color Codes

6. Contact

Brian Conte
Anne Leifer

SOP PM-001

Attachment A – Standard Utility Color Codes

<u>Color Code</u>	<u>Utility Description</u>
Red	Electric
Yellow	Gas-Oil
Orange	Communications
Blue	Water
Green	Sewer
White	Proposed Excavation

STANDARD OPERATING PROCEDURE

RE-001 Site Reconnaissance

1. Objective

Describe methods for conducting site reconnaissance and identifying the information that should be collected.

Site reconnaissance is conducted to evaluate the likelihood of contamination at a site that may be attributed to past or present spills, releases, or waste handling/disposal practices. A site reconnaissance should be conducted after available background information is compiled and reviewed. Site reconnaissance is used to confirm, supplement, or modify the existing information about the site.

2. Execution

- Record observations in a bound field notebook (See SOP FD-001 Field Notebook) or on the Site Reconnaissance Checklist (Attachment A).
- Make arrangements with the property owner or occupant for access to the site and site buildings. Be clear that access will need to be provided to all site features.
- Obtain a preliminary base map of the site and, if necessary, a road map with a 500-foot, 1,000-foot, and/or 0.5 mile radius drawn from the boundaries of the site. At the time of the site reconnaissance, determine the street names and numbers at each chosen radius, if necessary. In rural areas where street numbers are not available, maintain a radius of approximately 1,000 feet.
- If available, review surficial and bedrock geology and United States Geological Survey (USGS) and other maps prior to the site reconnaissance.
- Interview personnel familiar with past and present site conditions during the site reconnaissance. The following information should be recorded: the interviewed person's name, address, telephone number, position in firm or agency, relation to the study site, and years of experience at the site.
- Document the site reconnaissance with photographs. Maintain a photograph log that includes the photograph number, date, location where the photograph was taken, orientation of view, and subject manner.
- Walk entire site property boundaries and make traverses across the site.
- Each of the items on the attached form should be addressed and is described below. If something does not apply to the site, indicate N/A. Do not leave blank.
 - o Provide general information concerning site identification (street address, size).
 - o Document site weather conditions, amount of snow, temperature, flooding, etc., in field notebook.

- o Topography - Describe general site topography and estimate surface drainage direction.
- o Vegetation - Describe general surface vegetation at site. Look for evidence of stressed, dead, or dying vegetation. Changes in the size or age of similar vegetation can indicate areas of clearing, past site disturbance, or former access roads.
- o Hydrology and Hydrogeology - Locate surface water bodies and wetlands and, where possible, estimate surface flow directions. Identify the following.
 - Geology and surface features - Identify landforms, soil exposures, and rock outcrops. Describe the presence and character of artificial fill if visible.
 - Wells - Identify the location of monitoring wells, irrigation wells, and drinking water wells on base maps and measure distances of monitoring wells from buildings or other permanent structures. If possible, obtain information concerning the type of well and construction details from the client.
 - Trace or follow storm drain system, in general, to off-site discharge.
- o Land Uses - Describe current and former land uses and a history of known previous spills or releases. Obtain dates whenever possible. Information may be obtained through interviews with current or former owners, occupants, or employees.
- o USTs and ASTs - Describe condition of ASTs and USTs present on site. Look for indications of spills or staining around fill ports and vent pipes. Look for the presence of fill ports and vent pipes adjacent to buildings. Inquire about the presence or replacement of former UST and AST locations, sizes, and contents. Obtain copies of UST monitoring and test records, if available. Identify the number of vent pipes and compare to the number of identified or documented USTs/ASTs. Make note of pavement fracture patterns which may indicate pump islands or UST removal areas. Identify current and former heating sources.
- o Waste Information - Describe current operations likely to involve the use, treatment, storage, disposal, or generation of oil and/or hazardous materials (OHMs). Describe the presence and condition of drums, barrels, other storage containers, and disposal areas. Check for bermed areas and floor drains. Record indicators of spills, staining, cracked or broken flooring, soil discoloration, leachate breakout, fill materials, or odors. Locate and describe the condition of wastewater systems, pits, lagoons, and disposal areas. If available, obtain copies of Material Safety and Data Sheets for later review. Identify present and past locations where waste is or has been handled or disposed.

- o Site Utilities - Describe overhead and underground utilities. Identify whether site is on municipal water or if water is supplied through private wells on site. Identify whether site is on municipal sewer or on an on-site septic system, and include the location of the disposal area (leach field, pit, or trench). Inquire whether the site has had a former septic system or wastewater disposal area. Floors should be observed to identify existing or previously abandoned floor drains. Roof drains and grease traps, if any, should be identified. Discharge locations of floor drains, grease traps, roof drains, and catch basins should be identified. Check labels on transformers for polychlorinated biphenyls (PCBs). Note the absence of labels.
- o Buildings - Obtain as much information as possible about past and present use activities within the building(s). Describe the condition of floors in the basement or first floor, including cracks and evidence of spills. Describe building construction, (for example, a slab on grade or basement, steel or wood frame), and note exterior wall construction. Check building for additions or historical add-ons.
- o Site Access - Describe fences, roads, topography, vegetation, subsurface or overhead utilities, wet areas, and other factors that may affect site access for a subsurface exploration program.
- o Site Abutters - Describe types of general land use activities on abutting properties, including abutters across streets from the site. If possible look for indicators of disturbed land areas and vegetation. Describe general topography and drainage. Look for evidence of USTs. Record names of businesses for regulatory review. Do not trespass on abutting properties.
- o Site Vicinity - Identify street addresses at major cross streets up to 0.5-mile radius surrounding the site, if necessary. Identify sensitive receptors such as schools, nurseries, day care centers, parks, playgrounds, etc., within a 500-foot radius of the site.
- o Site Escort - Identify the person who is conducting the site walk with you.
- o Prepare a site sketch or mark the locations of observed conditions on a preliminary base map. Record locations of interior features on copies or sketches of floor plans.

3. Limitations

- If observations are recorded in a field notebook, use the Site Reconnaissance Form (provided below) as a checklist.
- Note any area of the site which could not be observed directly during the site reconnaissance because of restricted access, miscellaneous debris, snow cover, and other adverse conditions.

4. References

ASTM E1527-05, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (2005)

ASTM E1528-06, Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (2006)

ASTM E2247-08, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process for Forestland or Rural Property (2008)

Code of Federal Regulations All-Appropriate Inquiries Standards and Practices for All Appropriate Inquiries (40 CFR Part 312)

Guidance to Environmental Site Assessment (September 1992), National Ground Water Association

Site Characterization Guidance Document – Chapter 3 Phase I Environmental Site Assessments, (September 2007), The Connecticut Department of Environmental Protection

5. Attachments

Attachment A - Site Reconnaissance Checklist

6. Contact

Gary Iadarola
Anne Leifer

RE-001 Attachment A: Site Reconnaissance Checklist

GEI Job No.:

Date:

Site Reconnaissance performed by:

GEI Project Manager:

Part 1: General Information

Client

Property Name

Address

Size of Site

Easements

Paved parking lot areas (patched areas)

USGS Quadrangle

GIS Maps

Available bedrock or surficial geology maps

Weather at time of visit (include snow cover, flooding, etc.)

Part II: Topography (level-rolling-hilly-etc.)

Describe

Degree of slopes, approx.

Drainage (estimated surface water flow direction)

Part III: Surface Vegetation (wooded-brush-grass-landscaped)

Describe

Stressed or stained vegetation

Describe

Part IV: Hydrogeology (surface water bodies and wetlands)

Describe

a. Geology (bedrock outcrops, fill areas, soil exposures, trenches, etc.)

Describe

b. Surface features (drumlins-valley floor-flood plain)

Describe

c. Monitoring wells (number, size, roadbox, stand-up pipe, location, distance from buildings)

Describe

Part V: Land Use (current, former)

Describe

Part VI: USTs and/or ASTs

Vent and fill pipes (number and locations)

Tank ID	UST/ AST	Capacity (Gallons)	Date Installed	Date Removed	Date of Last Tightness Test

GEI CONSULTANTS, INC.

Environmental Standard Operating Procedures

Atlantic and New England Regions

Part VII: Waste Information (drums, barrels, storage containers, wastewater systems/discharges, pits, lagoons, odors)

Describe

Dumpsters/Trash Collection (past & present)

Waste Materials

Dumped Material or Miscellaneous Debris

Areas of Fill

GEI CONSULTANTS, INC.

Environmental Standard Operating Procedures

Atlantic and New England Regions

Part VIII: Utilities

Water	Electric	Gas	Oil	Cable/Phone
Sewer	Septic	Leachfield		Catch Basins
Manholes	Drywells	Transformers		

Describe

Part IX: Buildings (exterior)

Number of Buildings/Additions

Locations

Size of Buildings

Number of Stories

Age

Describe

GEI CONSULTANTS, INC.

Environmental Standard Operating Procedures
Atlantic and New England Regions

Part X: Buildings (interior) (Fill out this section for each building interior.)

Inside Building Descriptions and Uses (offices, commercial, industrial,
manufacturing, and other)

Chemical Storage

Basement and/or 1st Floor (type of construction)

Floor Drains, Sumps (number and location)

Floor Condition (cracks, spills)

Part XI: Site Access (fencing, gates, roads, etc.)

Describe

Part XII: Site Abutters (addresses and land uses)

North

East

South

West

Part XIII: Site Vicinity

Names of Cross Streets

Direction in which Street Addresses Increase or Decrease (within 1,000-foot radius of site)

Schools, nurseries/day care centers (within 500-foot radius of site)

Part XIV: Site Escort

Affiliation

Employed at facility

[illegible]

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

1. Objective

Describe methods for documentation of field activities.

Documentation of site activities is a crucial part of the field investigation process. The field notebook serves as the record of field activities performed or observed during the project. It provides a factual basis for preparing field observation reports, if required, and reports to clients and regulatory agencies. Example field notes are provided in Attachment A.

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. Spiral notebooks should not be used because pages can be easily removed.
- Write neatly using black or blue pen, preferably a waterproof pen. Use of pencil is also acceptable only with approval of the project manager, such as in but not limited to, certain field conditions [e.g., cold or wet weather].
- 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.
- Record activities as they occur. Record only facts and observations, regardless of whether they appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions (e.g. snow-covered ground surface, inability to access areas of interest).
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted.
 - o If an error is made on an entry in the field notebook, the individual who made the entry should make the corrections. The corrections must be initialed and dated by the person making the correction.
- Sign or initial and date the bottom of every page with an entry if the project requires such documentation.
- Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
 - o Date/time/weather.
 - o GEI personnel.
 - o Purpose of visit/daily objectives.
 - o People (client, contractor, landowners, etc.) present upon GEI arrival.

- Record the following information during the course of the day:
 - o Conversations with contractors/subcontractors, clients, visitors, GEI staff, landowners (site or abutters). If possible, record complete names, titles, and affiliations.
 - o Time of arrival and departure of individuals.
 - o Activities as they occur.
- Additional examples of observations to record may include and are not limited to:
 - o Type and quantity of monitoring well construction materials used.
 - o Use of field data sheets or electronic logging equipment (e.g. boring logs, monitoring well sampling logs, etc.).
 - o Ambient air monitoring data.
 - o Field equipment calibration information.
 - o Locations and descriptions of sampling points.
 - o Contractor/Subcontractor progress.
 - o Sample media (soil, sediment, groundwater, etc.).
 - o Sample collection method.
 - o Number and volume of sample(s) collected and sample bottle preservatives used.
 - o Sample identification number (s) and date and time of sample collection.
 - o Approximate volume of groundwater removed before sampling.
 - o Any field observations made such as pH, temperature, turbidity, conductivity, water level, etc.
 - o References for maps and photographs of the sampling site(s).
 - o Information pertaining to sample documentation: bottle lot numbers/dates, method of sample shipments, chain-of custody record numbers, and overnight shipping numbers.
 - o Surveying data (including sketches with north arrows).
 - o Changes in weather.
 - o Rationale for critical field decisions.
 - o Recommendations made to the client representative and GEI Project Manager.
 - o Site sketch of conditions at the end of the day.
 - o Summary of work completed/work remaining.
 - o Allow time at the end of the day to complete entries in the notebook.

3. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

*ASFE Daily Field Report for Geotechnical Field Observation, 2nd Edition (2001),
ASFE, Inc.*

4. Attachments

Attachment A - Example Field Notes

5. Contact

Melissa Felter
Leslie Lombardo

SOP FD-001

Attachment A – Example Field Notes

Start of each day includes:

- Date
- Project Number
- People on site
- Purpose of Work
- Weather Conditions

Each page is numbered

7/7/01 1/2

GEI: J. SMITH
ONSITE: 0845
OFFSITE: 1020
WEATHER: SUNNY, 70°F

PURPOSE:
1) GAUGE MONITORING WELLS FOR NAPL.
2) REMOVE NAPL FROM MONITORING WELLS IF DETECTED.

DEPTH TO WATER (Σ), DEPTH TO BOTTOM (DTB), AND DEPTH TO NAPL WERE GAUGED IN WELLS USING AN OIL/WATER INTERFACE PROBE.

MW301B
Σ - 3.68'
DTB - 26.52'
DEPTH TO NAPL - ND

~~JLS 7/7/01~~

2/2

MW309B
Σ - 11.35'
DTB - 28.77'
DEPTH TO NAPL - ND. Strong naphthalene odor.

MW308
Σ - 4.42'
DTB - 6.81'
DEPTH TO NAPL - ND

MW302B
JLS 7/7/01
Σ - ~~8.60~~ 8.59'
DTB - 28.81'
DEPTH TO NAPL - 27.58' (1.23 ft NAPL)

REMOVED APPROX. 1 GAL NAPL AND 1 GAL OF WATER FROM MW302B USING PERISTALTIC PUMP. TRANSFERRED NAPL/WATER MIXTURE TO DESIGNATED DRUM ON-SITE

OFFSITE: 1020

~~JLS 7/7/01~~

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

1. Objective

Describe methods to generate a Field Observation Report.

The Field Observation Report is used to record a summary of activities, observations, and decisions made during the day's field work. The daily field observation report serves as a permanent record of the day's activity for the Project Manager (PM), In-House Consultant (IHC), and/or client.

2. Execution

- If required, at the close of the day's field work, a Field Observation Report should be prepared by the individual responsible for the field notebook. This report should be completed before leaving work for the day. Contents of the report should include, at a minimum, the following information:
 - A record of person(s) present at the site, time of arrival, departure times (e.g., GEI, contractor(s), client, etc.).
 - A record of the daily objective(s) and the activities performed (e.g., drilled five borings in the overburden).
 - A summary of deviation(s) from the field plan or objectives.
 - A summary of field decisions made, who made them, and the basis for such decisions.
 - A diagram, sketch, and/or map showing the location and extent of the work or other significant observation(s) made during the day.
 - Recommendations that may result from field observations and actions that may result from implementation of those recommendations.
 - A summary listing and field sketch showing location(s) of field activity.
- Submit a draft report to the PM/IHC for review. 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.

3. Limitations

- The Field Observation Report is not a substitute for the field notebook.
- Not all projects require daily Field Observation Reports.
- The Field Observation Report should be based primarily on factual information. Opinions, if necessary, should be identified as such. 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 sign-off unless explicitly authorized by the PM/IHC.

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

ASFE Daily Field Report for Geotechnical Field Investigations, 2nd Edition (2001), ASFE, Inc.

5. Attachments

Attachment A - Example Field Observation Report

6. Contact

Melissa Felter
Leslie Lombardo

FIELD OBSERVATION REPORT

Project : Guard Booth Upgrades
Client : ACME Industries
Contractor: ABC Contracting
Subcontractor: NA

Date: November 8, 2006
Report No. 1
Page: 1 of 2
GEI Proj. No. 99999-0

SOP FD-002 - Attachment A – Example Field Observation Report

Time of Arrival: 0700 **Departure:** 1440 **Weather:** Overcast, Raining, 55⁰F

Persons Contacted, Company
Jane Doe, ABC Contracting

GEI Representatives
Bill Smith

Purpose of Site Visit: To observe excavation of soils for new guard booth and sidewalk.

Observations:

1. Excavation

- a. Areas for guard booth and sidewalk were laid out by ABC with stakes, string, and spray paint. Locations were between the pavement and wetland area; no excavation occurred in the wetland area.
- b. Staging area for soil stockpile was located to the west of the excavation, along the fenceline; polyethylene sheeting was placed beneath the pile.
- c. HDPE membrane delivered to site; stored in garage area through the inside fence.
- d. ABC crew began hand digging area for sidewalk and guard booth. Sidewalk area measured 22 feet long by 4 feet wide by 4 inches deep. Guard booth area measured 12 feet long by 10 feet wide by 9 inches deep. Utility pole and bollard locations started today.
- e. Rain continued to get worse in the afternoon; ABC covered the entire excavation and soil stockpile with poly sheeting and secured the sheeting with grade stakes.

2. Subgrade Preparation

- a. Subgrade preparation for the sidewalk and guard booth areas at the site is complete.

3. Dewatering

- a. No dewatering occurred today.

4. Air Monitoring

- a. During excavation, I monitored the breathing zone of the workers with an organic vapor meter (OVM). No headspace readings were measured in soil samples S-1 through S-8.

FIELD OBSERVATION REPORT

Project : Guard Booth Upgrades
Client : ACME Industries
Contractor: ABC Contracting
Subcontractor: NA

Date: November 8, 2006
Report No. 1
Page: 2 of 2
GEI Proj. No. 99999-0



Picture 1: Sidewalk excavation and bollard layout

By: Bill Smith

Reviewed By:

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

1. Objective

Describe methods to label sample containers, manage the samples, and prepare Chain of Custody documentation for the samples. Sample transport is also addressed.

2. Project Setup

When setting up a sampling event, inform the recipients of the samples (laboratories) and recipients of laboratory results (data group and project managers). Discuss with the laboratory the sampling media, turnaround times, and reporting limits for appropriate regulatory criteria for the site. Include the data group on correspondence so that turnaround times, data validation, and project deliverable schedules can be tracked successfully.

- Laboratory - Number of samples, analyses needed: bottle orders and holding times, turnaround times needed, reporting limits needed for regulatory criteria.
- Data group - Number of samples, analyses requested, turnaround times and reporting limits requested, data validation needed, regulatory criteria to use for tabulating results, deliverables needed, and project name and number.
- Schedule - Inform the laboratory and Data Group of schedule delays, changes to analyses, and expediting.

3. Sampling Execution

- Review the work plan prior to sampling to determine the following:
 - o Sample matrix and sampling method.
 - o Required analysis and sample volumes.
 - o Sample container type and preservative requirements.
 - o Required analysis methods and/or report formats.
 - o The turnaround time required by the project.
 - o If the data will be sent directly from the laboratory to the data validator, Project Manager, or Data Group.
 - o Holding time restrictions for sampling media and analytical methods.
 - o Sample naming convention used for this project site.
- Sample labels should be filled out using a waterproof or permanent marker or pen. Required information includes:
 - o Sample ID.
 - o Date and time (military time) of sample collection.
 - o Project number.
 - o Sample preservatives.
 - o Sampler's initials.
 - o Laboratory analytical methods.

- Place the label on the jar or bottle, not on the cap. Sample custody begins at this time.
- Record the above information in the field notebook.
- Individually wrap sample jars with packing material, if needed. See SOP SC-002 for guidance on packaging samples for shipment to the laboratory by way of common carrier. Place samples in a cooler with bagged ice or freezer packs (blue ice) immediately after collection. Add sufficient ice or freezer packs to cool samples to approximately 4°C.
- Complete a chain of custody (COC) for the samples as described below. GEI or laboratory COCs may be used as long as they contain fields for all required sample information as described in Section 2.1.

3.1.Chain-of-Custody (COC) Completion

- Fill out COC neatly and in permanent ink. Alternatively, an Excel version of the GEI COC is available and can be filled out electronically.
- Certain analyses (i.e. air analysis by TO-15) require specialized, laboratory issued COCs. Make sure any specialized COCs are available before sample collection.
- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, the number of sample containers, and any additional information to fulfill project, client or regulatory requirements.
- Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- 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 notebook. If required by the Project Manager or Data Group, also document this information on or attach a note to the GEI copy of the COC.
- Trip blanks for large sites should be named similar to the samples they are collected with so that there are not two of the same sample name for the same site. For example, "OU1TB-122509" and "OU3TB-122509" would avoid any mistakes.
- Strike incorrect entries on the COC with a single line, followed by the initials of the person making the correction, the date, and the correct entry.
- When sample custody is 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., Federal Express, 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.

- If the samples are placed in a designated secure area (e.g. GEI sample fridge), note this location in the “Received by” box on the COC.
- GEI uses both single sheet and triplicate COCs. If using the triplicate COCs (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.
- If you are using the single sheet COC, make a copy of the COC after it has been signed by the lab courier and forward it to the Data Group.
- Prior to sample shipment by common carrier, the COC must be placed inside the cooler in a Ziplock bag or other watertight package.
- 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.
- If a courier is used to transport samples to the laboratory (lab courier or GEI personnel), the courier signs the COC in the “Received by” box.
- Place a custody seal on the cooler if shipping via common carrier.
- Transport samples to the laboratory as soon as possible. It is preferable to transport the samples directly to the laboratory from the field. Samples brought back to the office for storage prior to submission to the laboratory must be kept cold (4° C).
- Unused sampling containers/media that are sent back to the lab should be included on a separate COC.
- After the samples are sent to the laboratory, the GEI copy of the COC must be forwarded to the Data Group: datagroup@geiconsultants.com.

4. Limitations

- Keep the number of people involved in handling samples to a minimum.
- Where practical, only allow people associated with the project to handle the samples.
- Always document the transfer of samples from one person to another on the COC.
- The COC should always accompany the samples.
- Give samples positive identification at all times that is legible and written with waterproof or permanent ink.
- When sending samples via a common carrier, use one COC per package.
- Where practical, avoid sending samples from more than one site with separate COCs in a single package.

5. 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*

6. Attachments

Attachment A - Example Chains of Custody
Attachment B - Shipping Info Pics

7. Contact

Brian Skelly
Leslie Lombardo

Chain of Custody Record

STL Connecticut
128 Long Hill Cross Road
Shelton, CT 06484
Tel: 203-929-8140

Example
COC

SEVERN
TRENT

STL

Severn Trent Laboratories, Inc.

STL-4124 (0901)

Client GEI		Project Manager Dave Terry		Date 12-31-07	Chain of Custody Number 00452
Address 455 Winding Brook Dr		Telephone Number (Area Code)/Fax Number 860 368 5300 / 860 368 5307		Lab Number	
City Glastonbury	State CT	Zip Code 06033	Site Contact M. Felter	Lab Contact Paul Hobart	Page 1 of 1
Project Name and Location (State) Carroll Gardens NY		Carrier/Waybill Number FedEx 9383 7603 0879		Analysis (Attach list if more space is needed)	
Contract/Purchase Order/Quote No.					

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix					Containers & Preservatives										Special Instructions/ Conditions of Receipt
			Air	Aqueous	Sed.	Soil	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc2	NaOH					
GSB-01 (0-2)	12-31-07	1130				X	X							X	X			
GSB-02 (3-4)	12-31-07	1250				X	X							X	X			
GSB-02 (3-4) NS	12-31-07	1250				X	X							X	X			
GSB-02 (3-4) MSD	12-31-07	1250				X	X							X	X			
GSB-XX (5-6)	12-31-07	0800				X	X							X	X			
CGTB-123107	12-31-07	1400					TB			X				X	X			
CGGW-01	12-31-07	1430		X			X			X				X	X			
CGSG-01	12-31-07	0700-1500	X													X		CANISTER# 2613 REGULATOR# 779

Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☒ Unknown

Sample Disposal
☐ Return To Client ☒ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required
☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other **See Contract**

1. Relinquished By **Melissa Felter** Date **12-31-07** Time **1600**

2. Relinquished By _____ Date _____ Time _____

3. Relinquished By _____ Date _____ Time _____

Comments
USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED
 DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Handwritten notes: **NEW JERSEY "CLP data package documents"**
See Contract NYS Cat B ASP deliverable send to Lorie Mackinnon
Send EDP to datagroup@geiconsultants.com
FedEx WAYBILL 923117-4432 Date **12-31-07**

[illegible]

Chain-of-Custody Record						Laboratory:				Laboratory Job # (Lab use only)									
 GEI Consultants 455 Winding Brook Drive, Suite 201 Glastonbury, CT 06033 PH: 860.368.5300 FX: 860.368.5307						Project Information												Page __ of __	
						Project Name/Number:						Project Location:							
						Project Contact:						Phone Number:							
						Send Report to:						Preservative						Sample Handling	
Send EDD to: datagroup@geiconsultants.com												Samples Field Filtered							
						Analysis						YES NO NA							
												Samples Shipped With Ice							
Deliverables:												YES NO							
If Yes, Have You Met Minimum Field QC Requirements?						YES		NO		NA		Sample Specific Remarks							
Lab Sample Number	GEI Sample ID	Collection		Matrix	No. of Bottles	Sampler(s) Initials													
		Date	Time																

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



C. Place double bagged or loose ice randomly around bottles throughout the cooler.



D. Place large bag of ice or loose ice on top of the bottles. In warm weather, the cooler should be packed with as much ice as possible.



E. Close outer bag, compress excess air out of bag, twist top and knot. If necessary, use more bubble wrap to fill the dead air spaces. Place chain of custody (COC) and other paperwork in plastic bag and seal. Place on top of cooler.



F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY



A. Line cooler with bubble wrap and large plastic bag. Use absorbent pad inside the bag if bottles contain preservatives.



B. Wipe outside of bottles and put glass in individual bubble bags & seal. Place bottles & the temperature blank into cooler. Leave room for ice in between bottles & on top.



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F. Close cooler, place signed and dated Custody Seals over opening. Tape over the Custody Seal and seal cooler securely. Fill out overnight shipping waybill and attach to the top or handle of the cooler. Attach Saturday delivery stickers if needed. Ship according to DOT regulations.

STANDARD OPERATING PROCEDURE

FD-004 Photo Documentation

1. Objective

Describe methods to document and retain photographic records.

Keeping a record of photographs taken is crucial to their validity as a representation of existing conditions.

2. Execution

- Photographs of a site, individual samples, or other observations should be taken using a digital camera.
- Set the camera to record the time and date for each photograph.
- All photographic records, along with the following information, should be recorded in the field notebook (SOP FD-001).
 - o If applicable, the compass direction describing the direction the photograph was taken (e.g. looking southeast). This may not apply to photographs of individual samples.
 - o Brief description of what the photograph is intended to show.
- The field notebook should note who took the photographs.
- The photographs should be electronically backed up on a computer or other data storage device.
- If photographs will be used in a report, memo, or letter, they 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.

3. Limitations

- Some clients and regulatory agencies require photographs of every subsurface soil sample collected. These photographs typically include a “whiteboard” which indicates the site, the boring ID, and the depth of the sample, while logging details are recorded in the field notebook. Under these circumstances, it is not necessary to include compass directions or descriptions.

4. References

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

5. Attachments

Attachment A – Example of Photo Documentation Template

6. Contact

Melissa Felter
Leslie Lombardo

Attachment A – Example of Photo Documentation Template
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

DM-002 Hollow-Stem Auger

1. Objective

Describe standard operating procedures for drilling of overburden soil borings using hollow-stem augers.

2. Execution

- Confirm that the appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned or pressure-washed. Record observations in the field notebook (See SOP FD-001).
- Observe that the augers are vertical when the first section is advanced into the ground.
- Use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOPs SM-001, *Split-Spoon Sampling* and SM-0003, *Soil Classification*, for details). Count and record the number of blows per 6-inch increments, confirming blow counts with driller if necessary).
- Decontaminate the split-spoon sampler after each use (see *Equipment Decontamination*, SOP QA-001) or use another decontaminated split-spoon sampler.
- Ensure that the drillers advance the augers only after they have inserted the auger plug (to prevent soil from entering the augers while advancing to the next sample interval).
- Request that the drillers remove the auger cutting bit/plug and insert the split-spoon sampler into the interior of the augers. 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.
- If subsurface soil samples are being collected with split-spoon samplers, ensure that the drillers use a 30-inch drop of the 140-pound hammer. The number of blow-counts for each 0.5 foot penetration provides important geotechnical data.
- Repeat until the borehole has been drilled to the desired depth.
- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout or properly-tamped and hydrated bentonite. Check with Project Manager and/or the appropriate regulatory personnel before using drill cuttings to backfill the boring.

- If a monitoring well will be installed, refer to SOP DM-007.
- 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. If the boring location will not be surveyed, measure each location from on-site reference points and record the information in the field notebook so that the location can be plotted on site figures.

3. Limitations

- 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 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 SOP DM-008 *Monitoring Well Telescoping Techniques*) 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 sands start to flow into the auger, pour clean water into the augers and keep the augers filled during sampling.
- 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.
- Down-hole drilling equipment should be steam cleaned or pressure-washed between holes unless otherwise directed by the project manager.
- Record when standard operating procedures are deviated from. The drilling inspector should also record any detected odor from the boring and depth encountered.

4. 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

5. Attachments

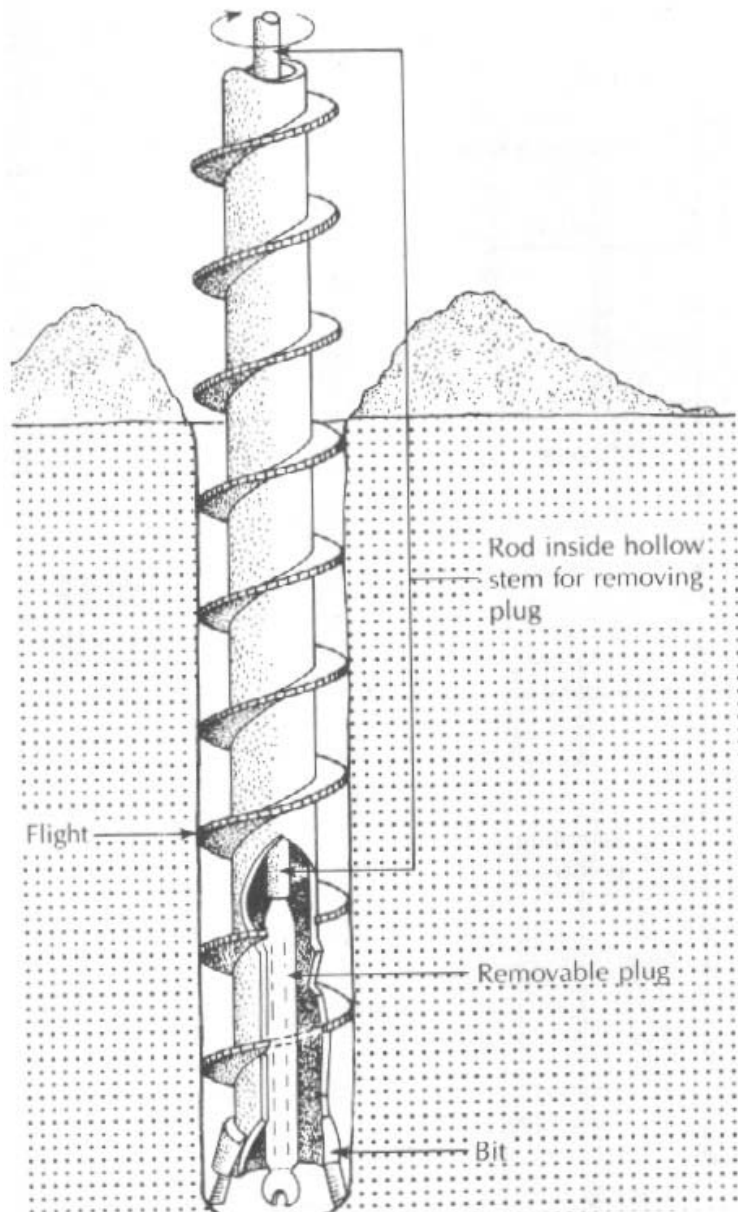
Attachment A – Hollow-Stem Auger

6. Contact

Gary Fuerstenberg
Cathy Johnson

SOP DM-002

Attachment A – Hollow Stem Auger



STANDARD OPERATING PROCEDURE

DM-006 Geoprobe® Direct Push Boring

1. Objective

Describe standard operating procedures (SOP) for drilling of overburden soil borings using Geoprobe® and MacroCore® technologies.

2. Execution

- Confirm that appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been decontaminated (QA-001). Record condition of all down-hole drilling equipment.
- Make sure the sampler is fitted with a piston rod assembly to block the sample tube until the desired subsurface sample interval is attained. 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. This reduces the volume of slough that is collected.
- When the sampler is brought to the ground surface, it should be opened immediately, and the length of recovery should be measured and recorded.
- Log the soil sample using USCS procedures (SOP SM-003). Collect analytical samples if necessary (SOP SM-001).
- Decontaminate the cutting shoe if necessary (SOP QA-001 Equipment Decontamination) and have driller reassemble the parts with a new liner.
- Repeat the procedure described above until refusal or the boring is terminated.
- Periodically verify that depths cited by drillers are accurate.

3. Limitations

- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and re-evaluate health and safety conditions.
- 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 Management*).
- If possible, 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 soil boring locations. These locations must also have been cleared by the state or local utility service prior to drilling.

4. 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

5. Attachments

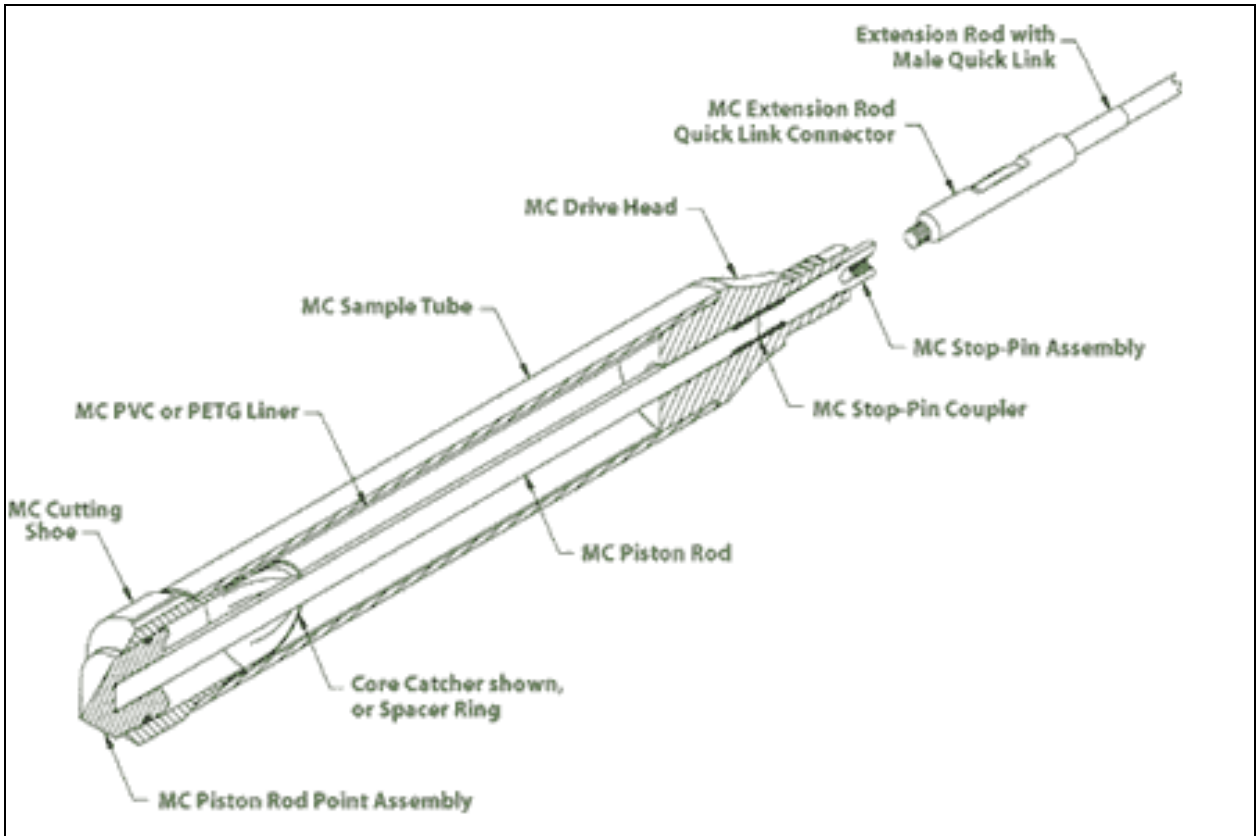
Attachment A – Geoprobe® with Macrocore® Sampler Assembly

6. Contact

Melissa Felter
Cathy Johnson

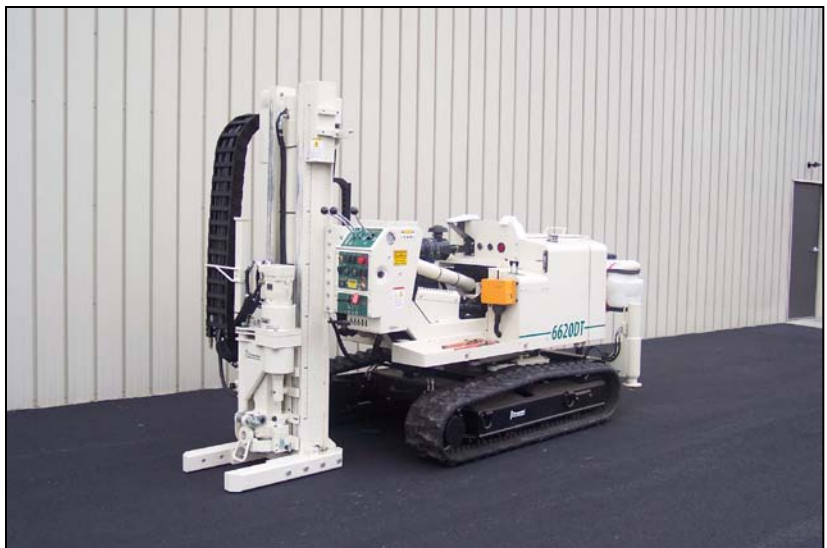
SOP DM-006

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a
Macrocore® sampler

Right: A track-mounted
GeoProbe ® Rig



STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

1. Objective

Describe installation procedures for overburden monitoring wells screened across or below the groundwater table.

Well dimensions (well diameter, screen length, and screen slot-diameters) will be specified in the Work Plan. This SOP assumes the monitoring wells will be constructed of flush-joint PVC pipe and the screened section will have factory-slotted openings.

2. Execution

Attachment A provides a diagram of typical shallow, intermediate, and deep groundwater monitoring well construction detail. A Groundwater Monitoring Well Installation Log is in Attachment B.

- Measure and record the depth of the completed soil boring before beginning the well installation.
- If possible, 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 split-spoon samples 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.
- If it is not possible to accurately measure the depth to groundwater in the borehole due to low permeability in the formation, use the saturated soil depth observed in the collected samples or measured water depth in a nearby existing monitoring well to estimate the depth to water in the borehole.
- For shallow monitoring wells, select the monitoring well screen and riser lengths so that the slotted section of the screen intersects the groundwater table. Screen lengths of 15 feet or less are preferred and 10 foot screens are most common. If the water table is seasonally high or low or if the well is in a location where the water table is likely to be tidally influenced, appropriately place the screened section to allow for the screen to intersect likely future water tables.
- For intermediate or deep wells screened entirely below the water table, select the monitoring well screen and riser lengths as described in the Work Plan. Screen lengths of 10 feet or less are preferred.
- If the borehole is deeper than the desired well depth or the bottom of the well is close to a change in soil strata, then fill the base of the borehole with bentonite. Keep in mind that bentonite swells when hydrated, and that filter

sand should be placed at the bottom of the borehole above the bentonite before installing the well.

- Prevent well materials from contacting foreign substances during installation. Precautions may include requiring the driller to wear clean gloves while handling well materials and requiring that well materials not be placed onto the ground or pavement without a protective barrier such as polyethylene sheeting being present
- Confirm that the driller installs a minimum one-inch sump with a bottom cap to the bottom of the well screen. See the Work Plan for locations that may require larger sumps.
- Monitoring wells can be constructed of either 1, 1.5, 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC. Refer to the work plan for the site-specific requirements. Flush-threaded well materials should be used. Do not allow the driller to use glues, as they typically contain solvents that could affect on groundwater quality.
- Stainless steel well materials may be used if required in the Work Plan. Select slot size based on grain size of the formation and on requirements in the Work Plan.
- Confirm that the driller places at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole, if required in the Work Plan.
- The driller should remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals, at the same time that filter sand is added. The drillers should take frequent measurements of the depth to sand.
- Confirm that the driller has added 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.
- The driller should place a 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 before grouting the remaining annular space, or otherwise backfilling the remaining annular space as discussed with the Project Manager. Tamp seal. It should extend 1 to 2 feet above the filter sand.
- If required by the Work Plan, the driller should use bentonite-cement and grout the annular space from the top of the bentonite seal to the ground surface. Bentonite cement grout should be placed using tremie methods. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using a pump (such as one on the rig) to ensure proper mixing.
- The drillers should cut the monitoring well riser at an angle or make "V"-notch in the riser pipe as a benchmark for surveying and groundwater measurements. The driller should cut the well riser so that the top of the well will be approximately 3 inches below the top of protective casing. The top of

the riser should be close enough to the top of the surface casing to allow reading of depth markings on a water level indicator tape.

- The protective surface casing is 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.
- The protective casing should be set by placing cement in the annular space between the protective casing and the borehole up to the ground surface. If possible, the driller should slope the cement 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 and is completed with a steel “stick up” pipe, additional protection such as steel pole bumpers around the steel “stick up” pipe may be necessary.
- If possible a locking cap should be placed on the steel “stick up” pipe. If the surface casing is flush mounted, a locking expansion plug should be placed, if possible, inside the top of the well riser pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the outside of the protective well casing with a paint pen. If the well is not going to be surveyed, measure the location to nearby landmarks so that the well may be located in the future and plotted on figures. 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*).

3. Limitations

- Do not screen across different hydrostratigraphic units (for example, outwash sands, confining layers or 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 should 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 drill cuttings to backfill during monitoring well installation unless specified by the work plan or project manager.

4. 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.

5. Attachments

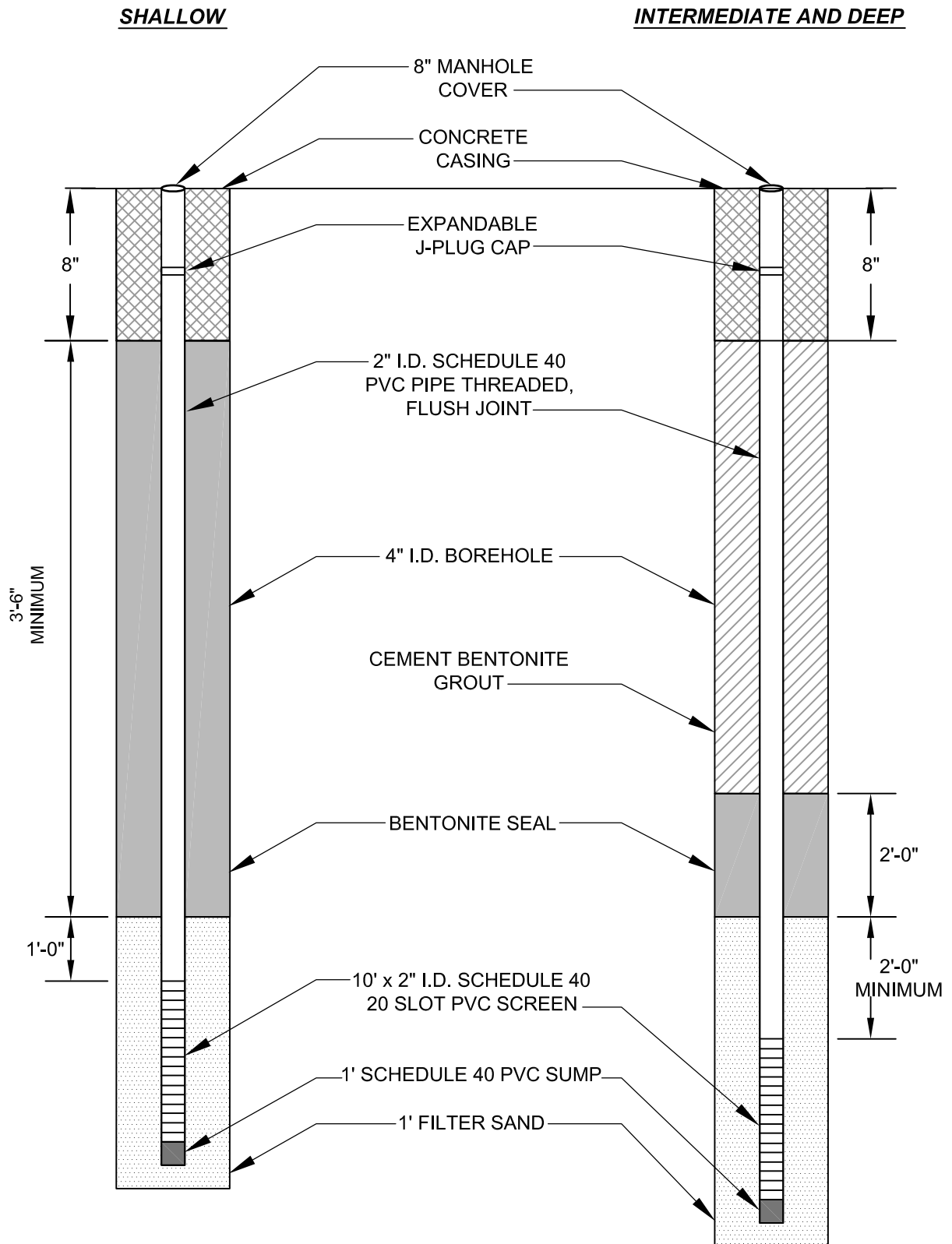
Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Groundwater Monitoring Well Installation Log

6. Contact

David Terry
Anne Leifer

Attachment A - Well Detail



NOT TO SCALE



**TYPICAL SHALLOW,
INTERMEDIATE AND DEEP
GROUNDWATER MONITORING
WELL CONSTRUCTION DETAIL**

June 2008

[illegible]

GEI  Consultant

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

1. Objective

Describe standard procedures to remove fluids from monitoring wells (introduced during drilling) and maximize the movement of groundwater into the well by removing fine particles in the well and sand pack around the screen.

2. Execution

To prevent cross contamination between monitoring wells, use dedicated equipment and/or appropriately decontaminated equipment to perform monitoring well development. See SOP QA-001 Equipment Decontamination and the Work Plan for more information.

For deep or large diameter monitoring wells, it may be necessary to use a re-usable pump system, such as a Grundfos pump, to develop monitoring wells.

- Calculate the volume of water in the monitoring well (one well volume) using the following table:

Well diameter (inches)	Volume (gal/ft)
1	0.04
1.5	0.09
2	0.16
3	0.36
4	0.65
6	1.50

The equation used to establish these volumes is presented in Section 4.

- Calculate or estimate the amount of water introduced to the borehole during drilling. At a minimum, this is the amount of water that should be removed during development. Removing less water than was introduced and allowing additional time for the surrounding formation to clear of injected drilling fluids may be considered as an alternative if the volume of introduced water was large.
- Record the volume of water purged in the field notebook or on the Monitoring Well Sampling Form (Attachment A).
- Collect a sample of water from the monitoring well with the selected submersible pump (e.g. 12-volt whale pump or Grundfos pump), a bailer, or a

Waterra system. Record the physical properties (color, turbidity, odors, etc.) of the sample.

- The volume of water that should be removed will depend on the work plan, local regulatory guidance, and/or the volume of water that was introduced during drilling and well installation. Typical guidance for the removal volume includes:
 - o Ten well volumes.
 - o The volume of fluid added during drilling.
 - o The volume required to remove enough suspended particles so that the turbidity of the water is less than 50 nephelometric turbidity units.

If needed, pump the ground water into a 5-gallon pail so that the volumetric flow rate and total water volume from the pump or bailer can be calculated.

Measure the groundwater level in the well during development to assess if the pumping rate is sufficient to create a drawdown in the well.

Observe the groundwater every few well volumes during the pumping and record the physical properties (color and turbidity).

If required by the Work Plan, conduct surging in the monitoring well. See the Work Plan for the method of well surging to be used. If surging is necessary, do so only after initial pumping at the well has occurred and fine sediments have been removed.

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.

3. Limitations

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. They may also damage the pump.

If the ground water in the monitoring well is contaminated, the water removed during well development may need to be placed in a properly-labeled drum and disposed of in accordance with local, state, and federal regulations (see SC-003 Investigation Derived Waste).

If the soils around the well screen are composed of fine-grained silts and clays, over-pumping and mechanical surging is not recommended since these more vigorous

techniques can cause mixing of the fines into the filter pack. To develop these wells, use of a bailer is recommended.

There are occasions when the turbidity of groundwater cannot be meaningfully reduced. On these occasions, a minimum of ten volumes should be removed, and the Project manager should be consulted.

Sampling of groundwater should generally not occur within one week after development. In some regions or regulatory jurisdictions, a minimum of two weeks may be required before sampling. If no water was introduced to the formation during drilling, this waiting period may be shortened if required by the project. See the Work Plan for additional information.

4. 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.

Massachusetts Department of Environmental Protection, "WSC-310-91 Standard References for Monitoring Wells, Section 4.5 Decommissioning of Monitoring Wells", January 1991

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

5. Attachments

Attachment A - Monitoring Well Sampling Form

6. Contact

Gary Fuerstenberg
Anne Leifer

MONITORING WELL SAMPLING RECORD

PID Reading _____
 Job Number _____
 Location _____
 Well Number _____

Job Name _____
 By _____ Date _____
 Measurement Datum _____

Pre-Development Information

Water Level _____
 One Purge Vol _____

Time (start) _____
 Total Depth of Well _____
 Three Well Volume _____

Water Characteristics

Color _____ Clear _____ Cloudy _____
 Odor _____ None _____ Weak _____ Moderate _____ Strong _____

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (μS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____
 Temperature (°C) _____ Specific Conductance (μS/cm) _____
 DO Concentration (mg/L) _____ ORP (mV) _____
 TDS _____

Post Development Information

Water Level _____ Time (Finished) _____
 Total Depth of Well _____
 Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ Clear _____ Cloudy _____
 Odor _____ None _____ Weak _____ Moderate _____ Strong _____

Any films or immiscible material _____

Comments _____

STANDARD OPERATING PROCEDURE

SC-002 Environmental Sample Handling

1. Objective

Describe appropriate environmental sample handling procedures.

The procedures include collection and transport of environmental samples to a laboratory for chemical analysis. Appropriate sample handling should ensure that samples are properly:

- labeled and documented;
- preserved;
- packaged; and
- transported

2. 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.
- A waterproof or permanent ink pen should be used for all labels. The label should have an adhesive backing and be placed on the jar or bottle, not on the cap. In addition, clear packing tape can be placed over the sample label to secure it to the bottle as moisture from the samples can loosen the label adhesive.
- Record the following information on the label and in the field notebook (See SOPs FD-001 and FD-003):
 - o Project number
 - o Sample identification (i.e. MW-201 or SS-2)
 - o Date and time (military time) of collection
 - o Sampler's initials
 - o Analysis methods
 - o Preservative, if present
- Pre-preserved laboratory jars are preferable and should be used whenever practicable. If sample jars are not pre-preserved, add preservative as appropriate.
- At each sampling location, samples should be collected in order of volatility, most volatile first. Samples collected for volatile analysis should be placed in sample containers immediately upon retrieval of the sample.
- Aqueous samples for volatile analysis should be collected without air bubbles.
- The collection and preservation method of soil samples for volatile analysis may depend on project, client, or state regulatory requirements. Check with your Project Manager and/or SOPs SM-001 and SM-002 where appropriate.

- Care must be taken to avoid getting soils on the threads of sample jars, which can cause a faulty seal.
- If compositing samples in the field, specify the basis for composite (i.e. volume, weight, spoon recovery, etc.) and record in the field book the procedure for compositing the sample.
- Once samples have been collected and labeled, place samples in a cooler with sufficient bagged ice or freezer packs (blue ice) (if allowed) to chill samples to 4°C. If using ice, use double-bagged ice.
- Complete the chain-of-custody (COC) (SOP FD-003).
- If transporting the samples by way of a shipper:
 - i. The sample cooler should have water drains securely sealed with duct tape, both on the inside and outside of the cooler.
 - ii. Place a layer of packing material on the bottom of the cooler as a cushion.
 - iii. Individually wrap each sample bottle with bubble packing or suitable packing material and place the wrapped bottles upright in the cooler with sufficient packing material between samples to avoid breakage.
 - iv. Methanol preserved samples for volatiles analysis should be packed so they remain upright with the soil completely covered by the methanol during transport.
 - v. Place a layer of packing material on top of the sample bottles.
 - vi. Place bagged ice or freezer packs 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.
 - vii. Place the completed and signed chain-of-custody form in a sealable plastic bag and place on top of the packing material in the cooler, or tape it to the inside lid of the cooler.
 - viii. Fill out the appropriate shipping or courier forms and attach to the top or handle 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 signed and dated custody seal on the cooler.
- All samples should be submitted to the laboratory as soon as possible. In many cases, same day shipping will be required by the client or the project manager. Be clear on this before beginning the field work.
- A copy of the waybills should be kept by the field supervisor to track shipments if necessary.

3. Limitations

- If samples are shipped on a Friday, call the laboratory ahead of time to confirm that personnel will be at the laboratory to receive and log-in the samples.
- During warm weather, make sure to use plenty of ice in the shipping container.

- Field personnel should be aware of analyses which have short hold times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short hold times must be arranged for in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when shipping samples with short hold time to ensure the lab is prepared for these analyses.
- For glassware containing preservatives (e.g., HCl, HNO₃), take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing, if needed.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, 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.

4. 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

Preservation Techniques for Volatile Organic Compound (VOC) Soil Sample Analyses, WSC#99-415. Massachusetts Department of Environmental Protection.

5. Contacts

Jennifer Belonsoff
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

1. Objective

Describe characterization and management of Investigation Derived Waste (IDW) resulting from site investigation activities.

IDW is solid and/or aqueous waste generated during environmental site investigations.

2. Execution

- Determine the suspected contamination type and impacted media based on previous investigations, available analytical data, and/or site history.
- Consider the following when selecting IDW management option(s):
 - Anticipated volume of IDW to be generated during on-site activities
 - Potential contaminants and their concentrations
 - Proximity to population centers and the potential for unauthorized site access
 - Potential exposures to workers
 - Potential for environmental impacts
 - Community concerns
 - Potential storage areas
 - Regulatory constraints
 - Potential on-site treatment options
 - Duration of storage
 - Client concerns or requirements
- Review IDW Management Options summarized in Attachment A for each media suspected of contamination.
- Select IDW Management Option(s) prior to the commencement of field activities that will generate waste materials.
- Include the selected IDW Management Option(s) in the Field Plan or other project documents.

Considerations and guidelines for IDW management for specific field tasks are provided below.

2.1. Test Pit Excavation

- Segregate contaminated soil from uncontaminated soil using visual and/or field screening methods.
- Use appropriate barrier (such as two layers of 6-mil plastic sheeting) for temporary stockpiling of contaminated soil adjacent to test pit.

- Backfill test pits with uncontaminated soil, unless otherwise directed by project manager.
- If directed by the Project Manager to return contaminated soil to the test pit, backfill soil in the same order as the soil was excavated from the test pit.

2.2. 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 it is acceptable to the client and the governing regulatory agency. If not, 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- $\frac{1}{4}$ -inch-I.D. augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground near the boring location, if acceptable to the client and governing regulatory agency, or containerizing the fluid in drums or tanks.

2.3. Well Development/Sampling

Contaminated groundwater removed from wells by pumping or bailing for the purpose of well development and sampling may be poured on the ground near the well, if it is acceptable to the client and the governing regulatory agency. Otherwise, it should be containerized in drums or tanks.

2.4. Decontamination Fluids

Decontamination fluids may be poured on the ground in the vicinity of the well if approved by the project manager. Alternatively, the fluids may be containerized in drums or tanks.

2.5. Disposable Personal Protective Equipment

Disposable personal protective equipment (PPE) should be managed like any other IDW. However, with the clients' and project manager's approval, it may be removed from the site and disposed of as ordinary rubbish if it has not come into contact with contaminated materials.

3. Limitations

- The simplest IDW management option is to return the IDW to its source location.
- However, the selected IDW management options must meet state/federal regulations and have the client's approval. Consult with state/federal policies for IDW-related matters.

- The client is responsible for the disposal of IDW, should disposal be necessary.

4. 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.

5. Attachments

Attachment A - Summary of Investigation Derived Waste Management Options

Attachment B - CTDEP Waste Guidance

6. Contacts

David Terry
Leslie Lombardo

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS GEI Consultants, Inc. Standard Operating Procedures Management of Investigation - Derived Waste			
Type of IDW	Generation Processes	Management Options	Remarks
Soil	Boring/monitoring well installation Test pit excavation Soil sampling	Return to source location immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Spread around boring, test pit, or original source location	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Containerize and temporarily store on site	Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure. Storage consistent with state/federal regulations.
		Send to off-site, treatment or disposal facility within appropriate timeframes	Requires proper shipping documents (i.e. manifest, Bill of Lading, etc.), analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Store temporarily awaiting laboratory analysis.	Storage consistent with state/federal regulations. Can temporarily store in stockpiles or covered containers (i.e. drums, roll-off containers). Stockpiles must be underlain by plastic sheeting and covered with plastic sheeting. Plastic sheeting must be secure.
Sediment/Sludge	Sludge pit sampling Sediment sampling	Return to source immediately after generation	Acceptable, if authorized by the client, the governing regulatory agency, and the project manager.
		Store temporarily on site.	Storage consistent with state/federal regulations.
		Send to off-site facility within 90 days	Requires manifests, analytical characterization
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS GEI Consultants, Inc. Standard Operating Procedures Management of Investigation - Derived Waste			
Type of IDW	Generation Processes	Management Options	Remarks
Aqueous liquids (groundwater, surface water, drilling fluids, other wastewater)	Well installation/development Well purging during sampling Ground water discharge - pump tests Surface water sampling	Pour onto ground close to well	Non-hazardous liquids only. Should not exhibit a sheen or separate phase product. Do not discharge to the ground up-gradient of the source location. Ensure that it is permissible by local, state, and Federal regulations Is acceptable to the client, the governing regulatory agency, and the project manager.
		Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site commercial treatment unit within appropriate timeframes	Refer to State regulations for appropriate timeframe. Requires appropriate shipping documents (i.e., manifest, Bill of Lading), analytical characterization
		Send to POTW	Obtain appropriate discharge permit(s)
		Store for future treatment and/or disposal.	Storage consistent with state/federal regulations. Consistent with final remedial action
		Discharge to surface water	OK if it complies with state and federal regulations. Obtain appropriate discharge permit(s).
Decontamination fluids	Decontamination of PPE and equipment	Store temporarily on site	If a RCRA hazardous waste, must meet RCRA Container/Waste Pile/Tank requirements (see notes)
		Send to off-site facility within appropriate timeframes	Requires manifests, analytical characterization
		Store for future treatment and/or disposal. Storage consistent with state/federal regulations.	Consistent with final remedial action
Disposable PPE	Sampling, drilling, and test pit excavation observation, other on-site activities	Store temporarily on site	Dispose of appropriately after characterization
		Place in on-site industrial dumpster	Project-specific determination required – must be acceptable to client and project manager
		Send to off-site facility within 90 days	Project-specific determination required
		Store for future treatment and disposal.	Storage consistent with state/federal regulations. Project-specific determination required

Notes:

- 1) PPE - personal protective equipment
- 2) POTW - publicly owned treatment works
- 3) Generation processes listed here are provided as examples.
IDW may also be generated as a result of other site activities.
- 4) RCRA Container/Waste Pile/Tank requirements:
Containers; 40 CFR 264 Subpart I and 265 Subpart I
Waste Piles; 40 CFR 264 Subpart L and 265 Subpart L
Tanks; 40 CFR 264 Subpart J and 265 Subpart J

Connecticut Department of Environmental Protection

Connecticut's RCRA "Contained-In" Policy

Characterization of Contaminated Soil and Groundwater

Policy

RCRA hazardous waste determinations for contaminated soil and groundwater may compare contaminant concentrations with the characterization criteria below. If the concentrations are below these criteria then the soil and groundwater do not need to be managed in Connecticut as RCRA hazardous waste. If the concentrations are above these levels then the soil/water must be treated, stored, transported, and disposed in the same manner as hazardous waste.

Purpose

To simplify the management of non-hazardous contaminated soil and groundwater and to encourage remediation of contaminated sites.

Applicability

This policy applies to contaminated soil and groundwater managed in Connecticut. It does not establish cleanup criteria. When contaminant concentrations are below the levels described in this policy, but are greater than applicable Connecticut Remediation Standard Regulations ("RSR") criteria, then the soil and groundwater must be handled as non-hazardous contaminated soil and groundwater subject to applicable RSR polluted soil reuse requirements and to Connecticut solid waste requirements.

Contaminant	Soil Characterization Criteria	Groundwater Characterization Criteria
Characteristically hazardous waste " D codes "	Non-hazardous if below levels in Toxicity Characteristic Table in 40 CFR 261.24 ("TC Table") ¹	Non-hazardous if below levels in Toxicity Characteristic Table in 40 CFR 261.24 ("TC Table")
Listed hazardous waste " F,K,P,U codes " See 40 CFR 261.33 for " P " & " U " See 40 CFR 261 Appendix VII to identify constituents for which " F " & " K " wastes are listed.	Non-hazardous if below the lower of A and B: (A) Industrial/Commercial Direct Exposure Criteria in RSR ² and ----- [choose one method from B]: (B) either TC Table ¹ or 100 x GA Pollutant Mobility Criteria in RSR ³ or 100 x Groundwater Protection Criteria in RSR ⁴	Non-hazardous if below 100 x GA Groundwater Protection Criteria in RSR

1. via Toxicity Characteristic Leachate Procedure ("TCLP")
2. via mass analysis
3. via mass analysis or leachate analysis
4. via leachate procedure (eg: TCLP or Synthetic Precipitation Leachate Procedure)

STANDARD OPERATING PROCEDURE

SC-004 Headspace VOC Screening

1. Objective

Describe methods to obtain site-specific measurement of the total volatile organic compound (VOC) concentrations present in the headspace of a jar containing soil.

This information can be used for several purposes:

- Segregate soil based on degree of contamination.
- Identify samples for quantitative analysis of VOCs.
- Evaluate the presence or absence of VOCs in soil.

2. Execution

- A photoionization detector (PID) or flame ionization detector (FID) instrument is used to measure VOCs in jar headspace (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, lamp, and results of calibration 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. 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 jar with the sample location and sample depth.
- 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 vehicle 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.

3. Limitations

- The instruments may work poorly in the rain and in freezing temperatures. Under such conditions, operate the instrument in a heated vehicle or building if possible.

- 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.
- Note that states may have specific procedures for field monitoring. In Massachusetts, the Massachusetts Department of Environmental Protection (DEP) requires that screening of gasoline-contaminated soil be performed in accordance with Attachment II of the DEP's policy #WSC-94-400 Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. Consult this procedure or any relevant guidance documents for assistance.

4. References

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

5. Contacts

Lynn Willey
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

1. Objective

Describe standard procedures for the collection of surface and subsurface soil samples.

The definition of “surface” soil varies considerably between regulatory organizations. Surface soils may be classified as soils between the ground surface and 2 inches below ground surface, ground surface and 6 inches below ground surface, and even as much as ground surface and 24 inches below ground surface.

The definition of subsurface soil will vary in relation to the definition of surface soil. In general, subsurface soil is everything deeper than surface soil.

Refer to state-specific regulations for the definitions of surface and subsurface soils.

2. Execution

2.1. Surface Soil Sampling

Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, scoops, etc. 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 decontaminated 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 compound (VOC) analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, small diameter core device, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a decontaminated stainless steel, plastic, or other appropriate 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 container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.

2.2. Sampling with Hand Augers and Thin Wall Tube Samplers

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are generally better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and generally cannot be used below a depth of approximately three feet.

2.2.1 Auger Sampling

- Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.
- Attach the decontaminated auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- After reaching the desired depth, carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole.

2.2.2 Thin-Walled Core Sampling

- Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- Remove the tube sampler, and unscrew the drill rods.
- Remove the cutting tip and the core from the device.
- Discard the top of the core (approximately 1 inch), as this may represent material knocked down from the sides of the boring and not the layer of interest. Place the remaining core into the appropriate labeled sample container.

One type of thin-wall sampler is depicted in Attachment A (this is typically used with a mechanical drill rig).

For either method, If VOC analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, small diameter core sampler, or equivalent and secure the cap tightly. VOC samples should be collected first to minimize the potential for losing volatiles prior to sample collection.

Place the remainder of the sample into a stainless steel, plastic, or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, 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 into the container and mix thoroughly.

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow previous steps, making sure to decontaminate the auger and tube sampler between samples.

Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

2.3. Sampling at Depth with a Split-Spoon (Barrel) Sampler

Split-spoon sampling is generally used with a mechanical drill rig to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split-spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split-spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted. A diagram of the split-spoon sampler assembly is provided as Attachment A.

When split-spoon soil sampling is performed to gain geologic information, work should be performed in accordance with ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". The following procedures are used for collecting soil samples with a split-spoon:

- Select the size (length and diameter) of split-spoon sampler based on the amount of soil that is needed for characterization. The ASTM standard for N-values is 1 3/8 - inch I.D (2-inch O.D.). Specify spoon size and basket type to driller prior to mobilization to the site. Split spoon samplers are typically available in 1 3/8 – and 3 – inch I.D. sizes. A larger barrel may be necessary to obtain the required sample volume. Note on the boring log where larger split spoon barrels are used because the ASTM standard penetration test does not apply when driving split spoons larger than 1 3/8 I.D. (2-inch O.D.).

- Select a soft or stiff basket for the spoon (a softer basket generally works better for loose or soft material).
- Prior to hammering the split spoon to collect the sample, verify that the split-spoon is seated at the beginning of the desired sample interval. If it is seated above the interval, have driller clean out the hole prior to sampling. Record all depth measurements relative to ground surface.
- Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top. See diagram in Attachment A.
- Place the sampler in a perpendicular position on the sample material.
- For all soil samples, use a 140-lb hammer falling 30 inches to drive the sampler, unless conditions necessitate using a 300-lb hammer.
- Record in the site fieldbook or on field data sheets the length of the tube used to penetrate the material being sampled, the split-spoon inside and outside diameters, and the hammer weight,
- Count and record the number of blow counts per 6-inch increments (confirming blow counts with driller if necessary).
- Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The length of recovery and soil type should be recorded on the boring log. If a soil sample is desired, a decontaminated stainless steel knife or spatula should be used to divide the tube contents in half, longitudinally. If possible, avoid collecting soil that has come in contact with the walls of the spoon, and soil at the top of the spoon.
- Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.
- Note any material in the nose (shoe) of the spoon.
- Immediately collect a sample for VOCs (if required by the site-specific field sampling plan) by collecting soil from the entire length of the split spoon, unless otherwise specified by the project manager. When the most impacted interval is sampled for laboratory analysis, screen the spoon with the field instrument first, then collect the soil sample for VOC analysis from the appropriate interval.

3. Limitations

- Weather conditions (e.g., frozen ground) may prevent the collection of samples and should be considered prior to sample collection.
- Tools plated with chrome or other materials should not be used.
- Be aware of local laws regarding subsurface utility clearance prior to conducting subsurface investigations. Contact DigSafe or local utility companies as required.
- Be aware of the length of the drill string, the sample depth, and the required stickup of the drill string to ensure accurate sample interval measurement.
- If drilling with hollow-stem augers, the removal of the drill string from the hole, prior to attaching the split-spoon sampler, may cause soils to be sucked up

into the augers (blow-in running sands). Upon recovery, determine if there is blow-in in the split spoon sampler. In general, blow-in is more unconsolidated than the rest of the sample and lacks stratification (do not include blow-in for recovery of sample collection).

- If soils consist of loose sands or soft clay, the drill string and sampler may advance slightly under its own weight, giving a false depth for soil collection.
- Never sample more than two spoons consecutively without advancing the augers unless material is tight. Do not let the split spoon penetrate more than it can hold.
- In many instances, groundwater will fill the auger and the split-spoon.

4. References

ASTM D1586-08a, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". 2008.

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

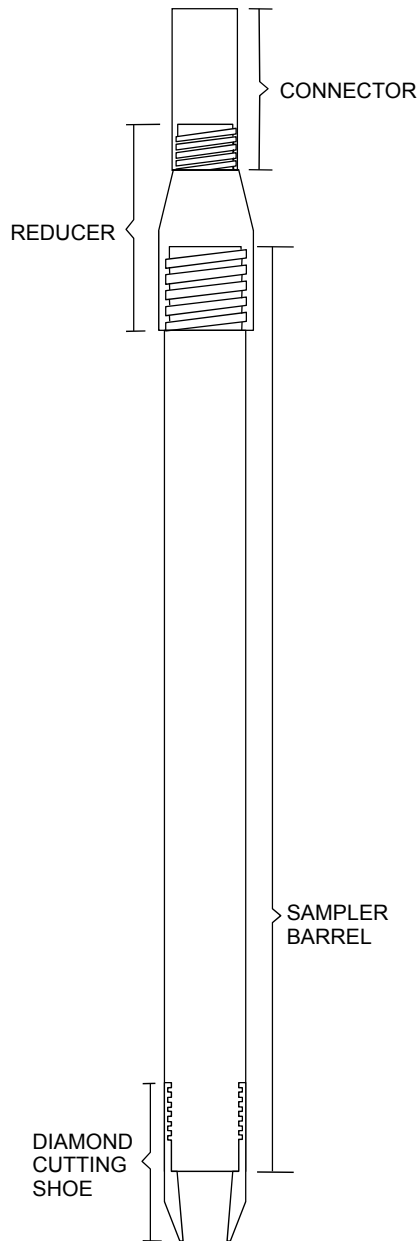
5. Attachments

Attachment A - Sampler Design Assembly

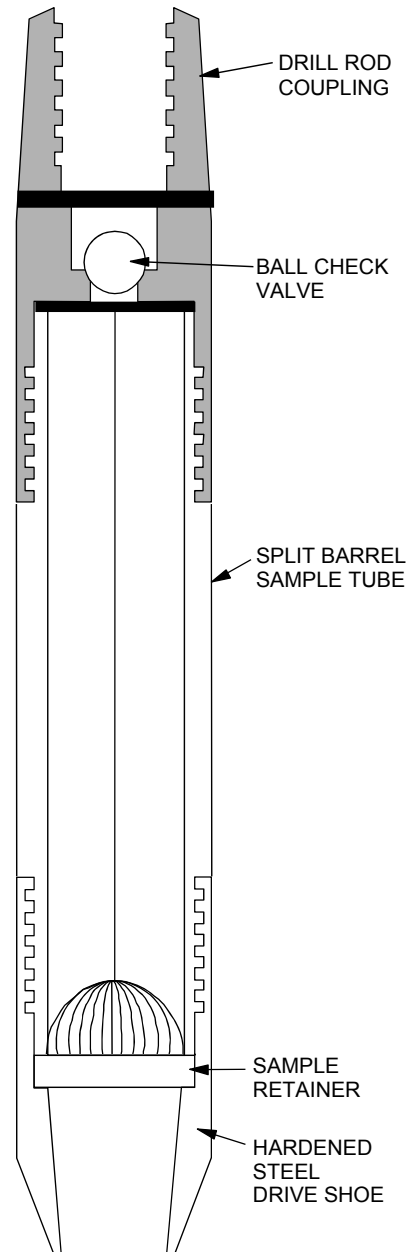
6. Contacts

Gary Fuerstenberg
Mark Ensign

THIN WALL HQ CORE SAMPLER
(2" width x 60" length)



SPLIT-SPOON SAMPLER
(2" width x 24" length)



STANDARD OPERATING PROCEDURES
SM-001

NEW ENGLAND AND ATLANTIC REGIONS



June 2011

**THIN WALL AND
SPLIT-SPOON
SAMPLERS**

Attachment A

STANDARD OPERATING PROCEDURE

SM-003 Classification of Soil Samples in the Field

1. Objective

Describe methods to classify soil samples collected in the field in a consistent manner.

2. Execution

- Describe soil samples according to *ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* and Attachments A and B. This standard is the basis for the Unified Soil Classification System.
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or 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.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment C).
- GEI consistently applies one modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded," respectively.

3. Limitations

Certain projects or clients will require the use of other classification systems. Other classification systems should not be used unless specifically required by the client. If the client requires that we use the Burmister method, obtain the details from the client. An example breakdown is shown below, but some clients (MassDOT, for example) have their own breakdown.

- "and" = 35-50%
 - "some" = 20-35%
 - "little" = 10-20%
 - "trace" = 1-10%
- Describing soil samples is often difficult during cold or wet weather. Make sure your field notes describe these conditions. When possible, collect archive samples and verify sample descriptions in the office.

- The ASTM Standard Practice for Classification of Soils for Engineering Purposes (D2487) may be used in conjunction with the Visual-Manual Method to confirm the soil classification. D2487 includes laboratory testing.

4. References

ASTM D2487-06e1, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM, 2006.

ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM, 2009.

Field Guide for Soil and Stratigraphic Analysis, Midwest Geosciences Group Press, 2001-2005.

Coarse-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

Fine-Grained Soils Visual-Manual Descriptions, GEI Consultants, Soil Description Chart.

5. Attachments

Attachment A – GEI Soil Description Charts (2007)

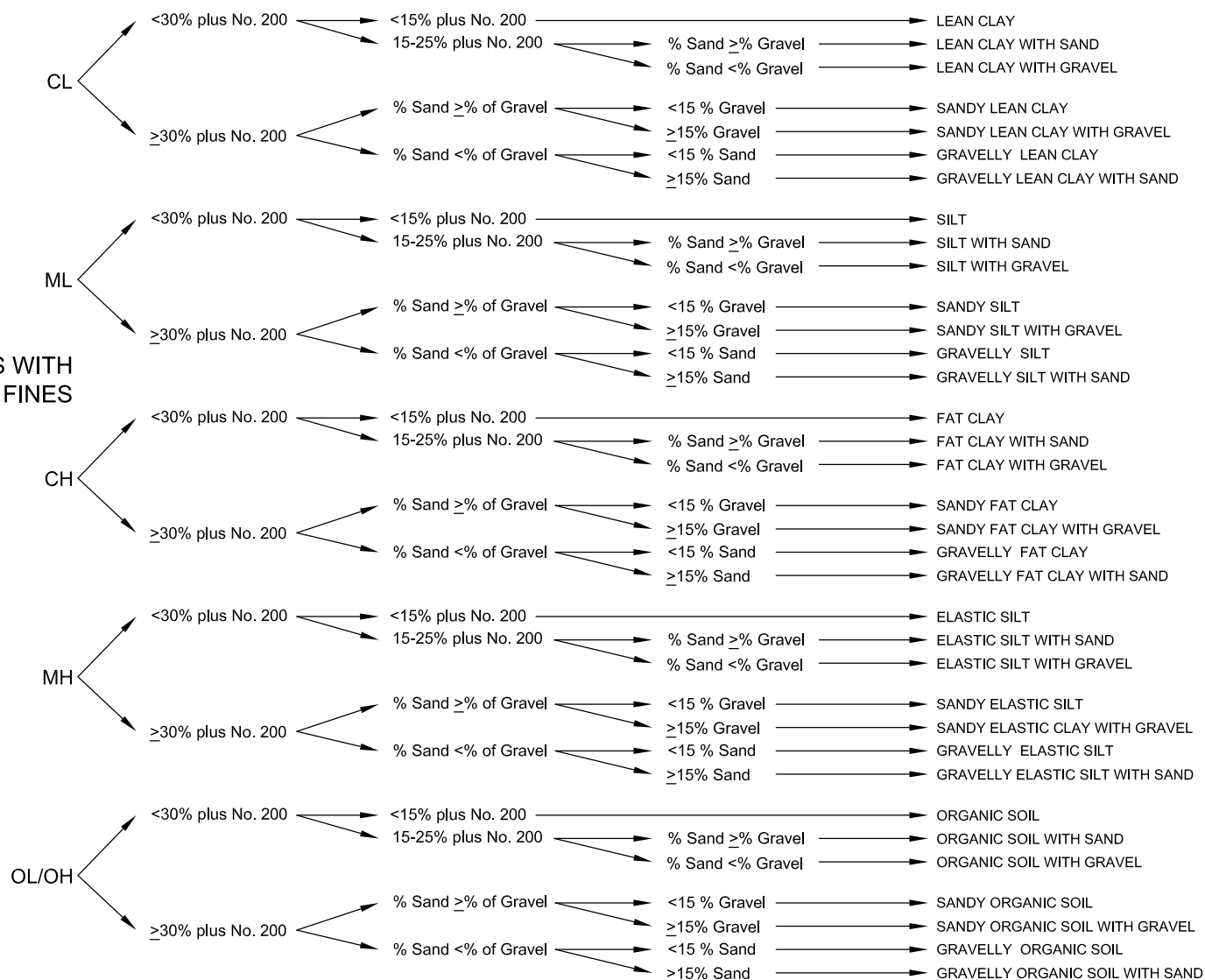
Attachment B – Visual Manual Descriptions with example boring log

Attachment C – Describing the Plasticity of Soil Samples

6. Contacts

Lynn Willey
Cathy Johnson

SOILS WITH ≥50% FINES



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

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

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

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 percentages of sand, gravel or fines.

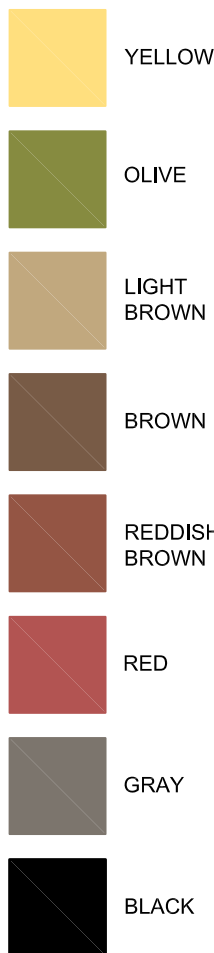
* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

COARSE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

GROUP SYMBOL

GROUP NAME



TYPICAL SOIL COLORS

GRAVEL
% Gravel >
% Sand

SOILS WITH
<50% FINES

SAND
% Sand ≥
% Gravel

≤5% Fines

~10% Fines

≥15% Fines

≤5% Fines

~10% Fines

≥15% Fines

WIDELY GRADED

NARROWLY GRADED

WIDELY GRADED

NARROWLY GRADED

WIDELY GRADED

NARROWLY GRADED

WIDELY GRADED

NARROWLY GRADED

WIDELY GRADED

NARROWLY GRADED

Fines = ML or MH

Fines = CL or CH

Fines = ML or MH

Fines = CL or CH

Fines = ML or MH

Fines = CL or CH

Fines = ML or MH

Fines = CL or CH

Fines = ML or MH

Fines = CL or CH

Fines = ML or MH

Fines = CL or CH

GW

GP

GW-GM

GW-GC

GP-GM

GP-GC

GM

GC

SW

SP

SW-SM

SW-SC

SP-SM

SP-SC

SM

SC

<15% Sand

≥15% Sand

<15% Sand

≥15% Sand

<15% Sand

≥15% Sand

<15% Sand

≥15% Sand

<15% Sand

≥15% Sand

<15% Sand

≥15% Sand

<15% Sand

≥15% Sand

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<15% Gravel

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≥15% Gravel

<15% Gravel

≥15% Gravel

<15% Gravel

≥15% Gravel

<15% Gravel

≥15% Gravel

<15% Gravel

≥15% Gravel

WIDELY GRADED GRAVEL

WIDELY GRADED GRAVEL WITH SAND

NARROWLY GRADED GRAVEL

NARROWLY GRADED GRAVEL WITH SAND

WIDELY GRADED GRAVEL WITH SILT

WIDELY GRADED GRAVEL WITH SILT AND SAND

WIDELY GRADED GRAVEL WITH CLAY

WIDELY GRADED GRAVEL WITH CLAY AND SAND

NARROWLY GRADED GRAVEL WITH SILT

NARROWLY GRADED GRAVEL WITH SILT AND SAND

NARROWLY GRADED GRAVEL WITH CLAY

NARROWLY GRADED GRAVEL WITH CLAY AND SAND

SILTY GRAVEL

SILTY GRAVEL WITH SAND

CLAYEY GRAVEL

CLAYEY GRAVEL WITH SAND

WIDELY GRADED SAND

WIDELY GRADED SAND WITH GRAVEL

NARROWLY GRADED SAND

NARROWLY GRADED SAND WITH GRAVEL

WIDELY GRADED SAND WITH SILT

WIDELY GRADED SAND WITH SILT AND GRAVEL

WIDELY GRADED SAND WITH CLAY

WIDELY GRADED SAND WITH CLAY AND GRAVEL

NARROWLY GRADED SAND WITH SILT

NARROWLY GRADED SAND WITH SILT AND GRAVEL

NARROWLY GRADED SAND WITH CLAY

NARROWLY GRADED SAND WITH CLAY AND GRAVEL

SILTY SAND

SILTY SAND WITH GRAVEL

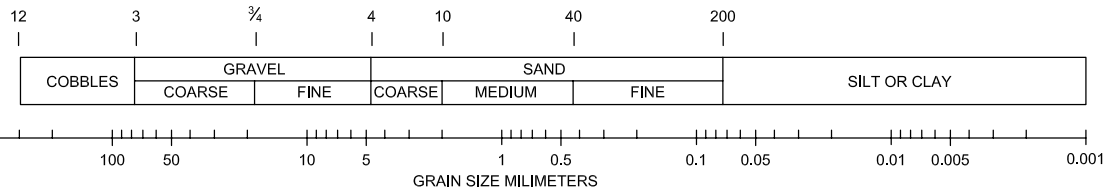
CLAYEY SAND

CLAYEY SAND WITH GRAVEL

U.S. STANDARD SIEVE OPENING IN INCHES

U.S. STANDARD SIEVE NUMBERS

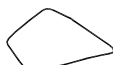
HYDROMETER



ROUNDED



SUBROUNDED



SUBANGULAR



ANGULAR

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

Describing the Plasticity of Soil Samples

M. Paster – November 2008

References ASTM D 2487 – Soil descriptions – lab
 ASTM D 2488 – Soil descriptions – field
 ASTM D 4318 – Atterberg limits testing

GEI Practice for Boring and Test Pit Logs

Describe the fines as:

Non-plastic

Low plasticity (The GEI laminated sheets incorrectly use “slightly plastic” for “low plasticity.”)

Medium plasticity

High plasticity

Example: ~25% low plasticity fines

Toughness and dry strength:

You should use these tests to help decide how plastic the fines are. Record the results in the remarks column of the field log, but not in the soil description and not necessarily in the typed log.

On final logs, if Atterberg limits tests have been performed:

Do not use the descriptive terms non-plastic, low plasticity, etc. for samples on which Atterberg limits tests have been run. Instead, just give the percentage of fines and then report the actual Atterberg limits at the end of the description.

For example, the end of a silty sand description might be:

... ~25% fines, ~10% gravel max size ½ inch, gray. PL=23, LL=35.

(Atterberg limits tests are performed on the fraction of the sample finer than the No. 40 sieve, not just the fines. So the Atterberg limits data applies to the sample, not just to the fines.)

Hints:

High plasticity soils are rare in New England. If you think it's high plasticity, it's probably medium. Some Boston blue clay and some Connecticut River varved clays are high plasticity, but if you think you've found some, check with the project manager.

In New England, if ~10% fines or more, generally stick with GM, SM, ML, and CL. Occasionally GC, SC, CH. Don't use MH unless you have Atterberg limits data.

Estimating plasticity in the field, GEI guidance based on ASTM D 2488:

Plasticity	1/8-inch thread	Dry strength	Toughness
non	Cannot be rolled at any water content.	Dry specimen crumbles when handled.	Only slight pressure needed to roll thread near plastic limit.
low	Thread can barely be rolled.	Dry specimen crumbles with some finger pressure.	Slight to medium pressure needed to roll thread near plastic limit.
medium	Thread is easy to roll. Not much time needed to reach plastic limit.	Dry specimen crumbles with considerable finger pressure.	Medium pressure needed to roll thread near plastic limit.
high	Takes considerable time rolling and kneading to reach plastic limit.	Dry specimen cannot be broken with finger pressure.	Considerable pressure needed to roll thread near plastic limit.

Non-plastic vs. low plasticity:

ASTM D 2488 (soil descriptions - field) defines non-plastic and low plasticity based on the 1/8-inch thread as shown in the table above.

ASTM D 4318 (Atterberg limits testing) indicates that a sample should be called non-plastic for either of the following cases:

- The liquid limit test (dropping the cup) or the plastic limit test (rolling out the thread) cannot be performed because the plasticity is too low.
- The plastic limit is greater than or equal to the liquid limit.

Unfortunately, there are some soils that are low plasticity based on D 2488 (a thread can be rolled), but are non-plastic based on D 4318 (the liquid limit cannot be measured or $PL \geq LL$).

GEI considers these soils to have low plasticity, because that is how they “look” and “feel.” We want to document this information so that other people will have a better feel for what the soil looks like and how it behaves. So, if the soil was low plasticity based on D 2488, but non-plastic based on D 4318, that should be explained in the letter or report, and possibly in a note on the log.

BORING LOCATION <u>Maple Ave Sidewalk</u>		DATE START/FINISH <u>2/14/07 - 2/15/07</u>		BIOI					
GROUND ELEVATION (NGVD) _____		DRILLED BY <u>Geologic: M. Costigan</u>							
GROUNDWATER EL. _____ DATE _____		LOGGED BY <u>T. Kahl/M. Yako</u> TOTAL DEPTH (FT) <u>25</u>		PG. OF					
EL.	DEPTH	SAMPLE				PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS	
FT.	FT.	TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.				
	2.5	S1	13-9 17-14	24	0	0.5 ppm	FILL	4" pavement S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sand, ~10% gravel to 1", <5% nonplastic fines, brown. Contains brick fragments and ash. Fill. S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% gravel to 3/4 inch ~10% non-plastic fines, brown. Fill. S3 (0-10"): Similar to S2.	
	5					hard drilling 3 to 4 ft, possible boulder			
	7.5	S2	7-7 11-13	24	8	2.0 ppm			
		S3	9-10 2-1	24	16	0.0 ppm	ORGANICS	S3 (10"-16"):	
	10								S3 (10"-16"):
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm			S3 (10"-16"):
	15					hard drilling at 15.5 ft	TILL	S4: Similar to S3, bot 6".	
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.			S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sand, ~25% slightly plastic fines, ~15% gravel to 1/2 inch, olive. Glacial Till.
	20								
	22.5	C1	RQD 70%	60	54	lost ~10 gallons drill fluid from 23 to 25 ft	ROCK	C1: SCHIST, hard, slight weathering at joint surfaces, joints at ~30 degrees from horizontal and generally parallel to foliation, gray. Marlborough Formation.	
	25								
	27.5								Bottom of Boring 25 ft Truck-mounted drill rig. 4-inch casing to 19 ft. Safety-hammer with rope and cathead for SPT. Backfilled with drill cuttings.
	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 RQD—LENGTH OF SOUND CORES > 4 IN./ LENGTH CORED, % S—SPLIT SPOON SAMPLE U—UNDISTURBED SAMPLES,							NOTES: 1: Groundwater at 10 ft depth at start of day 2/15/07.		
UF—FIXED PISTON UO—OSTERBERG GROUNDWATER							PROJECT 07999-0 DATE 		

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. $S_v = 0.5$, 0.5 , 0.8 tsf, $Q_p = 1.0$, 1.5 , 1.6 tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.

(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

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

GEOPROBE AND ROTOSONIC

When SPTs are not performed, 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 O.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 on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs** - Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("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.

STANDARD OPERATING PROCEDURE

SM-004 Test Pit Excavation

1. Objective

Describe methods for excavating test pits and documenting findings.

The test pit is used to characterize geologic strata, subsurface conditions and provide access for collection of representative soil samples from these strata.

2. Execution

- Before digging begins, proper permits and notifications must be obtained, in accordance with applicable rules or regulations.
- Make sure that utility clearance has been conducted. Contact the property owner to determine the location of underground utilities. Verify, with the contractor that local/regional utility clearance service has been contacted. Ask subcontractor to provide local/regional utility clearance service authorization number and record this in the field notebook. Show the contractor the approximate excavation area, and have the contractor confirm that the area is suitable for excavation. Clearance may require marking of subsurface explorations prior to contacting utility clearance service.
- Have contractors pressure wash or steam clean equipment before beginning field activities, if necessary.
- Observe the contractor excavating the designated area.
- If contamination is suspected, have the contractor place excavated material on plastic sheeting.
- During excavation, monitor ambient air for contaminants of concern identified in the site-specific Health and Safety Plan. Record readings in field notebook (see SOP FD-001 Field Notebook).
- Record in a field book or test pit log:
 - o Test pit dimensions,
 - o Soil classifications (see SOP SM-003 Soil Classification)
 - o Visual and olfactory indications of contamination
 - o Subsurface structures
 - o Obstructions to excavation
 - o Any other observations relevant to the project objectives
 - o Take photographs of excavation and completed test pit walls, etc. (SOP FD-004 Photodocumentation).
- Record technical information on a PDA, test pit log form, or a field book.
- Label sample bottles (see SOP SC-002 Sample Handling).
- Screen soil samples for contaminants of concern and record results in the field notebook or test pit log.
- Collect soil samples from the test pit as designated in the work plan including sidewalls and bottom at designated depths, at strata changes, or based upon

field screening using remote sampling equipment (backhoe bucket, stainless steel remote sampler, etc.). Do not enter a test pit unless side slopes satisfy Occupational Safety and Health Administration (OSHA) regulations and other health and safety concerns have been addressed.

- Transfer soil samples to the appropriate glassware according to soil sampling SOPs (SOP SM-002 VOC Soil Collection and Preservation Method, etc.).
- Store samples on ice in a cooler (see SOP SC-002 Sample Handling and SOP FD-003 Chain-of-Custody).
- Backfill excavation as soon as possible with material as described in the field plan. Place the excavated material back in the excavation in approximately the same strata it came from.
- Segregate contaminated soil as necessary (see SOP SC-003 IDW). Properly identify segregated material and secure as described in the work plan.
- Measure dimensions of excavation and record in the field notebook or test pit log. If sampling locations are to be surveyed, mark the corners and provide surveyor with location ID.
- Sketch dimension and location of the test pit relative to a site reference point and record in the field notebook. Note the sample locations by number on a cross-section sketch and plan view sketch.

3. Limitations

- Never enter the excavation unless it is shored or the sidewalls are sloped in accordance with OSHA regulations and all proper personal protective safety precautions have been considered and implemented.
- Terminate excavation if the flow of groundwater into the excavation adversely affects the stability of the excavation (i.e., slumping). Make sure to note in the field notebook or test pit log the depth to ground water.
- Terminate excavation if drums, tanks, or other potential sources of contamination are observed. Record visible drum markings, labels, and any other pertinent information on the test pit log and in the field notebook. Photograph drums and materials. Consult with the project manager before filling the excavation.
- Do not leave an open test pit unattended.

4. References

Earth Manual (1968), United States Department of the Interior, Bureau of Reclamation, United States Government Printing Office, Washington, D.C., pp. 134-139.

OSHA Standards for Excavations, Department of Labor, Federal Register, 29 CFR Part 1926, Aug. 9, 1994.

5. Contacts

Douglas Bonoff
Mark Ensign

STANDARD OPERATING PROCEDURE

GW-001 Water Level and NAPL Measurement

1. Objective

Describe procedures to measure the depth to water and non-aqueous phase liquid (NAPL) thickness in an open borehole, cased borehole, monitoring well or piezometer.

2. Equipment and Materials

Field forms and/or field notebook.

- Decontamination fluids
- Bailer
- Weighted cotton string
- Oil/Water interface probe
- Water level meter (if oil/water interface probe is not available)

Water level and NAPL measurements can be collected by a variety of methods. A water level meter is used to collect depth to water measurements however an oil/water interface probe or other methods must be used to gauge NAPL depths. An electronic oil/water interface meter, consists of a cable divided into incremental measurements of 0.01 feet, and probe that consists of an infra-red circuit that detects the presence of a liquid, and a conductivity circuit that differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or dense non-aqueous phase liquid [DNAPL] product). Typically, a steady tone and light indicate a non-conductive liquid (e.g. product) and an intermittent tone and light indicate a conductive liquid (e.g. water). Refer to the manufacturer's instructions for details. Alternately, water level and NAPL measurements can be collected using a water level meter, clear bailer and weighted cotton string. Each method of data collection is described below.

3. General Information

- The water level in a monitoring well or piezometer should be allowed to stabilize for a minimum of 24 hours after development or construction before groundwater elevation and/or NAPL measurements are collected. The water level in a borehole can be measured during drilling; however, this should be noted in the field notebook.
- Water levels in multiple wells should be collected within the shortest timeframe practicable.
- Water and NAPL levels should be measured from the designated survey point as specified by the surveyor or highest point (or "V" notch) on the PVC. If the well is new, mark the datum point with an indelible marker and note reference location in

field book. Discuss with the project manager what reference point should be used to collect water measurements for specific sites.

- Water level and/or NAPL measurements should be made before any water is removed from wells because doing so may influence groundwater levels in the area of the investigation.
- Measurements should be made approximately three 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).
- Water level and/or NAPL measurements should first be collected at the wells that are least contaminated and proceed towards the wells that are most contaminated. Decontaminate the water level meter or oil/water interface probe prior to initial use and after use at each location. If NAPL is encountered at a well where it was previously not observed, contact your project manager before continuing.
- Refer to the oil/water interface probe or water level meter instruction manual for guidance on indicator signals, as these may differ by manufacturer.

4. Execution

4.1 Water Level and NAPL Measurements Using Interface Probe

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- LNAPL Depth (if present): Measure the LNAPL/air interface by slowly lowering the interface probe to the LNAPL surface. Be ready to stop as soon as the probe signals the LNAPL surface.
- Record the depth to LNAPL.
- Groundwater Depth: Continue slowly lowering the probe until it signals the presence of water.
- Record the depth to water.
- The LNAPL thickness is determined by subtracting the water depth from the LNAPL depth.

The depth and thickness of DNAPL can sometimes be determined by slowly lowering the interface probe past the LNAPL (if present) and water layers. Record the depth to the DNAPL layer. Finally, measure the depth to the well bottom.

The DNAPL thickness is determined by subtracting the DNAPL depth from the depth to well bottom.

- Decontaminate the interface probe and tape according to SOP QA-001.
- Dispose of any NAPL-impacted debris properly.
- Check with the Project Manager if you are uncertain of the appropriate disposal method.

4.2 LNAPL Measurements Using Clear Bailer

If LNAPL is suspected at a site, an oil/water interface probe should be used when gauging water level and NAPL measurements. However, a water level meter and a clear bailer may be used instead to estimate approximate LNAPL thickness if an oil/water interface probe is not available.

- Open wells to the atmosphere and allow them to equilibrate prior to collecting LNAPL depth measurements.
- Slowly lower the water level meter until contact with fluid is indicated by the meter.
- Record the depth to fluid measurement.
- Lower a clear bailer into the well and slowly into the LNAPL. Do not submerge the bailer.
- Slowly raise the bailer out of the well and measure LNAPL thickness in the bailer using a ruler or tape measure.

Calculating Depth to Groundwater

The depth to water can be calculated as follows:

$$DTW = DTF + PT$$

DTW = Depth to Groundwater

DTF = Depth to Fluid

PT = Measured Product Thickness

Calculating Corrected Depth to Groundwater

Once the LNAPL thickness is known and the depth to groundwater is known, the corrected depth to groundwater can be calculated.

$$\text{Corrected DTW} = \text{Static DTW} - (PT \times G)$$

DTW = Depth to Ground Water

PT = Measured Product Thickness

G = Specific Gravity (density of free product / density of water)

4.3 DNAPL Measurements Using Weighted Cotton String

A weighted cotton string may be used to estimate approximate DNAPL thickness.

- Secure cotton string.
- Secure clean steel nuts and/or washers.

- Tie the string to the nuts/washers, so that there is adequate weight.
- Lower the weighted string into the well slowly, until a firm bottom is sensed.
- Remove the weighed string and measure the DNAPL coated portion of the string.
- Record the thickness.
- Dispose of any NAPL-impacted debris properly. Check with the Project Manager if you are uncertain of the appropriate disposal method.

5. Health and Safety Considerations

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). The collection and accumulation of NAPL presents the potential for significant hazards that need to be managed. A detailed job safety analysis (JSA) should be completed prior to the start of work.

6. Considerations

- Weak batteries in water level and oil/water interface meters 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 or NAPL. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Electronic oil/water interface meters do not respond to distilled water. Do not use de-ionized water to test these units.
- Wells that are not vertical may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water 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 ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe and tape may need to be retrieved and dried off before trying again.
- Accumulation of sediment, organic material, or floating debris in 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 ground water-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 it cannot contact the inner casing.
- Well gauging equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Water levels in wells may be influenced by changes in river stages, pumping of nearby wells, precipitation, tides, etc.
- Using a bailer to estimate LNAPL thickness can result in 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.
- The optical sensor on interface probes may become damaged if solvents are used to clean NAPL from the probes.
- The optical sensor may become smeared when used to measure NAPL, 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.
- 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 LNAPL can pose a problem when measuring the level of groundwater. Floating LNAPL can depress the groundwater level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown above should be applied to groundwater level measurements in monitoring points where LNAPL are present:
- Some interface probes are factory-calibrated based on an assumed conductivity of NAPL and water, both of which may vary. An interface probe that is functioning properly may not be able to discern different NAPLs at all sites.
- An interface probe may not successfully provide both LNAPL and DNAPL measurements in the same well because the probe is coated by LNAPL and loses its ability to detect DNAPL.
- DNAPL, in particular, may be only slightly heavier than water, or may be neutrally buoyant. As a result, it can be easily disturbed. Once it is disturbed, meaningful measurements can be difficult or impossible to obtain. As such, all tapes or probes used for measurements should be used slowly.

7. References

U.S. EPA Environmental Response Team Standard Operating Procedures SOP: 2043, "Water Level Measurement" REV: 0.0, 2/11/00

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

8. Contacts

Brian Conte – (860) 368-5412 Glastonbury
Mark Ensign – (781) 721-4010 Boston
Ryan Hoffman – (781) 721-4091 Boston

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

1. Objective

Describe methods to collect groundwater samples most likely to produce results that represent aquifer conditions.

Low-flow purging is limited to wells that, with sustained pumping, exhibit no continuous drawdown.

2. Execution

- Prior to groundwater sampling consult with the project manager to confirm that the type of pump is appropriate and consistent with the approved work plan.
- Record activities in the field notebook (see SOP FD-001 Field Notebook) and on a Monitoring Well Sampling Record such as the examples in Attachment A. Use a separate form for each sampling location and event. You may forego the forms and record all information in the field notebook if the Project Manager approves.
- Calibrate pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) on the meter(s). Use calibration methods provided by the manufacturer of the equipment. Note that appropriate calibration for dissolved oxygen requires a water saturated air environment, along with measured temperature and barometric pressure.
- Begin with the monitoring well believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- 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 in accordance with SOP GW-001 Water Level Measurement.
- Attach new polyethylene or Teflon lined tubing to the sampling pump and the flow-through cell that contains the meter probes.
- Slowly and gently insert new polyethylene or Teflon lined tubing to the pump intake (or use dedicated tubing that remains in the well) and to the middle of the saturated screened interval or to the pre-determined sampling depth.
- The tubing intake should be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well. Record the depth of the pump intake.

- If possible, position your sampling equipment and tubing so that it is in the shade. The goal is to minimize the effect of sunlight raising the temperature of water being collected.
- 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, is desirable but not mandatory). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure flow rate on the pump or using a graduated container every 3 to 5 minutes and record. The minimum purge volume will be twice the combined volumes of the sampling string (i.e. pump, tubing, and flow-through cell).
- While purging, record water levels every 3 to 5 minutes and monitor and record the water quality indicator parameters: pH, temperature, specific conductance (SC), dissolved oxygen (DO), and turbidity. If specified in the field sampling plan also include ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:
 - o pH (+/- 0.1 standard units)
 - o temperature (+/- 3%)
 - o SC (+/- 3%)
 - o turbidity (+/- 10% if >5 NTU; if 3 values are <5 NTU, consider the values as stabilized)
 - o DO (+/-10% if >0.5 mg/L; if 3 values are <0.5 mg/L, consider the values as stabilized)
 - o ORP (+/- 10 mV)
- Dispose of purge water according to the field plan.

Sample Collection:

- Following purge, remove the discharge tubing from the flow-through cell. Do not disturb pump and tubing between stabilization and sample collection.
- Fill sample containers directly from the sampling device in order of decreasing volatility (i.e., Volatile Organic Compounds (VOC) samples are collected first; see SOP SC-002 Sampling Handling). Fill all containers from the discharge end of the tubing. Collect samples at a flow rate equal to the steady state purge rate.
- If not using a dedicated pump, remove sampling device and decontaminate (see SOP QA-001 Equipment Decontamination). Discard used tubing.
- Store samples in a cooler on ice for transport to the laboratory.
- Measure depth to bottom of well.

- Secure the well cap.

3. Limitations

- Prior to departure for the field, 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 possible, when using dedicated equipment, 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.
- If water quality indicator parameters do not stabilize after removing 3 to 5 well volumes or 2 hours, contact the Project Manager. Three options will be available: 1) continue purging until stabilization; 2) discontinue purging and do not sample; or 3) discontinue purging and sample.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Consult with the project manager before field filtering samples for metals if using low-flow sampling.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

Standard Reference for Monitoring Wells (April 19, 1991), Massachusetts DEP, DEP Publication No. WSC-310-91.

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.

Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (2010), EQASOP-GW 001 Low Stress (Low Flow) SOP, Revision 3, U.S. Environmental Protection Agency, Region I, January 19, 2010.

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.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contacts

Brian Conte
Saskia Oosting



MONITORING WELL SAMPLING RECORD

PID Reading _____
Job Number _____
Location _____
Well Number _____

Job Name _____
By _____ Date _____
Measurement Datum _____

Pre-Development Information

Water Level _____
One Purge Vol _____

Time (start) _____
Total Depth of Well _____
Three Well Volume _____

Water Characteristics

Color _____ Clear _____ Cloudy _____
Odor _____ None _____ Weak _____ Moderate _____ Strong _____

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (μ S/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____
Temperature (°C) _____ Specific Conductance (μ S/cm) _____
DO Concentration (mg/L) _____ ORP (mV) _____
TDS _____



Post Development Information

Time (Finished) _____

Water Level _____

Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ Clear _____ Cloudy _____

Odor _____ None _____ Weak _____ Moderate _____ Strong _____

Any films or immiscible material _____

Comments _____

STANDARD OPERATING PROCEDURE

AR-002 Air Sampling for Dust (Particulate Matter) using the MIE DataRAM™ Real-Time Aerosol Monitor

1. Objective

Describe standard procedures for the real-time monitoring of airborne particulate matter using a MIE DataRAM™ model DR-2000 real-time aerosol monitor.

The MIE DataRAM™ is a real-time, portable monitor that measures airborne particulate matter. It is capable of monitoring total suspended particulate matter, particulate matter less than 10 microns (PM₁₀), and particulate matter less than 2.5 microns (PM_{2.5}) by using an appropriate orifice to control the size of the particles being measured. The DataRAM can be programmed to collect continuous real-time data, or to record time averaged data.

2. Materials

- MIE DataRAM™ model DR-2000
- Shelter/Enclosure - a pre-constructed enclosure capable of protecting the instrumentation from severe weather conditions during sample collection
- Omnidirectional inlet
- Inlet heater
- PM_{2.5}/PM₁₀ impactor
- IBM compatible computer loaded with MIE DataRAM™ software
- Field notebook

3. Meter Calibration

- Assemble all necessary DataRAM™ attachments.
- Make sure the power selector switch on the rear panel is in the “on” position. Turn on the power by pressing the “on” button on the front display panel of the DataRAM™. “Main Menu I” will appear on the screen.
- Activate the zero mode by pressing the button indicating zero.
- When the screen indicates the zero mode is complete, activate the span check mode by pressing the button indicated, and follow the prompts that appear on the screen.
- Record the time of the zeroing and the calibration difference percent in the field notebook. If the zeroing procedure takes longer than 5 minutes press “exit” and then “off,” and then put the power switch on the rear panel of the instrument in the “off” position. Wait several minutes, turn on the power and zero the instrument again. If the calibration difference percent is more than ±5% then follow the “Calibr Diff” Resetting Procedure in the DataRAM™ Instruction Manual.
- Set the DataRAM™ to automatically log data. Refer to the Instruction Manual for details on how to set the data logging function.

- Record the instrument flow rate from the parameters menu in the field notebook.

4. Sample Collection

- Set the DataRAM™ at the predetermined sampling location in a rain or weatherproof containment, with only the inlet tubing exposed to ambient air.
- Start the run.
- When sampling is completed, terminate run and download data using the RS-232 cable connector and the MIE DR-COM software.
- Once the data file has been successfully downloaded and saved in an appropriate location, clear the data from the instrument memory.

5. Limitations

Each instrument must be calibrated using the internal reference standard and zeroed at the start of each sampling event and at a frequency of once per day throughout the duration of the sampling event.

The DataRAM™ can be programmed to collect continuous real-time data, or can collect “averaged” real-time data. These various options should be addressed prior to field operations and must be referenced in an approved work plan. This work plan must be available to all field personnel.

Project objectives will usually dictate the sampling location. In general, for air monitoring, meters are usually placed near breathing height and away from objects that can interfere with air motions. Since the DataRAM™ is measuring particulate matter, placement of the instrument directly on the ground should be avoided to prevent the sampling of dust concentrations that may not be representative of the air that is intended to be sampled (e.g. air at breathing height).

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM₁₀ in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, D.C. EPA-454/B-08-003 December, 2008.

7. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

1. Objective

This SOP describes methods used to decontaminate reusable sampling equipment for projects that require collection of organic and inorganic analytical samples. The goal is to minimize cross-contamination between samples. This maximizes confidence that field samples will be representative of specific locations and conditions.

Refer to the work plan or project manager to determine if different decontamination methods are acceptable.

2. Execution

- All contractor-provided equipment (augers, rods, spoons, backhoe buckets) should be decontaminated by steam cleaning or pressure washing prior to coming on site. If there is doubt about cleanliness of drilling tools, they should be decontaminated before use at the site.
- Sampling equipment decontamination is a sequential procedure consisting of the following steps:
 - o Alconox-solution wash (or equivalent non-phosphate detergent)
 - o Potable water rinse
 - o A ten percent reagent grade nitric acid wash should be used to strip potential inorganic contaminants from sampling devices.
 - o Laboratory grade 100 percent methanol, should be used to strip potential organic contaminants from sampling devices.
 - o Three distilled/deionized water rinses.
- Alconox solution is a mixture of approximately 1 cup of Alconox per 1 gallon of potable water. Alconox solution wash requires scrubbing the equipment with a brush soaked in Alconox solution to remove visible contamination or dirt from sampling devices.
- Split-spoon samplers must be decontaminated prior to collecting each sample. The procedure follows:
 - o Overall wash and scrub in a bucket of Alconox solution
 - o Potable water rinse.
 - o 10% nitric rinse
 - o 100% laboratory grade methanol rinse
 - o Three distilled-water rinses.

The same procedure is applied to all devices that may contact soil or groundwater slated for analytical samples - spoons and knives used to inspect or sample soils; water level indicators; oil/water interface probes.

Equipment used for well development of multiple wells must be decontaminated between wells.

Pumps and tubing should be flushed using a minimum of one gallon of Alconox-solution followed by a gallon of potable water. Some projects may require methanol (in much lower quantities) and distilled water instead of or in addition to the Alconox-solution and potable water.

For pumps and tubing, a final rinse of the sampling equipment may be performed with the water being sampled.

Equipment blanks measure the effectiveness of the decontamination procedures. Blanks should be collected per guidance provided in QA-002, Field Quality Control Samples.

3. Limitations

- Do not store the deionized/distilled water in polyethylene bottles, use Nalgene, glass, or Teflon. Polyethylene may leach phthalates.
- Do not attempt to decontaminate string or rope - replace it.
- Due to eye and skin absorption hazards, safety glasses and gloves must be worn when handling decontamination solvents.
- Decontamination procedures may also require modification based on state or federal requirements.
- Steam cleaning or pressure washing with potable water is generally an acceptable decontamination method for drilling equipment (i.e., augers). Check with the work plan.
- Dedicated equipment need not be decontaminated beyond initial decontamination prior to field use.

4. References

Environmental Response Team (ERT), US EPA. Sampling Equipment Decontamination, SOP No. 2006, Revision 0.0. August 11, 1994.

US EPA Region 9. Sampling Equipment Decontamination, SOP No. 1230, Revision 1. September 1999.

5. Contacts

Brian Conte
Bill Simons

STANDARD OPERATING PROCEDURE

QA-002 Field Quality Control Samples

1. Objective

Field Quality Control (QC) samples are used to monitor the reproducibility and representativeness of field sampling. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, equipment blanks, and field duplicates.

2. Execution

2.1. Trip blanks

- Used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies.
- Sample containers filled at the laboratory with analyte-free water are transported to and from the site, and are not opened until time of analysis.
- Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed.
- Generally, one trip blank per volatiles analysis (e.g. volatile organic compounds) shipment.
- Consider submitting a trip blank when sample shipment is by Fed Ex or other large carrier, or laboratory courier.
- Trip blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.2. Equipment blanks

- Equipment blanks (also known as equipment rinsate blanks) are used to monitor possible sources of contamination associated with sample collection. Monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions
- Equipment blanks are collected by pouring laboratory supplied or distilled or deionized water over sampling tools that have been decontaminated per the work plan, into sample containers.
- Equipment blanks are stored with the associated field samples until submitted for analysis.
- Generally collected when site conditions indicate site related contamination is a concern. Check project-specific work plan and/or quality assurance project plan for required frequency.
- Prepare equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site.
- Prepare equipment blanks by rinsing the decontaminated sampling equipment set with the appropriate type of analyte-free water and collecting the rinse water in appropriate sample containers.

- If a potable water rinse is the typical final step, collect the equipment blank with analyte-free water after the potable water rinse.
- Equipment blanks should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

2.3. Field Duplicates

- Used to evaluate the precision and representativeness of the sampling procedures.
- Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.
- Field duplicates from groundwater sampling for all analyses except volatiles analysis are collected by alternating filling sample containers from the same sampling device. Field duplicates for volatiles analysis are filled sequentially.
- Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations.
- Each sample is assigned different sample identifications.
- Field duplicates are generally collected at frequency of 1/20 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.
- All field QC samples should be labeled in the field and submitted “blind” to the laboratory – as if they are separate, primary samples.
- Field duplicates should be recorded in the field notebook and on the chain-of-custody that same as all other samples.

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2.4. Matrix-Spike samples (MS/MSD)

- Matrix spike and matrix spike duplicate samples (MS/MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries.
- Matrix spike and matrix spike duplicate samples are primarily used to check sample matrix interferences. They can also be used to monitor error due to laboratory bias and poor precision. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.
- Generally, the laboratory is required to extract and analyze MS or MS / MSDs at a minimum frequency of 5% of samples being analyzed for the target analyte(s). If the project or client criteria require an MS or MS/MSD, collect sufficient volume in the appropriate containers, and designate the sample to be used as the MS or MS/MSD on the chain of custody.
- Calculate the percent recovery for all spiked analytes for both the MS and MSD. For MS/MSDs also calculate the relative percent difference (RPD). The

RPD for each spiked analyte is calculated using the amount detected not percent recovery. If your data will be subjected to validation, the % recovery and the RPD will generally be determined by the validator.

2.5. Typical QA/QC Frequency

- QA/QC frequency is determined by project, client or regulatory criteria and should be verified prior to sample collection. Generally, QA/QC samples are collected according to the frequency described below:

Duplicate Samples	One per sampling event, one per 10 samples collected, or one every two weeks, whichever comes first.
Equipment Blanks	For each equipment type that is not dedicated or disposable - one per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.
Trip Blanks	One per sample delivery group, or in each cooler containing VOC soil or aqueous samples, depending on project.
MS or MS / MSDs	One MS or MS/MSD per sampling event, one per 20 samples collected, or one every two weeks, whichever comes first.

3. Limitations

- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.
- Laboratory-grade water must be used during the collection of equipment blanks.
- Field duplicates must have different sample identifications.

4. References

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (November 1986), U.S. Environmental Protection Agency Department of Solid Waste, Washington, D.C.

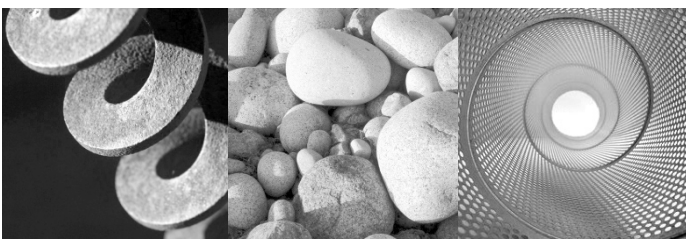
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5. Contact

Brian Conte
Pat King

Appendix E

Field Sampling and Analytical Plan



Consulting
Engineers and
Scientists

Appendix E

Field Sampling and Analytical Plan

Bath Former MGP Site

Bath, New York

NYSDEC Site # 851036

Submitted to:

Bath Electric, Gas and Water Systems
7 South Avenue
Bath, NY 14810

Submitted by:

GEI Consultants, Inc., P.C.
1301 Trumansburg Road, Suite N
Ithaca, NY 14850

May 2021

Project #: 1804919

Bruce Coulombe, P.G.
Project Manager

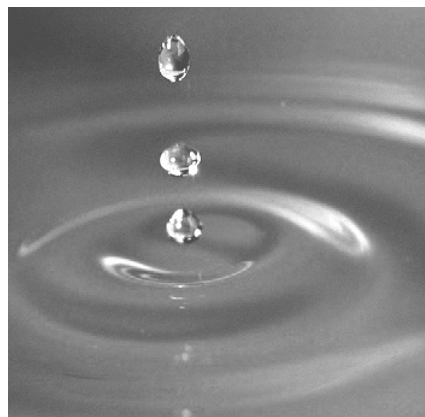


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Abbreviations and Acronyms

ASTM	American Society for Testing and Materials
BEGWS	Bath Electric, Gas and Water Systems
CAMP	Community Air Monitoring Plan
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	United States Environmental Protection Agency
FSAP	Field Sampling and Analytical Plan
GEI	GEI Consultants, Inc., P.C.
HASP	Health and Safety Plan
HSA	Hollow-Stem Auger
ID	Inner Diameter
LNAPL	Light Non-Aqueous Phase Liquid
MGP	Manufactured Gas Plant
mL	milliliter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAPL	Non-Aqueous Phase Liquid
NTU	Nephelometric Turbidity Unit
NYSDEC	New York State Department of Environmental Conservation
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protection Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RQD	Rock Quality Designation
SC	Site Characterization
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbon
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound

1. Introduction

This Field Sampling and Analytical Plan (FSAP) presents the methods and procedures to be used by GEI Consultants, Inc., P.C. (GEI) for performing the Site Characterization (SC) at the Bath Electric, Gas and Water Systems (BEGWS) Bath Former Manufactured Gas Plant (MGP) site located in the Town of Bath, New York.

1.1 Overview of Field Activities

The following field activities will be performed:

- **Utility Locating** – Subsurface utilities will be identified and marked-out.
- **Test Pit Excavation** – Six test pits will be excavated for visual observations and one analytical sample collected per excavation.
- **Soil Boring Advancement** – There will be nine soil borings (including three borings advanced for monitoring well installation) with approximately nine soil samples collected.
- **Groundwater Sampling** – There will be three groundwater samples collected, one from each monitoring well.
- **Surveying** – The locations and elevations of the SC data points and important site features will be surveyed.

2. General Field Guidelines

2.1 Site Hazards

Potential on-site surface hazards, such as sharp objects, overhead power lines, energized areas, and building hazards will be identified prior to initiation of the field work. The potential hazards at the site will be identified during a site reconnaissance by the project team on the first day of the investigation field activities. Additional safety measures to be undertaken for the work performed during the investigation are described in the site-specific Health and Safety Plan (HASP).

2.2 Underground Utilities

Underground utilities, including electric lines, gas lines, storm and sanitary sewers, and communication lines will be identified prior to initiation of drilling and other subsurface work. Underground utility location will be accomplished as follows:

- All SC data points will be flagged or marked-out with white paint.
- Dig Safely New York 800-272-4480 will be contacted to initiate the locating activities. New York State law requires that Dig Safely New York be notified at least two working days, and not more than 10 working days, before subsurface work is performed.
- Companies and municipalities with subsurface utilities present will locate and mark-out all subsurface utility lines.
- GEI will also utilize a utility locating subcontractor to assist with the utility locating task.

2.3 Field Log Books

All field activities will be carefully documented in field log books. Entries will be of sufficient detail that a complete daily record of significant events, observations, and measurements is developed. The field log book will provide a legal record of the activities conducted at the site. Accordingly:

- Field books will be assigned a unique identification number.
- Field books will be bound with consecutively numbered pages.
- Field books will be controlled by the Site Manager while field work is in progress.
- Entries will be written with waterproof ink.

- Entries will be signed and dated at the conclusion of each day of field work.
- Erroneous entries made while field work is in progress will be corrected by the field person that made the entries. Corrections will be made by drawing a line through the error, entering the correct information, and initialing the correction.
- Corrections necessary after departing the field will be made by the person who entered the original information. Corrections will be made by drawing a line through the error, entering the correct information, and initialing and dating the time of the correction.

At a minimum, daily field book entries will include the following information:

- Location of field activity
- Date and time of entry
- Names and titles of field team members on site and site contacts
- Names, titles of any site visitors, as well as the date and time entering and leaving the site
- Weather information, for example: temperature, cloud coverage, wind speed, and direction
- Purpose of field activity
- A detailed description of the field work conducted
- Sample media (soil, sediment, groundwater, etc.)
- Sample collection method
- Number and volume of sample(s) taken
- Description of sampling point(s)
- Volume of groundwater removed before sampling
- Preservatives used
- Analytical parameters
- Date and time of collection
- Sample identification number(s)
- Sample distribution (e.g., laboratory)
- Field observations
- All field measurements made during soil screening with the photoionization detector (PID), and groundwater sampling (pH, temperature, conductivity, turbidity, etc.)

- References for all maps and photographs of the sampling site(s)
- Information pertaining to sample documentation such as:
 - Dates and method of sample shipments
 - Chain-of-custody record numbers
 - Federal Express or UPS air bill numbers

3. Field Equipment Decontamination and Management of Investigation-Derived Residuals

3.1 Decontamination Area

A temporary decontamination area lined with polyethylene sheeting will be constructed for personal decontamination and for decontamination of the drilling and test pitting equipment. Wash water collected from the decontamination activities will be pumped from the pad with a sump pump or trash pump into 55-gallon drums or a bulk tank; and managed as described in Section 3.3.

3.2 Equipment Decontamination

The following procedures will be used to decontaminate equipment used during the SC activities:

- All drilling equipment including the backhoe bucket, and drilling rig; augers; bits; rods; tools; split-spoon samplers; soil core collection tubes and tremie pipes will be cleaned with a high-pressure washing unit before beginning work.
- Tools, drill rods, samplers, and augers will be placed on polyethylene plastic sheets following pressure washing. Direct contact with the ground will not be allowed.
- All augers, samplers, rods, and tools will be decontaminated between each drilling location.
- The back of the drill rig and all tools, augers, and rods will be decontaminated at the completion of the work and prior to leaving the site.

3.2.1 Sampling Equipment Decontamination

Suggested Materials

- Potable water
- Phosphate-free detergent (such as Alconox™ or Simple Green™)
- De-ionized water
- Aluminum foil
- Plastic/polyethylene sheeting
- Plastic buckets and brushes
- Personal protective equipment (PPE) in accordance with the HASP

Procedures

- Prior to sampling, all non-dedicated sampling equipment (bowls, spoons, interface probes, etc.) will be washed with potable water and a phosphate-free detergent (such as Alconox™). Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, etc.
- The sampling equipment will then be rinsed with potable water followed by a de-ionized water rinse.
- Between rinses, equipment will be placed on polyethylene sheets or aluminum foil, if necessary. Washed equipment will not be placed directly on the ground.
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location.

3.3 Management of Investigation-Derived Residuals

3.3.1 *Decontamination Fluids and Development and Purge Water*

Hot-water pressure wash, decontamination, and development and purge water will be collected in 55-gallon drums or a bulk tank. The storage drums or tank will be labeled as “pending analysis – investigation-derived residual decontamination water” and temporarily stored on wooden pallets in a plastic-lined containment area pending characterization and proper disposal.

3.3.2 *Drill Cuttings*

Drill cuttings will be contained in 55-gallon drums or in a covered roll-off container. The drums or covered roll-off container will be labeled as “pending analysis – investigation-derived residual – soil from drill cuttings”. If drums are used, they will be temporarily stored on wooden pallets in a plastic-lined containment area pending characterization and proper disposal.

3.3.3 *Personal Protective Equipment*

All PPE will be placed in 55-gallon drums, a lined cardboard yard box, or the covered roll-off container for proper disposal.

3.3.4 *Dedicated Sampling Equipment*

All used groundwater sampling equipment (e.g., disposable polyethylene bailer and polypropylene tubing) will be placed in the 55-gallon drums, cardboard yard boxes, or the covered roll-off container for disposal.

4. Subsurface Soil Sampling Procedures

4.1 Introduction

Subsurface investigation activities to be conducted at the site consist of:

- Exploratory test pit excavation
- The advancement of overburden soil borings
- The installation of groundwater monitoring wells

Procedures for these activities are described in the following sections.

4.2 Test Pit Excavation

Six test pits will be excavated using a track excavator or rubber-tired backhoe. The locations of test pits are based on presumed historical locations of MGP site features and existing underground utilities. The number of samples to be collected and the sampling rationale is included in Table 3 of the SC Work Plan. One sample for chemical analysis will be collected from each test pit.

During test pit investigation activities, personnel will stand upwind of the excavation area to the extent possible. Air monitoring and odor mitigation (if necessary) will be performed in accordance with the Community Air Monitoring Plan (CAMP) and HASP. Test pits will be photographed. Excavated soil will be logged using the Unified Soil Classification System (USCS). The observations will be recorded on a test pit log (Figure 1). Material removed from the test pit will be placed on polyethylene sheeting. Should sampling of excavated material be performed, samples will be collected from a remote sampler. Upon completion, the materials from the test pit will be placed back in the excavation in the reverse order in which it was removed. Visually clean soils, such as near-surface soils, will be segregated from soils that may be impacted. The visually clean soils will be used to cover the impacted soils/source materials when placed back in the excavation. At a minimum, the top 2 feet of backfilled soil will be visually clean. Compaction measures will be undertaken as test pits are filled, using the excavator bucket as a tamper. Soil will be replaced in the test pit excavations in 2-foot lifts. After each lift is placed in the excavation, the bucket will be used to compact the soil. This procedure will be repeated until the pit is filled to the ground surface. The test pit will be backfilled as soon as possible after completion and in general prior to the cessation of activities at the end of the day. Following restoration, the test pit will be staked-out and surveyed.

4.4 Soil Borings and Subsurface Soil Sampling

The following methods will be used during installation of the soil borings:

Required Equipment

- Field book
- Project plans
- PPE in accordance with the HASP
- Stakes, flagging and marking paint
- Plastic bags for soil screening samples
- Tape measure
- Decontamination supplies
- Water level indicator
- PID with a 10.2 or 10.6 eV lamp
- Camera
- Clear tape, duct tape
- Laboratory sample bottles
- Coolers and ice
- Shipping supplies

4.4.1 Overburden Drilling and Geologic Logging Methods

- Soil borings will be sampled initially with a direct-push drilling method. It is possible that a 4½-inch inner diameter hollow-stem auger (HSA) method will be utilized for some of the borings if the direct-push tools are refused. The use of these drilling methods allow for a more accurate determination of the depths and thicknesses of geologic units.
- Soil samples will be collected continuously from the ground surface to the bottom of the borings using 4-foot long, 2-inch diameter MacroCore™ samplers or 2-foot long by 2-inch diameter split-spoon samplers.
- Soil samples retrieved from the borehole will be visually described for: 1) percent recovery, 2) soil type, 3) color, 4) moisture content, 5) texture, 6) grain size and shape, 7) consistency, 8) visible evidence of staining or other hydrocarbon-related impacts, and 9) any other relevant observations. The descriptions will be in accordance with the USCS and the American Society for Testing and Materials (ASTM) guidelines as shown in Figure 3.

- Immediately after describing the core, a representative portion of the sample will be placed in a re-sealable plastic (e.g., “ziplock”) bag filled approximately half full. The bag will be labeled with the boring number and interval sampled.
- After allowing the bagged soil to warm, the tip of the sample probe attached to the PID will be inserted into the bag to measure the headspace for organic vapors.
- Soil remaining after completion of sample description, collection, and field screening will be disposed of properly.
- All borings will be sealed with bentonite hole plug or cement/bentonite grout following completion.
- All drilling equipment will be decontaminated between each boring in accordance with methods specified in Section 3.2.
- The drilling rig working platform/surface will be lined with plastic such that soil is contained while performing observations, measurements, and sampling.
- The field geologist will log borehole geology and headspace measurements in the field book and the Drilling Record shown in Figure 2, or similar form and any other observations (e.g., coal tar-impacted soil; coal tar non-aqueous phase liquid (NAPL)-impacted soil, and hydrocarbon odors, staining, or sheen, etc.).

4.4.2 Overburden Soil Sampling

- The number and frequency of samples to be collected from each boring and the associated analytical parameters are summarized in the SC Work Plan.
- Samples for laboratory analyses will be collected directly from the acetate liners or split-spoons and placed into appropriate containers, and compacted to minimize headspace and pore space.
- The sample containers will be labeled, placed in a laboratory-supplied cooler, and packed with ice. The coolers will then be shipped to the laboratory for analysis.
- If there is a delay of sample shipment due to insufficient samples to warrant overnight delivery, the samples will be stored in a cool, secure place with sufficient ice to maintain a temperature of 4° C.
- Chain-of-custody procedures will be followed as outlined in the Quality Assurance Project Plan (QAPP) using the chain-of-custody form as shown in Figure 8.
- The sampling equipment will be decontaminated between samples in accordance with procedures described in Section 3.
- Soil remaining after completion of sample description, collection, and field screening will be disposed of properly.

- The sample locations, descriptions, and depths will be recorded on the borelogs in the field book.

4.4.3 Bedrock Drilling and Logging Method

The SC Work Plan does not specify that any bedrock coring will be performed at the site. If deep coal tar NAPL impacts are identified at the site, then the New York State Department of Environmental Conservation (NYSDEC) may require that bedrock coring be performed as described below. The need for any bedrock coring will be discussed with the NYSDEC as the field work progresses.

- Similar to the overburden soil sampling, soil at the location of each bedrock core location or well will be sampled with the MacroCore™ samplers or split-spoon samplers inside of a larger diameter (8 ¼-inch inner diameter (ID)) HSA auger. The augers will be advanced to the bedrock surface, and the rock surface will be confirmed by attempting to drive a split-spoon sampler or the sonic core barrel sampler. When the core barrel or split-spoon sampler meets with refusal, augers will be used to advance the borehole 2-feet into the bedrock unit (bedrock rock socket).
- A Schedule 40, 4-inch diameter steel isolation casing will then be inserted into the borehole to prevent any potential migration of dense non-aqueous phase liquid (DNAPL) into the bedrock cores or wells from the overburden soils, and to allow water to be circulated for completing the rock coring.
- The isolation casing will be placed inside the augers to the final depth in each borehole (bottom of the rock socket) and the augers will be withdrawn as the casing is grouted in place with a cement/bentonite grout. The grout mix will consist of 94 pounds of Type I Portland cement and 5% (approximately 5 pounds) of granular bentonite. Water (approximately 6-7 gallons) will be added to the grout in a grout mixing tub and pumped into the borehole annulus via a tremie pipe. The grout surrounding the isolation casing will be left to cure for a minimum period of 24 hours prior to completing any additional drilling work.
- After the curing process is complete, a 3 ⅞-inch diameter HQ rock core barrel equipped with a diamond cutting bit will be inserted into the borehole and used to advance the borehole into the bedrock unit.
- The core barrel will be advanced in depth intervals ("runs") of up to 5 feet in length by a drill rod. After each run is complete, the core will be extracted from the borehole via a wire line tool and the core will be placed into a wooden core storage box. The field geologist will then photograph the core, and log the core for: 1) length of rock recovered, 2) the percent of the run recovered, 3) the rock quality designation (RQD), 4) the rock type (USCS), 5) evidence of weathering and the

presence and orientation of fractures and voids, and 6) any visible or olfactory evidence of MGP-related residuals.

- Soil samples retrieved from the borehole will be visually described for: 1) percent recovery, 2) soil type, 3) color, 4) moisture content, 5) texture, 6) grain size and shape, 7) consistency, 8) visible evidence of staining or other hydrocarbon-related impacts, and 9) any other relevant observations. The descriptions will be in accordance with the USCS and the ASTM guidelines (Figure 3).
- All corings not finished as a monitoring well will be sealed with bentonite or cement/bentonite grout following completion.
- All drilling equipment will be decontaminated between each boring in accordance with methods specified in Section 3.2.
- The field geologist will log borehole geology and headspace measurements in the field book and the Drilling Record shown in Figure 2, or similar form and any other observations regarding the presence of MGP-related residuals.

4.4.4 Borehole Abandonment

Boreholes for the direct-push borings will be filled with bentonite chips or bentonite powder. All auger soil borings and bedrock cores not used for the construction of monitoring wells will be filled with bentonite hole plug or grouted to the ground surface following the completion of the soil sampling to prevent cross-contamination of permeable zones. If the grouting method is used, borings will be filled using a cement/bentonite grout mixture with the following specifications:

- Bentonite will be powdered sodium montmorillonite furnished in moisture resistant sacks without additives.
- Cement shall be a low-alkaline Portland cement, Type I in conformance with ASTM C-150 and without additives.
- The cement/bentonite grout mixture shall be to the following proportion:
 - Three sacks (94 pounds) of Type I Portland cement
 - 14 pounds of granular bentonite (5% mix)
 - 25 gallons of water

The cement will be mechanically mixed, above ground, with water from a potable water source. Bentonite will be added to ensure a lump-free consistency. The mixture will be pumped through a tremie pipe as the drill is being withdrawn.

4.5 Monitoring Well Installation and Development

The following methods will be used for drilling, installing, and developing the monitoring wells:

Required Equipment

- Field book
- Project plans
- PPE in accordance with the HASP
- Plastic bags for soil screening samples
- Tape measure
- Decontamination supplies
- Electronic oil/water interface probe
- PID
- Camera
- Clear tape, duct tape
- Aluminum foil
- Laboratory sample bottles
- Coolers and ice
- Shipping supplies
- Clear polyethylene disposable bailers (NAPL confirmation)
- Polyethylene disposable bailers (development)
- Polypropylene rope (development)
- Waterra™ pump or other purge pump (development)
- Submersible electric pump (development)
- Stainless steel or glass beakers (development)
- Turbidity meter (development)
- Temperature, conductivity, pH meter (development)

4.5.1 Overburden Monitoring Well Installation

Figure 4 illustrates the construction details for a typical overburden monitoring well. The monitoring wells will be installed according to the following specifications:

- The monitoring well borings will be advanced with 4 ¼-inch ID HSAs, or with the roto-sonic dual-core samplers.
- Wells will be constructed with 2-inch ID, threaded, flush-joint, polyvinyl chloride (PVC) casings and screens.
- Screens will be 10-feet long with 0.02-inch slot openings and will be equipped with a 2-foot long DNAPL sump at the base. Alternative screen lengths up to 20 feet long may be used at the discretion of the field geologist and with the approval of BEGWS and NYSDEC, based on site conditions. It is the intent of the Work Plan to have well screens straddle the water table, or across any NAPL-impacted zones identified.
- If deep zone wells are required, the augers will be used to make a 2-foot deep rock socket in the bedrock unit. The 2-foot long DNAPL sump will be housed in the bedrock unit and the bottom of the monitoring well screen will be equal to the top of the bedrock unit. Locating the screen at this interval will provide information regarding the presence of DNAPL at the soil and bedrock interface. The sump will be positioned to collect DNAPL at this zone, if present.
- The annulus around the 2-foot long DNAPL sump will be filled with bentonite chips. The bentonite chips will not be placed higher than the top of the sump, so that the well screen will not be blocked.
- The annulus around the screens will be backfilled with clean silica sand having appropriate size (e.g., Morie No. 0) to a minimum height of 2 feet above the top of the screen. Auger flights will be withdrawn as sand is poured in a manner that will minimize hole collapse and bridging.
- A bentonite chip seal with a minimum thickness of 2 feet will be placed above the sand pack. The bentonite seal will be hydrated with clean, potable water before placement of grout above the seal layer.
- The remainder of the annular space will be filled with cement-bentonite grout to ground surface. The grout will be allowed to set for a minimum of 24 hours before wells are developed.
- Each monitoring well will be a flush-mounted installation with a locking cap.
- The concrete seal or pad will be sloped to channel water away from the well, and be deep enough to remain stable during freezing and thawing of the ground.
- The top of the PVC well casing and ground surface will be marked and surveyed to 0.01 foot, and the elevation will be determined relative to a fixed benchmark or datum.
- The measuring point on all wells will be on the innermost PVC casing.

- Monitoring well construction details will be recorded in the field book and on the Construction Log shown in Figure 5.

4.5.2 Bedrock Monitoring Well Installation

Bedrock wells are not proposed for the SC. The methods are included, should the investigation need to assess deeper MGP impacts. Figure 6 illustrates the construction details for a typical bedrock monitoring well. The monitoring wells will be installed according to the following specifications:

- The HSA augers or sonic core barrel will be advanced to the bedrock surface, and the rock surface will be confirmed by attempting to drive a split-spoon sampler or the core barrel. When the barrel or split spoon sampler meets with refusal, the augers or sonic drive head will be used to advance the borehole 2 feet into the bedrock unit (bedrock rock socket).
- A Schedule 40, 4-inch diameter steel isolation casing will then be inserted into the borehole to prevent any potential migration of DNAPL into the bedrock wells from the overburden soils and to allow water to be circulated for completing the rock coring.
- The isolation casing will be placed inside the augers to the final depth in each borehole and the augers will be withdrawn as the casing is grouted in place with a cement/bentonite grout. The grout mix will consist of 94 pounds of Type I Portland cement and 5% (approximately 5 pounds) of granular bentonite. Water (approximately 6-7 gallons) will be added to the grout in a grout-mixing tub and pumped into the borehole annulus via a tremie pipe. The grout surrounding the isolation casing will be left to cure for a minimum period of 24 hours prior to completing any additional drilling work.
- After the curing process is complete, a 3 7/8-inch diameter HQ rock core barrel equipped with a diamond cutting bit will be inserted into the borehole and used to advance the borehole into the bedrock unit.
- When the borehole is advanced to the total depth, the core tools will be removed from the borehole. PVC well materials will be inserted into the borehole to secure the longevity of the well in the event of borehole collapse.
- A 2-inch diameter, 20-slot (0.02 inch) screen will also be used for this application. Screen lengths will be 10-foot long unless modified by GEI and the NYSDEC in the field.
- A DNAPL sump will be included to the bottom of the well screen. Similar to the overburden wells, the borehole annulus surrounding the sump will be filled with

bentonite chips to ensure that DNAPL, if present in the zone of interest, is collected in the sump.

- The wells will then be constructed inside the bedrock unit and the steel isolation casing using the procedures specified for the overburden wells above.
- Each monitoring well will be a flush-mounted installation with a locking cap.
- The concrete seal or pad will be sloped to channel water away from the well, and be deep enough to remain stable during freezing and thawing of the ground.
- The top of the PVC well casing and ground surface will be marked and surveyed to 0.01 foot, and the elevation will be determined relative to a fixed benchmark or datum.
- The measuring point on all wells will be on the innermost PVC casing.
- Monitoring well construction details will be recorded in the field book and on the Construction Log shown in Figure 6, or similar form.

4.5.3 Monitoring Well Development

- After a minimum of 24 hours after installation, the monitoring wells will be developed by surging and pumping. The information generated during development will be recorded on the Monitoring Well Development Log (Figure 7, also used for groundwater sampling). Surging will be performed periodically, across the lengths of screen in 2-foot increments prior to, at interim periods of pumping, and immediately before the final pumping. Pumping methods may include using a centrifugal, submersible, or peristaltic pump and dedicated polyethylene tubing, using a Waterra™ positive displacement pump and dedicated polyethylene tubing, or other methods at the discretion of the field geologist.
- Water levels will be measured in each well to the nearest 0.01 foot prior to development.
- The wells will be developed until the water in the well is reasonably free of visible sediment (50 nephelometric turbidity unit (NTU) if possible) or until pH, temperature, and specific conductivity stabilize. A portable nephelometer will be used to make the turbidity measurement.
- Development water will be contained in and properly disposed of.
- Following development, wells will be allowed to recover for at least 14 days before groundwater is purged and sampled. All monitoring well development will be performed or overseen by a field geologist and recorded in the field book.

4.5.4 Non-Aqueous Phase Liquid (NAPL) Gauging

Two weeks or more after well development and prior to the collection of the groundwater samples from the temporary or permanent monitoring wells, the wells will be checked for the presence of light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL). To check for LNAPL a clear bailer will be used to obtain a sample at the elevation of the water table. The bailer will be retrieved and observed for evidence of LNAPL. If LNAPL is observed, an oil-water interface probe will be used to measure the thickness of the LNAPL layer. The wells will also be checked for the presence of DNAPL layers. A weighted cotton string will be lowered to the bottom of each well. The string will then be retrieved and observed for the presence of DNAPL-stained intervals at the bottom of the string. DNAPL layers may also be checked with the oil-water interface probe if possible.

5. Groundwater Sampling Procedures

5.1 Introduction

Procedures for obtaining samples of groundwater are described in this section. Groundwater samples will be collected using low-flow, low-stress purge and sampling methods.

5.2 Groundwater Sampling

The number and frequency of the samples that will be collected for laboratory analysis from each well and the analytical parameters are listed in Table 7 of the SC Work Plan.

The following method will be used to collect groundwater samples from monitoring wells:

Required Equipment and Supplies

- Field book
- Project plans
- PPE in accordance with the HASP
- Electronic oil/water interface probe
- Disposable polyethylene bailers and low-flow sampling pump
- Polypropylene rope
- Temperature, conductivity, and pH meter
- Turbidity meter
- Flow-through cell
- Decontamination supplies
- Peristaltic or submersible pump capable of achieving low-flow rates (i.e., 0.5 liters per minute or less)
- Plastic tubing
- Plastic sheeting
- PID
- Clear tape, duct tape
- Coolers and ice
- Laboratory sample bottles

- Federal Express or UPS labels

5.2.1 Groundwater Sampling Method

Purging

- Prior to sampling, the static water level and thickness of any LNAPL or DNAPL will be measured to the nearest 0.01 foot from the surveyed well elevation mark on the top of the PVC casing with a decontaminated oil/water interface probe. NAPL presence will be determined using a clear bailer or a weighted string. The measurements will be recorded in the field book.
- The probe will be decontaminated between uses.
- Groundwater from the well will be purged until field parameters stabilize. Field parameters are considered stable when three consecutive readings are within the stabilization criteria for that parameter. The stabilization criteria are as follows: 3% for conductivity and temperature, and 0.1 unit for pH. The target turbidity values will be <10 NTUs, if possible.
- The flow rate measurement will be approximately 0.5 liter per minute or less.
- If the parameters do not stabilize, then the next step for the sampling will be to remove up to three well volumes, or to purge wells for at least 1 hour prior to sampling.
- If a well goes dry before the required volumes are removed, it will be allowed to recover, and sampled when it recovers sufficiently.
- Purge water will be managed and disposed of properly.

Sampling

- Samples will be collected using dedicated ¼- or ⅜-inch polyethylene tubing.
- Prior to filling the sample bottles, the final temperature, pH, and conductivity will be measured within a flow-through cell. Turbidity will be measured with a hand-held turbidity meter. All measurements will be recorded in the field book.
- Three 40-ml VOA vials with Teflon™ lined septa and hydrochloric acid as a preservative will be filled for analysis of volatile organic compounds (VOCs). The VOA vials will be filled to ensure that no bubbles are in the sample. Two 1-liter amber glass sample bottles for semi-volatile organic compound (SVOC) analysis and two 1-liter amber glass bottles for polychlorinated biphenyl (PCB) analysis (if required) will then be filled followed by a 500 milliliter (mL) plastic bottle preserved with nitric acid for the total metals analysis. An opaque, 250 mL plastic bottle, with

sodium hydroxide added for preservative will then be filled for the analysis of cyanide.

- The sample containers will be labeled, placed in a laboratory-supplied cooler, and packed on ice (to maintain a temperature of 4° C). The cooler will be shipped overnight or delivered to the laboratory for analysis.
- Chain-of-custody procedures will be followed as outlined in the QAPP using the chain-of-custody form shown in Figure 8.
- Well sampling data will be recorded on the Groundwater Sampling Record shown in Figure 7, or similar form.

6. Air Monitoring

6.1 Introduction

Two types of air monitoring will be performed during the site investigation: 1) work zone monitoring for protection of the workers performing the site investigation, and 2) community air monitoring at the perimeter of the work site for protection of the local community.

6.2 Breathing Zone Air Monitoring During Drilling and Sampling

Monitoring of air in the breathing zone within the work site will be conducted periodically during all drilling and sampling activities.

- A PID will be used to monitor for VOCs or other organic vapors in the breathing zone and borehole, and to screen the samples.
- Additional air monitoring may be required as specified in the site-specific HASP.
- The PID readings will be recorded in the field book and on the boring log during drilling activities. The procedure for the PID operation and calibration is included in the HASP. Note that equipment calibration will be performed as often as needed to account for changing conditions or instrument readings. The minimum frequency of calibration is specified in the HASP; more frequent calibration will be performed if spurious readings are observed or there are other problems with the instruments.

6.3 Community Air Monitoring

Community air monitoring requires real-time monitoring for VOCs, particulates (i.e., dust), and MGP-related odors at the downwind perimeter of each designated work area when certain activities are in progress at impacted sites. The community air monitoring is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., any and all off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels for community air monitoring require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, community air monitoring helps to confirm that work activities do not spread contamination off site through the air.

The procedures and action levels for community air monitoring are presented in the CAMP that has been prepared for the SC at the Bath Former MGP site.

7. Field Instruments and Calibration

All field analytical equipment will be calibrated immediately prior to each day's use and more frequently if required. The calibration procedures will conform to manufacturer's standard instructions. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. All instrument calibrations will be documented in the project field book and in an instrument calibration log. Records of all instrument calibration will be maintained by the Field Team Leader. Copies of all of the instrument manuals will be maintained on site by the Field Team Leader. All changes to instrumentation will be noted in the field log book.

The following field instruments will be used during the investigation:

- PID
- Particulate monitors

7.1 Portable Photoionization Analyzer

- The photoionization analyzer will be equipped with either a 10.2 or a 10.6 eV lamp. The PID is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73% of the VOCs on the U.S. Environmental Protection Agency (EPA) Target Compound List (TCL).
- Calibration must be performed at the beginning of each day of use with a standard calibration gas having a concentration of 100 parts per million of isobutylene. If the unit experiences abnormal perturbation or erratic readings, more frequent or additional calibration will be required.
- All calibration data must be recorded in the project field notebooks.
- A battery check must be completed at the beginning and end of each working day.
- All changes to the PID will be noted in the field notes (such as lamp or filter cleaning or replacement or change of instrument).

7.2 Particulate Monitor

MIE pDR 1200 with cyclone and pump, or similar, will be used and calibrated according to the manufacturer's specifications.

7.3 pH Meter

- Calibration of the pH meter must be performed at the start of each day of use, and after very high or low readings as required by this Plan, according to manufacturer's instructions.
- National Institute of Standards and Technology - traceable standard buffer solutions which bracket the expected pH range will be used. The standards will be pH of 4.0, 7.0, and 10.0 standard units.
- The use of the pH calibration must be used to set the meter to display the value of the standard being checked.
- The calibration data must be recorded in the project field book.

7.4 Specific Conductivity Meter and Temperature Probe

- Calibration checks using the conductivity standard must be performed at the start of each day of use, after five to 10 readings or after very high or low readings as required by this Plan, according to manufacturer's instructions.
- The portable conductivity meter must be calibrated using a reference solution of 200 $\mu\text{ohms/cm}$ (or the manufacturer's specified concentration) on a daily basis. The date and lot number of the reference solution must be recorded. Readings must be within 5% to be acceptable.
- The thermometer of the meter must be calibrated against the field thermometer on a weekly basis.

7.5 Turbidity Meter

- The turbidity meter must be checked at the start of each day of use according to manufacturer's instructions.

8. Analytical Program

8.1 Environmental Sample Analyses

The laboratory samples for each media and the chemical analyses to be performed, including the quality assurance/quality control (QA/QC) samples, are summarized in the SC Work Plan.

8.1.1 Subsurface Soil Analyses

The subsurface soil samples will be analyzed for the following parameters:

- TCL VOCs by EPA Method 5035
- TCL SVOCs by EPA Method 8270D
- Total polychlorinated biphenyls (PCBs) by EPA Method 8082
- Target analyte list (TAL) Metals by EPA Method 6000/7000 series
- Total Cyanide EPA Method 9010

8.1.2 Groundwater Analyses

The groundwater samples will be analyzed for the following parameters:

- TCL VOCs by EPA Method 8260C
- TCL SVOCs by EPA Method 8270D
- Total polychlorinated biphenyls (PCBs) by EPA Method 8082
- TAL Metals by EPA Method 6000/7000 series
- Total Cyanide EPA Method 9010

8.1.3 Waste Profiling

One soil sample and one wastewater sample will be collected during the investigation and analyzed for waste characterization testing. The samples will be composited from the investigation-derived waste. The testing will include the following analyses:

- Total VOC EPA Method 5035
- Total SVOC EPA Method 8270D

- Total Metals [arsenic, barium, cadmium, chromium (total), lead, mercury, selenium, silver, antimony, beryllium, nickel, thallium, vanadium, and zinc] EPA Method 6010B (Mercury 7470A)
- Total PCBs EPA Method 8082
- Total Cyanide EPA Method 9010
- Percent Sulfur ASTM D129-64
- BTU content ASTM D240-87

8.1.4 Forensic Analysis

Samples may be analyzed for forensic purposes to evaluate potential source areas at the site. The analyses may be performed using multiple chemical fingerprinting methods as summarized below. If forensic analyses are needed for this project, the final scope of the sampling and analyses will be determined in consultation with the NYSDEC.

- **High Resolution Hydrocarbon Fingerprinting and Total Petroleum Hydrocarbons (TPH):** A modified EPA Method 8015B will be used to provide a detailed fingerprint of the hydrocarbons and quantitative measurement of TPHs present in each sample.
- **PAH Quantification and Fingerprinting:** A modified EPA Method 8270C will be used to determine the concentrations of 51 semi-volatile compounds representing several groups including: EPA 16 Priority Pollutant Polycyclic Aromatic Hydrocarbons (PAHs), alkylated PAHs, and sulfur-containing aromatics.
- **Quantitative Biomarker Fingerprinting:** A modified EPA Method 8270C will be used to determine the distributions of numerous biomarker groups.
- **Quantitative Metals and Sulfur:** EPA Method 6010B and ASTM Method D-3120 will be used to determine the concentrations of metals and sulfur, respectively, in NAPL samples.

8.2 Field Quality Control Samples

Field quality control samples will be collected and analyzed to document the accuracy and precision of the samples. The quality control samples are described as follows:

- **Trip Blank:** One trip blank will accompany each shipment of samples for VOC analysis sent to the laboratory. The trip blank will be analyzed to test for any contaminants introduced while samples are being stored or transported to the laboratory. The trip blanks will be analyzed for volatiles only.

- **Field Equipment Blanks:** The purpose of the equipment blank is to detect any contamination from sampling equipment, cross-contamination from previously sampled locations, and contamination caused by conditions at sampling locations (e.g., airborne contaminants). One equipment blank will be collected for every 20 samples collected during sampling. The samples will be collected by pouring analyte-free water, prepared in the laboratory, over decontaminated sampling equipment and collecting it in sample jars. The blanks will be collected in the vicinity of a sample location. This field blank will be analyzed for VOCs and SVOCs. An equipment blank will not be collected if sampling is conducted with dedicated sampling equipment.
- **Field Duplicates:** Field duplicates are collected to determine the precision of the soil samples collected. This is achieved by compositing soil and splitting it evenly between separate sample jars. Duplicate samples will be collected and analyzed for VOCs and SVOCs. The minimum required number of field duplicates is one for every 20 samples.
- **Matrix Spikes (MS), and Matrix Spike Duplicates (MSD):** These samples are laboratory quality control samples and will be completed as part of the laboratory analytical batch quality control. These samples will be collected in the same manner as the field duplicates and at a frequency of one MS/MSD sample per 20 field samples. Both the MS and MSD will be collected at the same sample location.

8.3 Sample Location Numbering System

Subsurface soil borings will be numbered consecutively beginning with SB-01. Monitoring wells will be numbered consecutively beginning with MW-01. Test pits will follow the same convention beginning with TP-01. Individual samples will also be designated with a depth code (see below).

8.4 Sample Identification

Each sample will be given a unique alphanumeric identifier in accordance with the following classification system:

SAMPLE IDENTIFICATION			
LL*	NN*	N-N	LL
Sample Type	Sample Number	Depth Code	QC Identifier
	<u>Solid</u>		<u>Water</u>
Sample Type:	MW – Monitoring Well Boring		MW – Monitoring Well
	SB – Soil Boring		
	BSS – Background Surface Sediment		
	SD – Surface Sediment (0-6 inches)		

	SDC – Deeper Sediment (>6 inches)	
Sample Number:	Number referenced to a sample location map.	
Depth Code:	Depth in feet of sample interval (0-0.5, 2-4, 10-12, etc.)	
QC Identifier:	TB – Trip Blank	MS – Matrix Spike
	EB – Equipment Blank	MSD–Matrix Spike Duplicate
		MB – Matrix Blank

* L = Letter

* N = Number

Field duplicate samples will be assigned identifiers that do not allow the laboratory to distinguish them as field duplicates. Each sample container will be labeled prior to packing for shipment. The sample identifier, site name, date and time of sampling, and analytical parameters will be written on the label in waterproof ink and recorded in the field book. The sample container will be labeled with the proper sample identifier as soon as the sample is taken to avoid confusion about the sample location/identifier.

8.5 Chain-of-Custody

- A chain-of-custody record (Figure 8 or similar) will accompany the sample containers during selection and preparation at the laboratory, during shipment to the field, and during return shipment to the laboratory.
- The chain-of-custody will include the sample identities of each sample container and the analytical parameters for each, and will list the field personnel that collected the samples, preservation method, the project name and number, the name of the analytical laboratory that will receive the samples, and the method of sample shipment.
- If samples are split and sent to different laboratories, such as to a specialty laboratory for fingerprint analysis, a copy of the chain-of-custody record will be sent with each sample shipment.
- The chain-of-custody will be completed by field personnel as samples are collected and packed for shipment.
- Erroneous markings will be crossed-out with a single line and initialed by the author.
- The REMARKS space will be used to indicate if the sample is an MS, MSD, or matrix duplicate.
- Trip and field blanks will be listed on separate rows.
- After the samples have been collected and sample information has been listed on the chain-of-custody form, the method of shipment, the shipping cooler identification number(s), and the shipper air bill number will be entered on the chain-of-custody.

- Finally, a member of the sampling team will write his/her signature, the date, and time on the first RELINQUISHED BY space.
- One copy of the chain-of-custody will be retained by sampling personnel. The other copy and the original will be sealed in a plastic bag and taped inside the lid of the shipping cooler.
- Sample shipments will be refrigerated at 4°C, typically by packing with bagged ice, to preserve the samples during shipment.
- After the shipping cooler is closed, custody seals provided by the laboratory will be affixed to the latch and across the front and back of the cooler lid, and signed by the person relinquishing the samples to the shipper.
- The seal will be covered with clear tape, and the cooler lid will be secured by wrapping with packing tape.
- The cooler will be relinquished to the shipper, typically an overnight carrier.
- The chain-of-custody seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the samples will not be analyzed until directed to do so.
- The samples must be delivered to the laboratory within 48 hours of collection.

8.6 Sample Documentation

The field team leader will retain a copy of the chain-of-custody, and, in addition, the field team leader will ensure that the following information about each sample is recorded in the field book:

- Sample identifier
- Identification of sampled media (e.g., soil, sediment, groundwater)
- Sample location with respect to known reference point
- Physical description of sample location
- Field measurements, (e.g., pH, temperature, conductivity, and water levels)
- Date and time of collection
- Sample collection method
- Volume of groundwater purged before sampling
- Number of sample containers
- Analytical parameters

- Preservatives used
- Shipping information:
 - Dates and method of sample shipments
 - Chain-of-custody Record numbers
 - Federal Express Air Bill numbers
 - Sample recipient (e.g., laboratory name)

Figures



Test Pit Log

TP

GEI PROJECT NO:				TEST PIT DESIGNATION:		SURFACE ELEVATION END NAVD88:	
CLIENT:				SITE LOCATION OR AREA:		SURFACE ELEVATION CENTER NAVD88:	
SITE NAME: MGP				EQUIPMENT USED:		SURFACE ELEVATION END NAVD88:	
GEOLOGIST:				EARTHWORK SUBCONTRACTOR:		NORTHING NAD83:	
DEPTH WATER ENCOUNTERED:				OPERATOR:		EASTING NAD83:	
START DATE:				START TIME:		LATITUDE:	
FINISH DATE:				FINISH TIME:		LONGITUDE:	
DEPTH (FEET)	PID HEADSPACE (PEM)	LABORATORY SAMPLE (FEET)	VISUAL OBSERVATIONS	SOIL LITHOLOGY USCS	SOIL DESCRIPTION LOG	STRUCTURES ENCOUNTERED OR COMMENTS	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14					BOTTOM OF TEST PIT EXCAVATION		
Comments: TEST PIT LENGTH:						GEI Consultants, Inc., P.C. 1301 Trumansburg Road Suite N Ithaca, New York 14850	
TEST PIT WIDTH:							
TEST PIT BACKFILL:							
LABORATORY ANALYSES: VOCs, SVOCs, TAL Metals, Total Cyanide							

Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York



Project 1804919

TEST PIT FORM
1 OF 1

May 2021

Fig. 1a



Test Pit Plan View and Photographs

TP

IMPORT PLAN VIEW FROM CAD BASEMAP

IMPORT PHOTOGRAPHIC TEMPLATE WITH TEST PIT PHOTO(S)

Comments:

	Hydrocarbon Stain, Sheen, or NAPL Blobs
	Coal Tar or Coal Tar NAPL Coated or Saturated Soil

GEI Consultants, Inc., P.C.
1301 Trumansburg Road
Suite N
Ithaca New York 14850

Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York



Project 1804919

TEST PIT FORM
2 OF 2

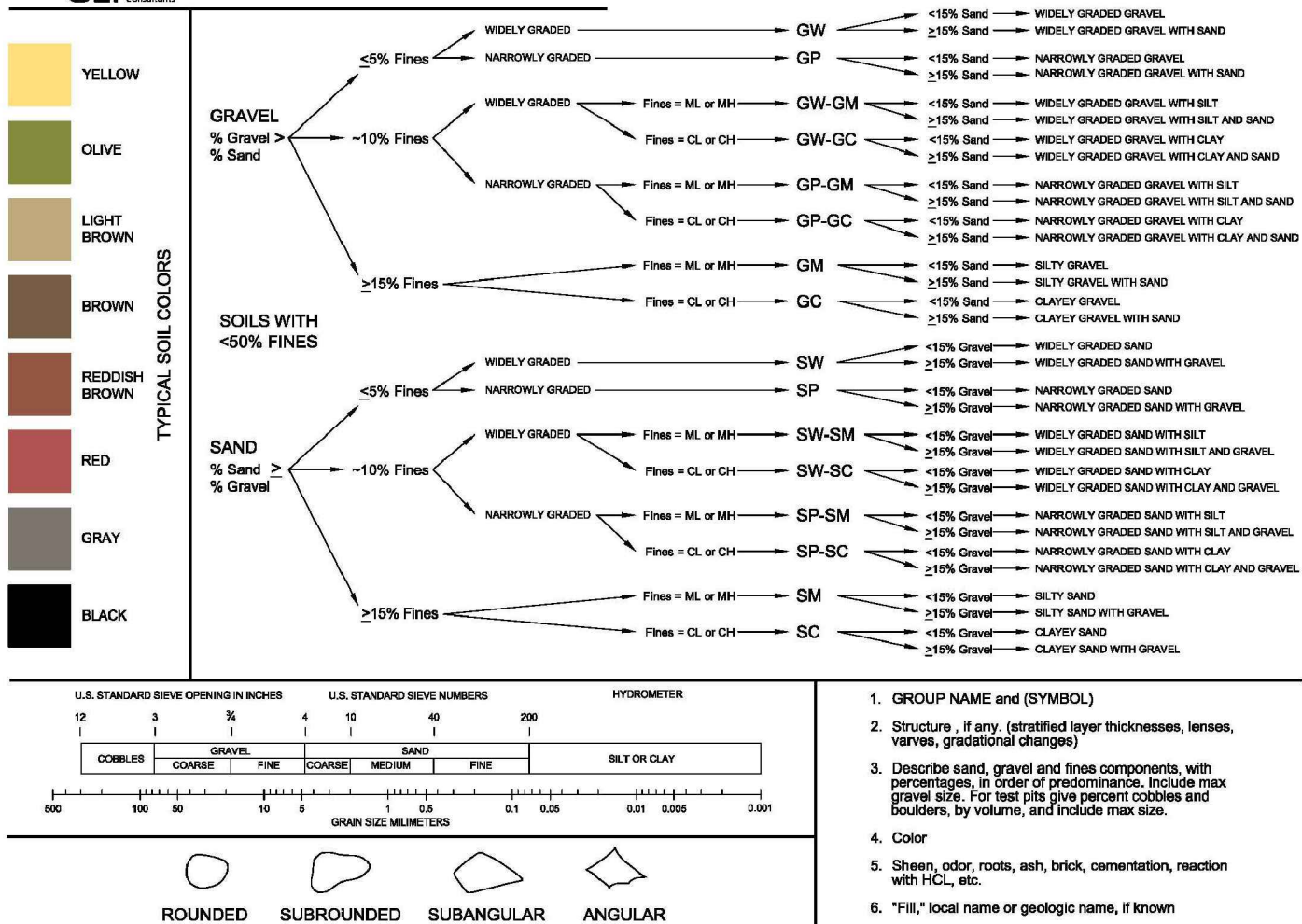
May 2021

Fig. 1b

Field Sampling Analytical Plan Bath Former MGP Site Bath, New York	 GEI Consultants	DRILLING RECORD	
Bath Electric, Gas and Water Systems Bath, New York		Project 1804919	May 2021



COARSE-GRAINED SOILS VISUAL-MANUAL DESCRIPTIONS



Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York

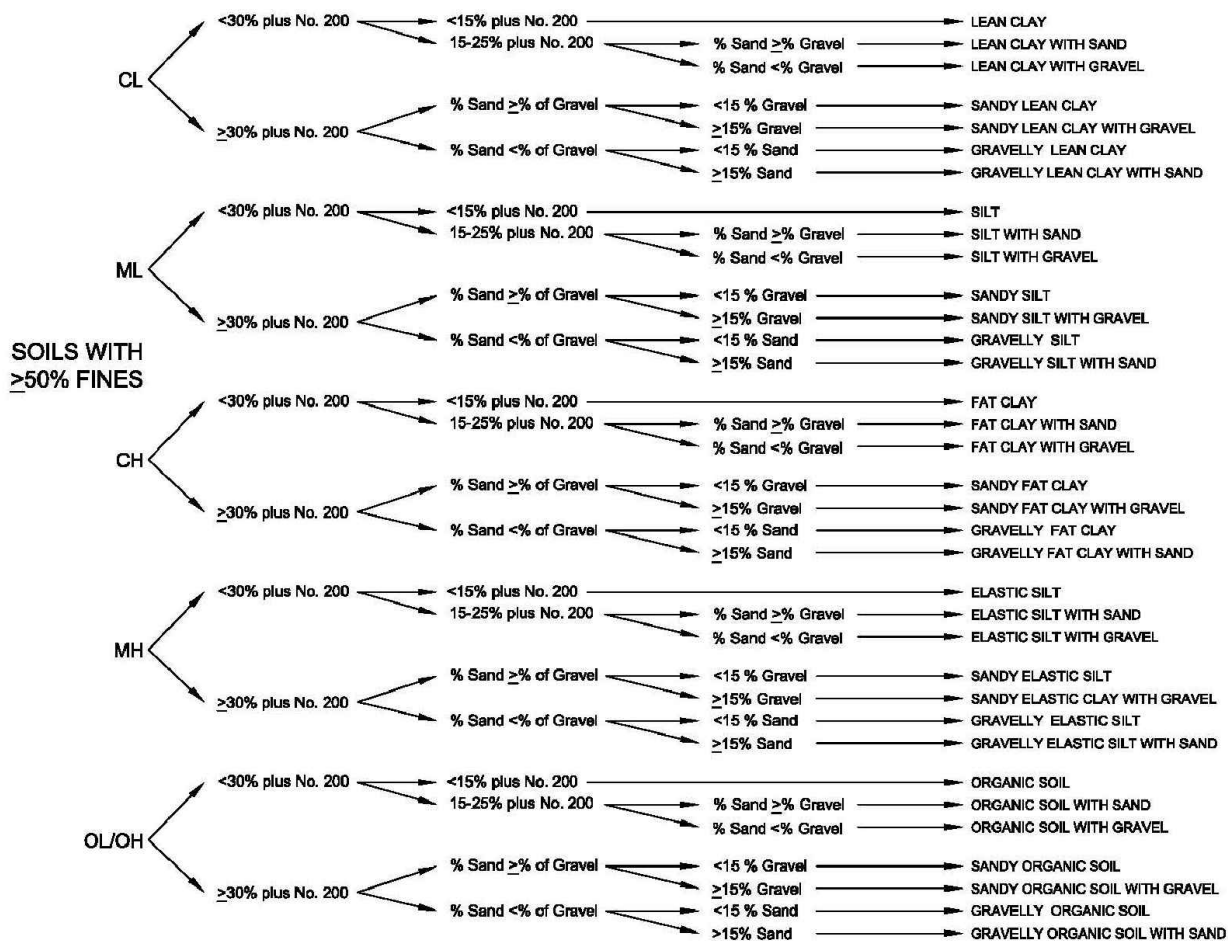


Project 1804919

SOIL DESCRIPTIONS
1 OF 4

May 2021

Fig. 3a



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

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

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

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 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.

Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York

Field Sampling Analytical Plan Bath Former MGP Site Bath, New York	 GEI Consultants	SOIL DESCRIPTIONS 3 OF 4	
Bath Electric, Gas and Water Systems Bath, New York		Project 1804919	May 2021

EXAMPLE SOIL DESCRIPTIONS

SANDY SILT (ML) ~60% slightly plastic fines, ~40% mostly fine sand, 1" thick layer of fine to medium sand with <20% fines, gray.

LEAN CLAY (CL) ~90% moderately plastic fines, ~10% fine sand, olive. Boston Blue Clay. $S_v = 0.5, 0.5, 0.8$ tsf, $Q_p = 1.0, 1.5, 1.6$ tsf

Stratified CLAYEY SAND (SC) and WIDELY GRADED SAND (SW) SC layers 1 to 2 inches thick consist of fine sand with ~30% moderately plastic fines, gray. SW layers 1 to 4 inches thick consist of fine to coarse sand, ~10% gravel to 1/2 inch, <5% fines, brown. Hydraulic Fill.

EXAMPLE ROCK DESCRIPTIONS

(0-9"): **GRANITE**, hard, one piece, joint surface slightly weathered, pink.

(6-60"): **PHYLLITE**, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

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

GEOPROBE AND ROTOSONIC

When SPTs are not performed, 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 O.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 on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs** - Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("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.

Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York



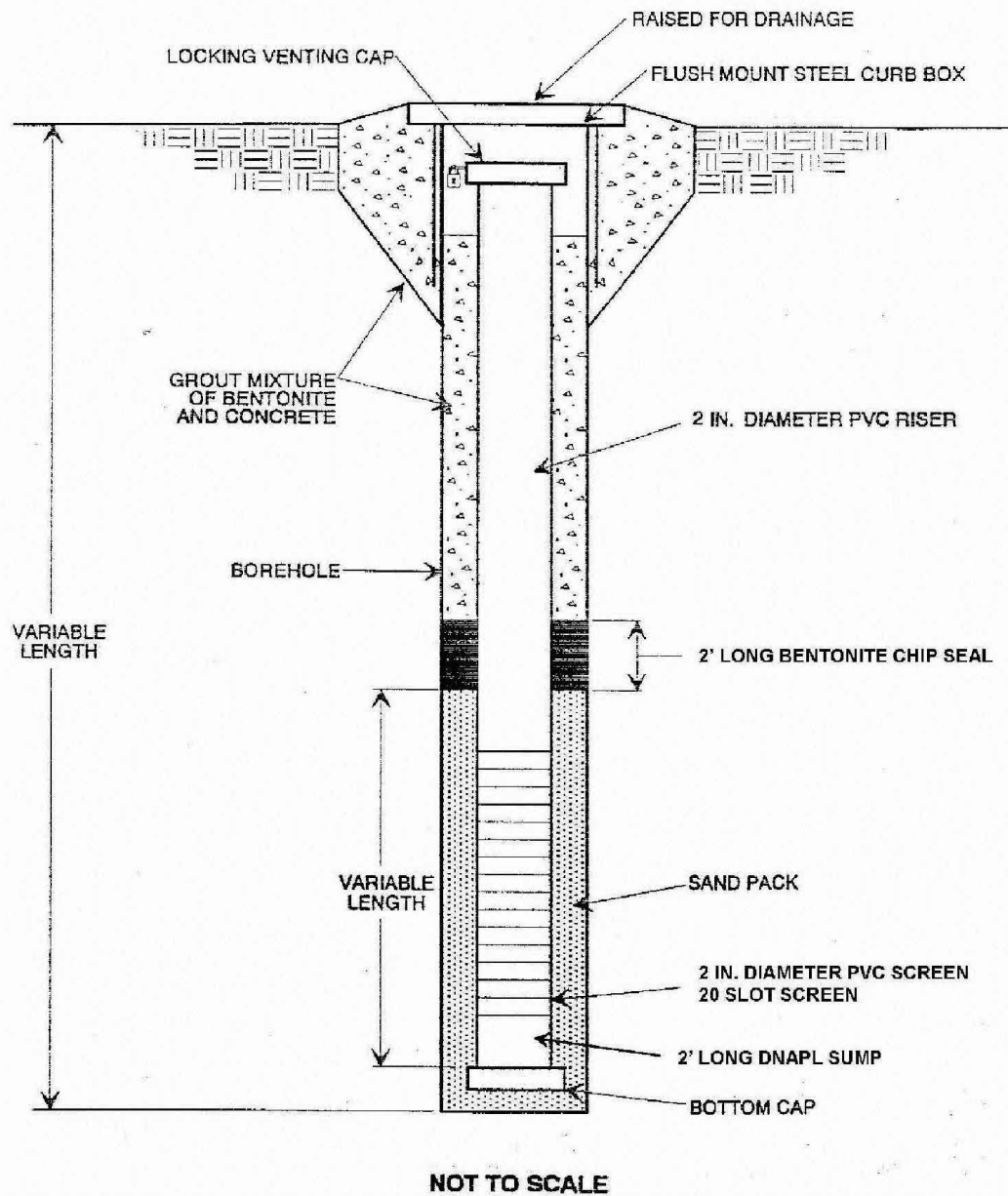
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SOIL DESCRIPTIONS
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Fig. 3d

TYPICAL MONITORING WELL CROSS SECTION



Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York



Project 1804919

MONITORING WELL
CROSS SECTION

May 2021

Fig. 4

Groundwater Well Installation Log		Well ID	
Project		GEI Proj. No.	
City / Town		Location	
Client			N
Contractor			E
Driller	GEI Rep.	Install Date	
Survey Datum: _____ Ground Elevation: _____			
General Soil Conditions (Not to Scale)		Length of Surface Casing above Ground _____ Dist. Top of Surf. Casing to Top of Riser Pipe _____ Type and Thickness of Seal around Surface Casing _____ ID of Surface Casing _____ Type of Surface Casing _____ Depth Bottom of Surface Casing _____ ID and OD of Riser Pipe _____ Type of Riser Pipe _____ Type of Backfill around Riser Pipe _____ Diameter of Borehole _____ Depth Top of Seal _____ Type of Seal _____ Depth Bottom of Seal _____ Depth Top of Screened Section _____ Type of Screen _____ Description of Screen Openings _____ ID and OD of Screened Section _____ Type of Filter Material _____ Depth Bottom of Screened Section _____ Depth Bottom of Silt Trap _____ Depth Bottom of Filter Material _____ Depth Top of Seal _____ Type of Seal _____ Depth Bottom of Seal _____ Type of Backfill below Filter Material _____ Bottom of Borehole _____	
		depth _____	
		Fill	
		depth _____	
		Sand	
		depth _____	
		Till	
		Notes:	
		Date Time Distance to ▼ below top of riser pipe	

Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York

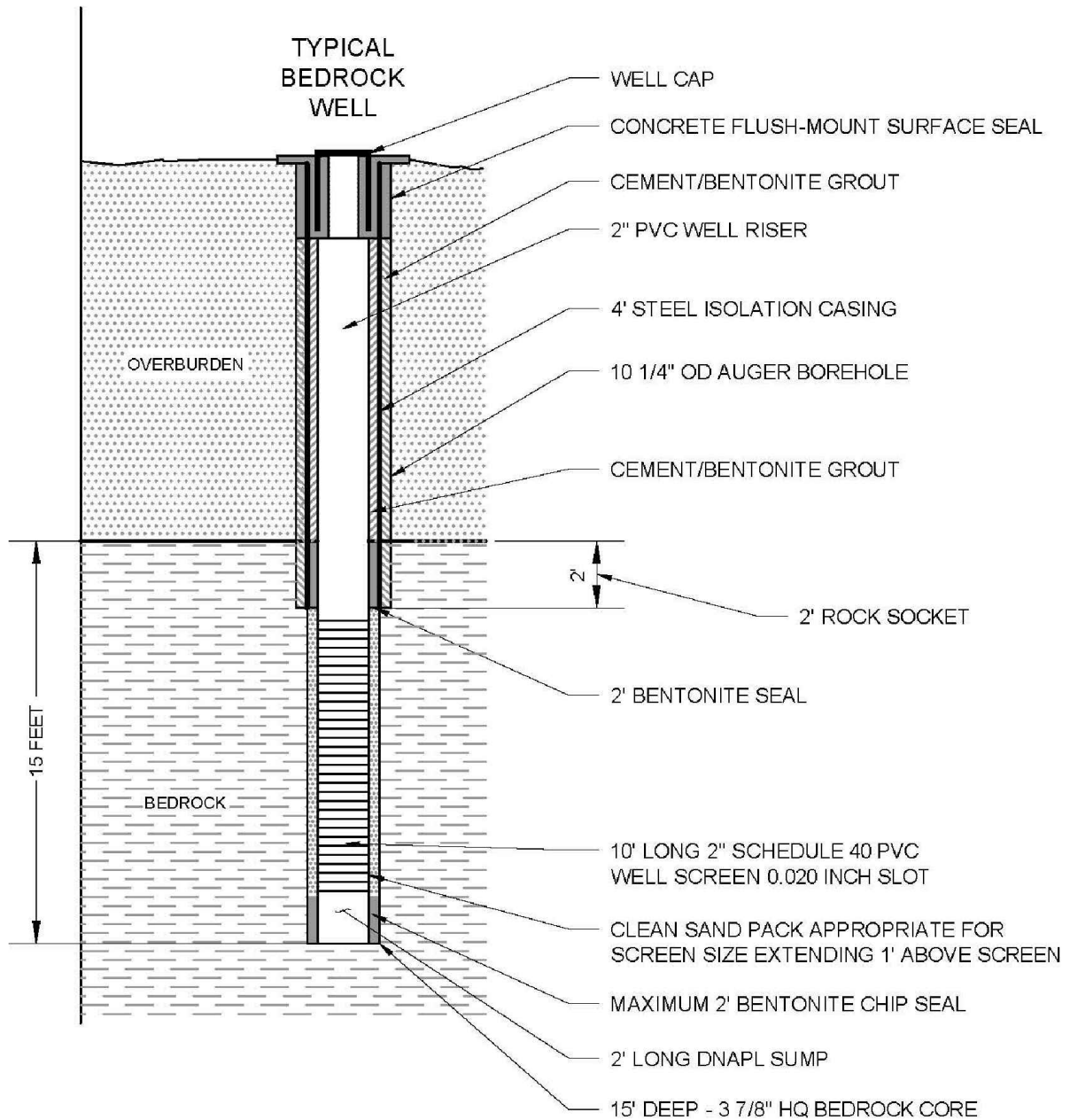


Project 1804919

GROUNDWATER WELL
INSTALLATION LOG

May 2021

Fig. 5



Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York



Project 1804919

TYPICAL BEDROCK WELL
INSTALLATION

May 2021

Fig. 6



MONITORING WELL SAMPLING RECORD

PID Reading _____

Job Number _____

Location _____

Well Number _____

Job Name _____

By _____ Date _____

Measurement Datum _____

Pre-Development Information

Water Level _____

One Purge Vol _____

Time (start) _____

Total Depth of Well _____

Three Well Volume _____

Water Characteristics

Color _____ Clear _____ Cloudy _____

Odor _____ None _____ Weak _____ Moderate _____ Strong _____

Any films or immiscible material _____

Volume (gal)	Time	pH	Temp (°C)	Spec. Conductance (µS/cm)	Turbidity (NTU)	DO Conc. (mg/L)	ORP (mV)	TDS

Total Volume Removed (gal) _____ pH _____

Temperature (°C) _____ Specific Conductance (µS/cm) _____

DO Concentration (mg/L) _____ ORP (mV) _____

TDS _____

Post Development Information

Time (Finished) _____

Water Level _____ Total Depth of Well _____

Approximate Volume Removed (gal) _____

Water Characteristics

Color _____ Clear _____ Cloudy _____

Odor _____ None _____ Weak _____ Moderate _____ Strong _____

Any films or immiscible material _____

Comments _____

Field Sampling Analytical Plan
Bath Former MGP Site
Bath, New York

Bath Electric, Gas and Water Systems
Bath, New York



Project 1804919

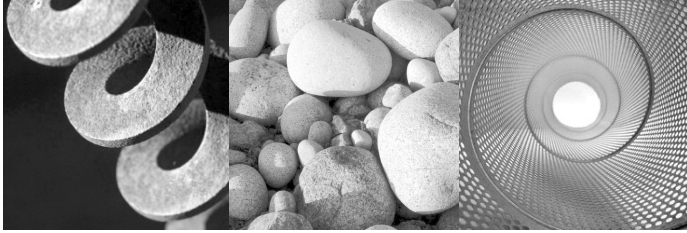
MONITORING WELL
SAMPLING RECORD

May 2021

Fig. 7

Appendix F

Quality Assurance Project Plan



Consulting
Engineers and
Scientists

Appendix F

Quality Assurance Project Plan

Bath Former MGP Site

Bath, New York

NYSDEC Site # 851036

Submitted to:

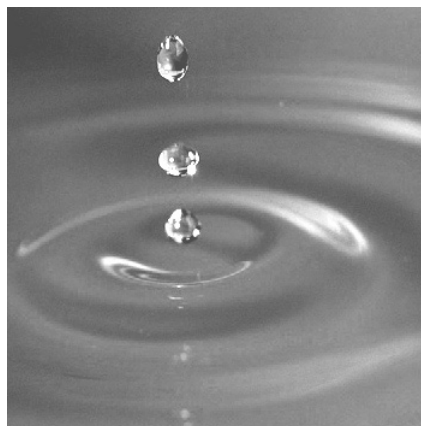
Bath Electric, Gas and Water Systems
7 South Avenue
Bath, NY 14810

Submitted by:

GEI Consultants, Inc., P.C.
1301 Trumansburg Road, Suite N
Ithaca, NY 14850

May 2021

Project #1804919



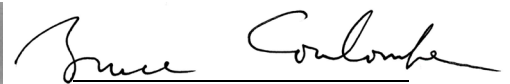

Bruce Coulombe, P.G.
Project Manager

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Abbreviations and Acronyms

ASP	Analytical Service Protocols
BEGWS	Bath Electric, Gas and Water Systems
CAR	Corrective Action Request
CERCLA	Comprehensive Environmental Response, Compensations and Liability Act
CLP	Contract Laboratory Protocol
CRQL	Contract Required Quantitation Limits
DQO	Data Quality Objective
DUSR	Data Usability Summary Report
EDD	Electronic Data Deliverable
EIMS	Environmental Information Management System
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
FSAP	Field Sampling and Analytical Plan
GC/MS	Gas Chromatography/Mass Spectroscopy
GEI	GEI Consultants, Inc., P.C.
HASP	Health and Safety Plan
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NIST	National Institute of Standards and Technology
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
P.G.	Professional Geologist
PQL	Practical Quantification Limit
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SC	Site Characterization
SOP	Standard Operating Procedure
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TIC	Tentatively Identified Compound
TCLP	Toxicity Characteristic Leaching Procedure
VOC	Volatile Organic Compound

Quality Assurance Glossary

“Analytical Services Protocol” or “ASP” means the New York State Department of Environmental Conservation (NYSDEC’s) compendium of approved United States Environmental Protection Agency (EPA) and NYSDEC laboratory methods for sample preparation and analysis and data handling procedures.

“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 EPA to support Comprehensive Environmental Response, Compensations and Liability Act (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 on-site inspections and evaluation of principles of credentials and proficiency testing.

“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.

“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.

“PAH” means polycyclic aromatic hydrocarbon as defined by EPA Method 8270D.

“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.

“Tentatively identified compound” or “TIC” means a non-targeted compound detected in a sample using a Gas Chromatography/Mass Spectroscopy (GC/MS) analytical method, which has been tentatively, identified using a mass spectral library search. An estimated concentration of the TIC is also determined.

“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 organics” 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 8260C 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.

1. Project Description

This Quality Assurance Project Plan (QAPP) specifies the quality control and quality assurance procedures to ensure the generation of statistically valid data. All procedures are equivalent to those specified in the *United States Environmental Protection Agency's QA/R-5 "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations," "Test Methods for Evaluating Solid Waste," EPA SW-846, Third Edition*, and its promulgated updates, and New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocols (ASP) to be used to ensure that data from the Site Characterization (SC) at the Bath Electric, Gas and Water Systems (BEGWS) Bath Former Manufactured Gas Plant (MGP) site in Bath, New York are precise, accurate, representative, comparable, and complete. An ELAP-certified laboratory will be used for the analysis of the samples. However, should forensic analysis be needed, BEGWS may negotiate with the NYSDEC for the use of specialty analytical services.

1.1 Introduction

A description of the Bath Former MGP site is included in the SC Work Plan (attached). There has been no investigation conducted at this site to date. Investigation is required to obtain geotechnical and hydrogeological data for initial site characterization.

1.2 Scope of Work

The scope of work for the SC is described in the project Work Plan (attached). Soil samples will be collected during the SC. These samples will be analyzed using EPA SW-846 Methods with NYSDEC ASP Category B laboratory data deliverables. Samples submitted for Toxicity Characteristic Leaching Procedure (TCLP) analysis will be analyzed using *EPA SW-846 "Test Methods for Evaluating Solid Waste," November 1986, 3rd edition* (and subsequent updates).

1.3 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements to ensure that data of known and appropriate quality are obtained during sampling and analysis activities. Data developed during the site investigation will be used to fulfill the overall objectives of the program.

1.3.1 Data Quality Levels

There are five analytical levels of data quality which may be used to accomplish these site objectives. They are typically designated as follows:

- Level I - field screening or analysis using portable instruments, calibrated to non-compound specific standards
- Level II - field analysis using portable instruments, calibrated to specific compounds
- Level III - non-Contract Laboratory Program (ASP-CLP) laboratory methods
- Level IV - ASP-CLP Routine Analytical Services methods
- Level V - non-standard analytical methods

To meet the specific objectives of this project, Levels I, IV and V data quality objectives will be utilized.

Level I - Field Screening Methods

Level I screening will be performed for health and safety purposes according to procedures provided in the site-specific Health and Safety Plan (HASP) as well as to qualitatively assess the presence of volatile organic compounds (VOCs) in soil at the site.

Level IV - CLP/ASP Methodologies

Soil samples will be analyzed according to the EPA SW-846 Methods following procedures specified in the most recent edition of the NYSDEC ASP (July, 2005). Analytical reports will be prepared in accordance with NYSDEC ASP Category B laboratory data deliverable specifications. This level of data quality will ensure the generation of legally, and technically defensible data for project use. Level IV data will also be provided for the hazardous characteristics testing. If available cyanide is analyzed, a CLP-equivalent data package will be prepared for this analysis.

Level V - Non-Standard Analytical Methods

Samples may be analyzed using non-standard analytical methods should forensic analyses be needed. If these analyses are proposed for the SC, the analyses to be performed and the methods to be used will be discussed with, and approved by the NYSDEC prior to sample collection.

2. Project Organization

This SC will be performed for BEGWS by GEI Consultants, Inc., P.C., an environmental consultant (the Consultant). GEI will arrange for the drilling and analytical services and provide on-site field representative to perform the soil characterization and soil sampling. The Consultant will also perform the data interpretation and reporting tasks.

Key contacts for this project are as follows:

BEGWS Project Manager:

Erin Bonacci	Bath Electric, Gas and Water Systems 7 South Avenue Bath, New York 14810 Telephone: (607) 664-9103 Cell: (716) 998-9794
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Consultant Senior Project Manager (GEI):

Bruce Coulombe, P.G.	GEI 1301 Trumansburg Road, Suite N Ithaca, New York 14850 Cell: (607) 793-3426
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Senior Reviewer (GEI):

Joseph Simone, P.E.	GEI 1301 Trumansburg Road, Suite N Ithaca, New York 14850 Cell: (607) 592-4677
---------------------	---

Consultant Field Team Leader (GEI):

TBD	GEI 1301 Trumansburg Road, Suite N Ithaca, New York 14850 Cell: TBD
-----	--

Quality Assurance Officer (QAO) (GEI):

TBD	GEI 455 Winding Brook Drive, Suite 201 Glastonbury, Connecticut 06033 Telephone: TBD
-----	---

Laboratory Representative (TestAmerica):

David Dunlap	TestAmerica - Pittsburgh RIDC Park 301 Alpha Drive Pittsburgh, Pennsylvania 15238-2907 Telephone: (412) 963-7058 Fax: (412) 963-2468
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3. Quality Assurance/Quality Control Objectives for Measurement of Data

3.1 Introduction

The quality assurance and quality control (QA/QC) objectives for all quantitative measurement data include precision, accuracy, representativeness, completeness, and comparability. These objectives are defined in the following subsections. They are formulated to meet the requirements of the NYSDEC ASP and EPA SW-846. The analytical methods and Contract Required Quantitation Limits (CRQLs) are provided in Section 7.

3.2 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value [EPA, 1987]. Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be determined by analyzing coded duplicate samples (labeled so that the laboratory does not recognize them as duplicates) for the same parameters, and then, during data validation (Section 8), calculating the RPD for duplicate sample results.

Analytical precision will be determined by the laboratory by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates. The formula for calculating RPD is as follows:

$$\text{RPD} = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where:

RPD = Relative percent difference.
V1, V2 = The two values to be compared.

$|V1 - V2|$ = The absolute value of the difference
 between the two values.

$(V1 + V2)/2$ = The average of the two values.

The DQOs for analytical precision, calculated as the RPD between duplicate analyses, are presented in Table 1.

3.3 Accuracy

Accuracy is a measure of the degree of agreement between a measured value and the true or expected value of the quantity of concern (Taylor, 1987), or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best determined by the analysis of a sample containing a known quantity of material, and is expressed as the percent of the known quantity which is recovered or measured. The recovery of a given analyte is dependent upon the sample matrix, method of analysis, and the specific compound or element being determined. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes which are close to the detection limits are less accurate because they are more affected by such factors as instrument "noise". Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be determined through the assessment of the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be determined for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike). The %R is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery.

- SSR = Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added.
- SR = Sample result: the background value, i.e., the concentration of the analyte obtained by analyzing the sample.
- SA = Spiked analyte: concentration of the analyte spike added to the sample.

The acceptance limits for accuracy for each parameter are presented in Table 1.

3.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program (EPA, 1987). Samples must be representative of the environmental media being sampled. Selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of sampling devices will be performed between samples as outlined in the Field Sampling and Analysis Plan (FSAP). Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded field duplicate samples. The analytical laboratory will also follow EPA-approved procedures to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank, duplicate, and chain-of-custody procedures are presented in Sections 4 and 5.

3.5 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid [EPA, 1987]. The QC objective for completeness is generation of valid data for at least 90 percent of the analyses requested. Completeness is defined as follows for all sample measurements:

$$\%C = \frac{V}{T} \times 100$$

where:

- %C = Percent completeness.
- V = Number of measurements judged valid.
- T = Total number of measurements.

3.6 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another (EPA, 1987). The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both sampling and analysis phases of this project.
- Requiring traceability of all analytical standards and/or source materials to the EPA or National Institute of Standards and Technology (NIST).
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable).
- Using standard reporting units and reporting formats including the reporting of QC data.
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate.
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose.

These steps will ensure all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

4. Sampling Program

4.1 Introduction

The sampling program was developed to provide analytical and field data that can be used to satisfy the project objectives (as outlined in Section 1.2). This section presents sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements. Sample locations, and the number of environmental and QC samples to be collected, are summarized in Table 2. The sampling procedures are presented in the FSAP.

4.2 Analytical Methods

The laboratory samples for each media and the chemical analyses to be performed, including the QA/QC samples, are included in Table 2. These analyses are summarized below.

4.2.1 Subsurface Soil Analyses

The subsurface soil samples will be analyzed for the following parameters:

- Total VOC by EPA Method 5035
- Total SVOC by EPA Method 8270D
- Total Metals [arsenic, barium, cadmium, chromium (total), lead, mercury, selenium, silver, antimony, beryllium, nickel, thallium, vanadium, and zinc] by EPA Method 6010B (Mercury 7470A)
- Total Cyanide by EPA Method 9010
- Polychlorinated biphenyls (PCBs) by EPA Method 8082

4.2.2 Groundwater Analyses

The groundwater samples will be analyzed for the following parameters:

- Total VOC by EPA Method 8260C
- Total SVOC by EPA Method 8270D
- Total Metals [arsenic, barium, cadmium, chromium (total), lead, mercury, selenium, silver, antimony, beryllium, nickel, thallium, vanadium, and zinc] by EPA Method 6010B (Mercury 7470A)

- Total Cyanide by EPA Method 9010
- Polychlorinated biphenyls (PCBs) by EPA Method 8082

4.3 Sample Container Preparation and Sample Preservation

Sample containers delivered to the field will be new and certified clean by the vendor. Copies of the sample container QC analyses will be provided by the laboratory for each container lot used to obtain samples. The containers will be tagged, and the appropriate chemical preservatives will be added. The types of containers are shown in Table 3.

Samples shall be preserved according to the preservation techniques listed in Table 3. Preservatives will be added to the sample bottles by the laboratory prior to their shipment in sufficient quantities to ensure that proper sample pH is met. Following sample collection, the sample bottles should be placed on ice in the shipping cooler, cooled to $4^{\circ} \pm 2^{\circ} \text{C}$ with ice, and delivered to the laboratory within 48 hours of collection under chain-of-custody. Chain-of-custody procedures are described in Section 5.

4.4 Sample Holding Times

The sample holding times for organic and inorganic parameters are listed in Table 3 and are in accordance with the NYSDEC ASP requirements. Holding times for TCLP samples are given in Table 4. The NYSDEC ASP holding times must be strictly adhered to by the field and laboratory personnel.

4.5 Field Quality Control Samples

Field QC samples will consist of a series of blanks and duplicates that will be collected to assess field sampling and decontamination performance. Two types of blanks to assess the collection of field samples will be collected and submitted to the laboratory for analyses (trip and equipment blanks). In addition, the precision of the laboratory analytical procedures will be assessed by collecting coded field duplicates and matrix spike/matrix spike duplicates (MS/MSDs). The blanks will include:

- Trip blanks** - A Trip Blank will be prepared before the sample containers are sent by the laboratory. The trip blank will consist of one or more 40-ml VOA vials containing EPA Type 2 water, that accompanies all water sample bottles into the field and back to the laboratory. A trip blank will be included in each shipping container of water samples for volatiles analysis. The trip blank will be analyzed for VOCs to assess any contamination from sampling, storage, transport, and internal laboratory procedures.

- b. **Equipment blanks** - Equipment blanks are collected to determine the effectiveness of the decontamination procedures for sampling equipment. Equipment blanks are collected by passing EPA Type 2 water provided by the laboratory through decontaminated sampling equipment. It is usually collected as a last step in the decontamination procedure, prior to taking an environmental sample. The equipment blank will be analyzed for all of the parameters of interest.

The duplicates will consist of:

- a. **Coded field duplicate** - To determine the representativeness of the sampling methods, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are duplicate samples. This will eliminate any possible bias that could arise. The coded field duplicates will be taken at a frequency of one duplicate per 20 field samples.
- b. **Matrix spike/matrix spike duplicate** - MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be taken at a frequency of one pair per 20 field samples. These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The percent recoveries and relative percent differences (RPDs) are listed in Table 1.

5. Sample Tracking and Custody

5.1 Introduction

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the chain-of-custody and transfer of samples will be trained on the purpose of the chain-of-custody and specific procedures prior to implementation.

Evidence of sample traceability and integrity is developed by implementation of, and adherence to, the chain-of-custody procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. The sample custody flowchart is presented in Figure 1. A sample is considered to be in a person's custody if the sample is:

- In a person's possession
- Maintained in view after possession is accepted and documented
- Locked and tagged with Custody Seals so that no one can tamper with it after having been in physical custody
- In a secured area which is restricted to authorized personnel

5.2 Field Sample Custody

A chain-of-custody record (Figure 2 or equivalent) accompanies the sample containers from selection and preparation at the laboratory, during shipment to the field for sample containment and preservation, and during return to the laboratory. Triplicate copies of the chain-of-custody must be completed for each sample set collected.

The chain-of-custody lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. The chain-of-custody also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will be sent with each sample.

The REMARKS space on the chain-of-custody is used to indicate if the sample is an MS/MSD, or any other sample information for the laboratory. Since they are not specific to any one sample point, trip and equipment blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time on the first RELINQUISHED BY space. The sampler will also write the method of shipment, the shipping cooler identification number, and the shipper air bill number on the top of the chain-of-custody. Errors will be crossed out with a single line in ink and initialed and dated by the author.

One copy of the chain-of-custody is retained by sampling personnel and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs their name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The chain-of-custody seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample(s) will not be analyzed.

5.3 Laboratory Sample Custody

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples, and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check cooler temperature, and check the original chain-of-custody documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the chain-of-custody record and record the date and time received.
- Care will be exercised to annotate any labeling or description errors. In the event of discrepant documentation, the laboratory will immediately contact the Project Manager or Field Team Leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as

broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.

- The samples will be stored in a secured area and, if required, stored at a temperature of $4^{\circ} \pm 2^{\circ}$ C.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis and final storage for control.
- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

6. Calibration Procedures

6.1 Field Instruments

All field analytical equipment will be calibrated immediately prior to each day's use. The calibration procedures will conform to manufacturer's standard instructions and are described in the FSAP. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of all instrument calibration will be maintained by the Field Team Leader in a notebook. Copies of all the instrument manuals will be maintained on site by the Field Team Leader. Calibration procedures for instruments used for monitoring health and safety hazards (e.g., photo-ionization detector and explosimeter) are provided in the Health and Safety Plan. More frequent calibration may be needed depending on conditions encountered in the field.

6.2 Laboratory Instruments

The laboratory will follow all calibration procedures and schedules as specified in the sections of the EPA SW-846 and NYSDEC ASP and subsequent updates as they apply to the instruments used for the analytical methods listed in Section 7.

7. Analytical Procedures

7.1 Introduction

Samples will be analyzed according to methods approved by the NYSDEC ASP program or EPA SW-846 “*Test Methods for Evaluating Solid Waste*,” November 1986, 3rd edition, and subsequent updates. The methods to be used for the laboratory analysis of water and soil samples are listed in Table 2. These methods were selected because they attain the DQOs required for the project, and the quantitation limits that are listed in Table 5. If TCLP analyses are to be run, the quantitation limits are listed in Table 6.

Should an analytical method be required that is outside the scope to the references cited above, the method used will be published by a nationally recognized authority (e.g., EPA, API) and approved for use by the regulatory agency.

The Project Manager shall ensure that laboratories (primary or subcontracted) generating data in support of BEGWS remediation and investigative projects maintain the relevant state and federal government regulatory accreditations, certifications, and/or registrations to perform the required analyses.

8. Data Reduction, Assessment, and Reporting

8.1 Data Reduction

Data collected during the field investigation will be reduced in accordance with NYSDEC ASP protocols. The procedures for identification and quantification of the analytes will be specified in the NYSDEC ASP or EPA SW-846 *“Test Methods for Evaluating Solid Waste,”* November 1986, 3rd edition and subsequent updates and peer reviewed by laboratory supervising personnel.

8.2 Data Quality Assessment

NYSDEC generally recommends two levels of data review for data collected during site investigations. The basic review is a Data Usability Summary Report (DUSR). Current NYSDEC policy is to require a DUSR for data collected during investigations on most sites. The more rigorous full data validation procedure is called for at sites where the data will be used in litigation. The laboratory deliverables (i.e., NYSDEC ASP Category B) are the same in both cases, and a DUSR can be upgraded to full validation at a later time if necessary. For this investigation, a DUSR will be generated.

Based on the results of data assessment, the validated analytical results reported by the laboratory will be assigned one of the following usability flags by the data validator:

- U The analyte was analyzed for, but was not detected above the level of the reported samples quantitation limit.
- UJ The analyte was analyzed for, but was not detected. The reported quantitation limit is approximated and may be inaccurate or imprecise.
- J The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
- J- (Inorganics) The result is an estimated quantity, likely to be biased low. The associated numerical value is the approximate concentration of the analyte in the sample.
- J+ (Inorganics) The result is an estimated quantity, likely to be biased high. The associated numerical value is the approximate concentration of the analyte in the sample.
- N Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling events.

- NJ Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity.
- R The data are unusable. The sample results are rejected due to serious deficiencies in the ability to meet quality control criteria. The presence or absence of the analyte cannot be verified.

Trained and experienced data assessors, who meet NYSDEC approval criteria, will perform the data assessment. Resumes of people performing data assessments and generating DUSRs will be provided to NYSDEC for review and approval.

8.2.1 Data Usability Summary Report

Data for this investigation will be evaluated in accordance with the “*EPA National Functional Guidelines for Organic Data Review*,” October 1999 and “*EPA Validation Functional Guidelines for Inorganic Data Review*,” October 2004. A DUSR will be generated in accordance with the NYSDEC guidelines. The data validator will be an independent third party person and will meet the qualification requirements stated in Section 2.0 (b) of Appendix 2B of DER-10. The data validator will not perform the duties of the Quality Assurance Officer (QAO).

A DUSR will be prepared which will include a review and an evaluation of all the analytical results. To ensure compliance with the analytical method protocols the following will be reviewed:

- Chain-of-custody forms
- Holding times
- Initial and continuing calibrations
- Blanks
- Laboratory control standards and matrix spikes
- Surrogate recoveries
- Matrix interference checks
- Field and laboratory duplicates
- Sample data

The DUSR will contain a description of the samples and parameters reviewed. Any deficiencies identified during the review will be noted and the effect on the generated data will be discussed. Any re-sampling or re-analysis recommendations will then be made to the

investigation's Project Manager. The results of the evaluation will be incorporated into the final investigative report.

8.2.2 Data Validation

The determination to validate data will be made based on the presence of data anomalies, suspect data, or laboratory issues. Unless required to address anomalies, the data will be subject to the DUSR process and will not be subject to full validation. Where necessary, data will be validated in accordance with the "*EPA National Functional Guidelines for Organic Data Review*," October 1999 and "*EPA Validation Functional Guidelines for Inorganic Data Review*," October 2004. If applicable, a data validation report will be prepared and reviewed by the QAO before issuance. A resume for the GEI QAO is attached (Figure 4). The data validation report will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain-of-custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method. A detailed assessment of each sample delivery group will follow. For each of the organic analytical methods, the following will be assessed:

- Holding times
- Instrument tuning
- Instrument calibrations
- Blank results
- System monitoring compounds or surrogate recovery compounds (as applicable)
- Internal standard recovery results
- MS and MSD results
- Field duplicate results
- Target compound identification
- Result calculations
- Pesticide cleanup (if applicable)
- Compound quantitation and reported detection limits
- System performance
- Results verification

For each of the inorganic compounds, the following will be assessed:

- Holding times
- Calibrations
- Blank results
- Interference check sample
- Laboratory check samples
- Duplicates
- Matrix spike(s)
- Furnace atomic absorption analysis QC
- ICP serial dilutions
- Results verification and reported detection limits
- Result calculations

8.3 Data Reporting

The data package provided by the laboratory will contain all items discussed above in a “CLP-equivalent” format. Data quality issues will be discussed in a case narrative included with the data report. The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

One copy of the analytical data packages in an electronic disk deliverable format will be provided by the laboratory approximately 30 days after receipt of a complete sample delivery group. The Project Manager will immediately arrange for filing of the package, the data validation, the preparation of the DUSR, and the preparation of the data summary tables. These tables will form the database for the assessment of the extent of the MGP-related impacts at the site.

8.3.1 NYSDEC Data Submittal

The NYSDEC has implemented an Environmental Information Management System (EIMS). The EIMS uses the database software application EQUIS™ from EarthSoft® Inc.

The data submitted to the Department of Environmental Remediation will be in the NYSDEC-approved Electronic Data Deliverable (EDD). New data will be submitted on a continuous basis immediately after data validation occurs but in no event more than 90 days after the data has been submitted to the Consultant. The field and character lengths for the disk deliverable are in Table 7. The EDD format will be provided by the NYSDEC.

9. Internal Quality Control Checks and Frequency

9.1 Quality Assurance Batching

Each set of up to 20 samples submitted to the laboratory will be analyzed concurrently with associated calibration standards, method blanks, MS/MSD or laboratory duplicates, and QC check samples (if required by the protocol). Note that the MS/MSD samples will be provided with the field samples and identified by the field personnel.

9.2 Calibration Standards and Surrogates

All organic standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. All standards are traceable to a source of known quality certified by the EPA or NIST, or other similar nationally-recognized program. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard working solutions are replaced monthly or more frequently, based upon data indicating deterioration. No stock or working standard will be used past the manufacturer's expiration date.

9.3 Organic Blanks and Matrix Spike

Analysis of blank samples verifies that the analytical method does not introduce contaminants or detect "false positives". The blank water can be generated by reverse osmosis and Super-Q filtration systems, or distillation of water containing KMnO_4 . The matrix spike is generated by addition of analyte and surrogate standards to a designated field sample.

9.4 Trip and Field Blanks

Trip blanks and equipment blanks will be utilized in accordance with the specifications in Section 4. These blanks will be analyzed to provide a check on sample bottle preparation and to evaluate the possibility of atmospheric or cross-contamination of the samples.

10. Quality Assurance Performance Audits and System Audits

10.1 Introduction

Quality assurance audits may be performed by the project quality assurance group under the direction and approval of the project QAO. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). Functioning as an independent body and reporting directly to corporate QA management, the QAO may plan, schedule, and approve system and performance audits based upon procedures customized to the project requirements. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

10.2 System Audits

System audits may be performed by the QAO or designated auditors, and encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory QC procedures and associated documentation may be audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may occur.

10.3 Performance Audits

The laboratory is required to perform periodic analyses of Performance Evaluation samples to maintain NELAP accreditation and/or state regulatory certifications. Performance Evaluation samples obtained from an EPA-approved vendor or a state agency must be analyzed by the laboratory at least semi-annually.

10.4 Formal Audits

Formal audits refer to any system or performance audit that is documented and implemented by the QA group. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that QA requirements have been developed, documented, and instituted in accordance with contractual and project

criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by auditors who have performed the site audit after gathering and evaluating all data. Items, activities, and documents determined by lead auditors to be out of compliance shall be identified at exit interviews conducted with the involved management. Compliance deviation will be logged, and documented through audit findings which are attached to and are a part of the integral audit report. These audit finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within 15 days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QAO prior to issue. Verification of acceptable resolutions may be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QAO will close out the audit report and findings.

11. Preventive Maintenance Procedures and Schedules

11.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators.

A list of critical spare parts will be established by the operator. These spare parts will be available for use in order to reduce downtime, if any. A service contract for rapid instrument repair or backup instruments may be substituted for the spare part inventory.

11.2 Schedules

Written procedures will establish the schedule for servicing critical items in order to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Required service will be performed by qualified personnel.

11.3 Records

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories. The QAO may audit these records to verify complete adherence to these procedures.

12. Corrective Action

12.1 Introduction

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected.

12.2 Procedure Description

When a significant condition adverse to quality is noted at site, laboratory, or subcontractor location, the cause of the condition will be determined and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the QAO, Project Manager, Field Team Leader, and involved contractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained
- When procedure or data compiled are determined to be deficient
- When equipment or instrumentation is found to be faulty
- When samples and analytical test results are not clearly traceable
- When QA requirements have been violated
- When designated approvals have been circumvented
- As a result of system and performance audits
- As a result of a management assessment
- As a result of laboratory/field comparison studies
- As required by EPA SW-846, and subsequent updates, or by the NYSDEC ASP

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups monitor on-going work performance in the normal course of daily responsibilities. Work may be audited at the sites, laboratories, or contractor

locations. Activities, or documents ascertained to be noncompliant with QA requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to QA functions will have the responsibility to issue and control Corrective Action Request (CAR) Forms (Figure 3 or similar). The CAR identifies the out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the close out action. The Project Manager will be responsible for ensuring that all recommended corrective actions were implemented and effective, documented, and approved.

References

EPA, 1986. SW-846 "Test Method for Evaluating Solid Waste," dated November 1986 and subsequent updates. U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1987. Data Quality Objectives for Remedial Response Actions Activities: Development Process, EPA/540/G-87/003, OSWER Directive 9355.0-7B U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2001. CLP Organics Data Review and Preliminary Review based on CLP/SOW OLM04.2. SOP No. HW-6, Revision 12 dated September 2005. EPA Region II.

EPA, 2005. Evaluation of Metals Data for the Contract Laboratory Program (CLP) based on SOW - ILM05.3. SOP No. HW-2, Revision 13, dated January 1992. EPA Region II.

Taylor, J. K., 1987. Quality Assurance of Chemical Measurements. Lewis Publishers, Inc., Chelsea, Michigan.

Tables

Table 1
Quality Control Limits for Soil Samples

Laboratory Accuracy and Precision							
Analytical Parameters	Analytical Method ^(a)	Matrix Spike (MS) Compounds	MS/MSD ^(b) % Recovery	MS/MSD RPD ^(c)	LCS ^(d) % Recovery	Surrogate Compounds	Surrogate % Recovery
VOCs (e)	8260C / 5035	1,1-Dichloroethane	70-142	22	70-142	Toluene-d8	71-125
		Trichloroethene	79-121	24	79-121	p-Bromofluorobenzene	72-126
		Benzene	78-122	25	78-122	1,2-Dichloroethane-d4	64-126
		Toluene	74-123	25	74-123		
		Chlorobenzene	79-118	25	79-118		
SVOCs (f)	8270D	Phenol	36-110	25	36-110	Nitrobenzene-d5	35-113
		2-Chlorophenol	38-104	26	38-104	2-Fluorobiphenyl	43-119
		1,4-Dichlorobenzene	34-120	30	34-120	p-Terphenyl-d14	51-125
		N-Nitroso-di-n-propylamine	46-120	20	46-120	Phenol-d5	36-116
		1,2,4-Trichlorobenzene	39-105	24	39-105	2-Fluorophenol	30-107
		4-Chloro-3-methylphenol	49-125	20	49-125	2,4,6-Tribromophenol	46-129
		Acenaphthene	53-119	16	53-119		
		4-Nitrophenol	44-137	25	44-137		
		2,4-Dinitrotoluene	55-125	19	55-125		
		Pentachlorophenol	33-136	27	33-136		
		Pyrene	51-133	25	51-133		
PCBs	8082A	PCB 1016	59-154	50	59-154	Decachlorobiphenyl	34-148
		PCB 1260	51-179	50	51-179	Tetrachloro-m-xylene	35-134
Pesticides	8081A	4,4'-DDD	45 - 129	18	45 - 129	DCB Decachlorobiphenyl	42 - 146
		4,4'-DDE	49 - 120	16	49 - 120	Tetrachloro-m-xylene	37 - 136
		4,4'-DDT	47 - 145	17	47 - 145		
		Aldrin	35 - 120	24	35 - 120		
		alpha-BHC	49 - 120	19	49 - 120		
		alpha-Chlordane	45 - 120	13	45 - 120		
		beta-BHC	46 - 120	17	46 - 120		
		delta-BHC	45 - 123	14	45 - 123		
		Dieldrin	47 - 120	13	47 - 120		
		Endosulfan I	29 - 125	16	29 - 125		
		Endosulfan II	39 - 121	17	39 - 121		
		Endosulfan sulfate	43 - 120	14	43 - 120		
		Endrin	44 - 127	19	44 - 127		
		Endrin aldehyde	33 - 120	23	33 - 120		
		Endrin ketone	50 - 150	14	50 - 150		
		gamma-BHC (Lindane)	50 - 120	20	50 - 120		
		gamma-Chlordane	51 - 120	14	51 - 120		
		Heptachlor	47 - 120	16	47 - 120		
		Heptachlor epoxide	44 - 122	17	44 - 122		
		Methoxychlor	46 - 152	14	46 - 152		
		Chlordane (technical)	51 - 120	14	51 - 120		
		Toxaphene	47 - 120	16	47 - 120		
Inorganics (i)	6010B and 7471A (metals)	Inorganic Analyte	75-125 (j)	20 (k)	80-120	NA	NA
	9012 A (Total Cyanide)		75-125 (j)	20 (k)	80-120	NA	NA
	9016 (Free Cyanide)		75-125 (j)	20 (k)	80-120	NA	NA

(a) Analytical Methods: NYSDEC ASP-CLP Methods with Category B data deliverables, NYSDEC, 2000 and EPA SW-846, 3rd edition, Revision 1, November 1990,

(b) Matrix Spike/Matrix Spike Duplicate

(c) Relative Percent Difference

(d) Laboratory Control Sample

(e) Target Compound List Volatile Organic Compounds

(f) Target Compound List Semi-Volatile Organic Compounds

(g) Limits are advisory only

(h) Target Analyte List Inorganics (metals and cyanide)

(i) Matrix spike only

(j) Laboratory duplicate RPD

NA - Not Applicable

Table 2
Summary of Sampling and Analytical Program

Matrix	Parameter	Analytical Method	Field Samples				QC Blanks		Total
			Field Samples	Field Duplicate	MS/MSD ^(a) (Total)	Sub-Total	Trip Blank	Equipment Blank	
Soil Boring Samples	BTEX	EPA SW 5035	9	1	1	11	1	1	13
	PAHs	EPA SW 8270D	9	1	1	11	NA	1	12
	Total Metals ^(b)	EPA SW 6010B/7470A	9	1	1	11	NA	1	12
	Total Cyanide	EPA SW 9010	9	1	1	11	NA	1	12
	Total PCBs	EPA SW 8082	9	1	1	11	NA	1	12
Test Pit Soil Samples	BTEX	EPA SW 5035	6	1	1	8	1	1	10
	PAHs	EPA SW 8270D	6	1	1	8	NA	1	9
	Total Metals ^(b)	EPA SW 6010B/7470A	6	1	1	8	NA	1	9
	Total Cyanide	EPA SW 9010	6	1	1	8	NA	1	9
	Total PCBs	EPA SW 8082	6	1	1	8	NA	1	9
Groundwater Samples	BTEX	EPA SW 8260C	3	1	1	5	1	1	7
	PAHs	EPA SW 8270D	3	1	1	5	NA	1	6
	Total Metals ^(b)	EPA SW 6010B/7470A	3	1	1	5	NA	1	6
	Total Cyanide	EPA SW 9010	3	1	1	5	NA	1	6
	Total PCBs	EPA SW 8082	3	1	1	5	NA	1	6
Hazardous Characterization	TPH DRO/GRO		2	NA	NA	2	NA	NA	2
	Total VOCs	EPA SW 8260C	2	NA	NA	2	NA	NA	2
	Total SVOCs	EPA SW 8270D	2	NA	NA	2	NA	NA	2
	Total Metals ^(b)	EPA SW 6010B/7470A	2	NA	NA	2	NA	NA	2
	Total PCBs	EPA SW 8082	2	NA	NA	2	NA	NA	2
	Total Cyanide	EPA SW 9010	2	NA	NA	2	NA	NA	2
	Percent Sulfur	ASTM D129-64	2	NA	NA	2	NA	NA	2
	BTU Content	ASTM D240-87	2	NA	NA	2	NA	NA	2

(a) Matrix spike / matrix spike duplicate for organic analyses; matrix spike and laboratory duplicate for inorganic analysis.

(b) arsenic, barium, cadmium, chromium (total), lead, mercury, selenium, silver, antimony, beryllium, nickel, thallium, vanadium, and zinc

* The number of duplicates, MS/MSD, and field QC samples can be reduced if these samples are obtained in conjunction with the sampling of other media during the sampling event.

+ Rinse blanks not required if dedicated sampling equipment is used.

Table 3
Soil and Hazardous Characteristics

Analysis ^(b)	Bottle Type	Preservation ^(a)	Holding Time ^(b)
Volatile Organic Compounds (VOCs)	TerraCore sampler 1- 40-ml VOA vial preserved with methanol; 2- 40 ml VOA vial with DI water; 2 oz jar for moisture	Cool to 4°±2°C	48 hours to extraction 14 days to analysis
Semi-Volatile Organic Compounds (SVOCs)	8 ounce wide-mouth clear glass w/ teflon-lined cap	Cool to 4°±2°C	7 days to extraction 40 days to analysis
PCBs	8 ounce wide-mouth clear glass w/ teflon-lined cap	Cool to 4°±2°C	7 days to extraction 40 days to analysis
Pesticides	8 ounce wide-mouth clear glass jar	Cool to 4°±2°C	7 days to extraction 40 days to analysis
Herbicides	8 ounce wide-mouth clear glass jar	Cool to 4°±2°C	7 days to extraction 40 days to analysis
TAL Metals	4 ounce wide-mouth clear glass jar	Cool to 4°±2°C	6 months, except mercury (28 days)
Total Cyanide	4 ounce wide-mouth clear glass jar	Cool to 4°±2°C	14 days
Free Cyanide	4 ounce wide-mouth amber glass jar	Cool to 4°±2°C	NA
TCLP Organic Compounds	8 ounce wide-mouth clear glass w/ teflon-lined cap	Cool to 4°±2°C	See Table 4
TCLP Metals	4 ounce wide-mouth clear glass	Cool to 4°±2°C	See Table 4
Corrosivity	4 ounce wide-mouth clear glass	Cool to 4°±2°C	2 days
Ignitability	4 ounce wide-mouth clear glass	Cool to 4°±2°C	NA
Reactive Cyanide	4 ounce wide-mouth clear glass	Cool to 4°±2°C	14 days
Reactive Sulfide	4 ounce wide-mouth clear glass	Cool to 4°±2°C	7 days

(a) All samples to be cooled during collection and transport.

(b) Days from date of sample collection.

NA Not Applicable

Table 4
Toxicity Characteristics Leaching Procedure Sample Holding Times

Analytical Parameter	From: Sample Collection To: TCLP Extraction*	From: TCLP Extraction To: Preparative Extraction	From: Preparative Extraction To: Determinative Analysis
Volatiles	14 days	NA	14 days from date of TCLP extraction
Semi-Volatiles	14 days	7 days	40 days
Mercury	28 days	NA	28 days from the date of TCLP extraction
Metals (except Mercury)	180 days	NA	180 days

NA Not Applicable

*Times shown are from verified time of sample receipt.

Table 5A
Project Quantitation Limits
Soil, Sediment and Groundwater VOCs

		Quantitation Limits		New York State Standard or Guidance Values
Analysis/Compound	Method	Water (ug/L)	Soil/Sediment (ug/Kg)	Water (ug/L)
Volatile Organics				
1,1,1-Trichloroethane	8260C / 5035	1.0	5	5
1,1,2,2-Tetrachloroethane	8260C / 5035	1.0	5	5
1,1,2-Trichloroethane	8260C / 5035	1.0	5	1
1,1,2-Trichloro-1,2,2-trifluoroethane	8260C / 5035	1.0	5	5
1,1-Dichloroethane	8260C / 5035	1.0	5	5
1,1-Dichloroethene	8260C / 5035	1.0	5	5
1,2-Dibromoethane	8260C / 5035	1.0	5	NL
1,2-Dichlorobenzene	8260C / 5035	1.0	5	3
1,2-Dichloroethane	8260C / 5035	1.0	5	0.6
1,2-Dichloropropane	8260C / 5035	1.0	5	1
1,2-Dibromo-3-chloropropane	8260C / 5035	1.0	5	0.04
1,2,4-Trichlorobenzene	8260C / 5035	1.0	5	5
1,3-Dichlorobenzene	8260C / 5035	1.0	5	3
1,4-Dichlorobenzene	8260C / 5035	1.0	5	3
2-Butanone (MEK)	8260C / 5035	5.0	5	50
2-Hexanone	8260C / 5035	5.0	5	50
4-Methyl-2-pentanone(MIBK)	8260C / 5035	5.0	5	NL
Acetone	8260C / 5035	5.0	20	50
Benzene	8260C / 5035	1.0	5	1
Bromodichloromethane	8260C / 5035	1.0	5	50
Bromoform	8260C / 5035	1.0	5	50
Bromomethane	8260C / 5035	1.0	5	5
Carbon Disulfide	8260C / 5035	1.0	5	60
Carbon Tetrachloride	8260C / 5035	1.0	5	5
Chlorobenzene	8260C / 5035	1.0	5	5
Chloroethane	8260C / 5035	1.0	5	5
Chloroform	8260C / 5035	1.0	5	7
Chloromethane	8260C / 5035	1.0	5	5
Cyclohexane	8260C / 5035	1.0	5	NL
cis-1,2-Dichloroethene	8260C / 5035	1.0	5	5
cis-1,3-Dichloropropene	8260C / 5035	1.0	5	0.4
Dibromochloromethane	8260C / 5035	1.0	5	5
Dichlorodifluoromethane	8260C / 5035	1.0	5	5
Ethylbenzene	8260C / 5035	1.0	5	5
Isopropylbenzene	8260C / 5035	1.0	5	5
Methyl acetate	8260C / 5035	1.0	5	NL
Methylene Chloride	8260C / 5035	1.0	5	5
Methylcyclohexane	8260C / 5035	1.0	5	NL
Methyl tert-butyl ether	8260C / 5035	1.0	5	10
Styrene	8260C / 5035	1.0	5	5
Tetrachloroethene	8260C / 5035	1.0	5	5
Toluene	8260C / 5035	1.0	5	5
trans-1,2-Dichloroethene	8260C / 5035	1.0	5	5
trans-1,3-Dichloropropene	8260C / 5035	1.0	5	0.4
Trichloroethene	8260C / 5035	1.0	5	5
Trichlorofluoromethane	8260C / 5035	1.0	5	5
Vinyl Chloride	8260C / 5035	1.0	5	2
Xylenes(total)	8260C / 5035	3.0	15	5

NL = Not Listed

Note: RLs and MDLs are subject to change due to % moisture, matrix interference, and dilution factors

Table 5B
Project Quantitation Limits
Soil and Groundwater SVOCs

		Quantitation Limits	Quantitation Limits	New York State Standard or Guidance Values
Analysis/Compound	Method	Water (ug/L)	Soil (ug/Kg)	Water (ug/L)
Semivolatile Organics				
1,1'-Biphenyl	8270D	10	330	5
2,2'-oxybis(1-chloropropane)	8270D	10	330	5
2,4,5-Trichlorophenol	8270D	10	330	1
2,4,6-Trichlorophenol	8270D	10	330	1
2,4-Dichlorophenol	8270D	10	330	1
2,4-Dimethylphenol	8270D	10	330	1
2,4-Dinitrophenol	8270D	50	1600	1
2,4-Dinitrotoluene	8270D	10	330	5
2,6-Dinitrotoluene	8270D	10	330	5
2-Chloronaphthalene	8270D	10	330	10
2-Chlorophenol	8270D	10	330	1
2-Methylnaphthalene	8270D	10	330	NL
2-Methylphenol	8270D	10	330	1
2-Nitroaniline	8270D	50	1600	5
2-Nitrophenol	8270D	10	330	1
3,3'-Dichlorobenzidine	8270D	50	1600	5
3-Nitroaniline	8270D	50	1600	5
4-Bromophenyl-phenyl ether	8270D	10	330	NL
4-Chloro-3-methylphenol	8270D	10	330	NL
4-Chloroaniline	8270D	10	330	5
4-Chlorophenyl phenyl ether	8270D	10	330	NL
4-Methylphenol	8270D	10	330	1
4-Nitroaniline	8270D	50	1600	5
4-Nitrophenol	8270D	50	1600	1
4,6-Dinitro-2-methylphenol	8270D	50	1600	NL
Acenaphthene	8270D	10	330	20
Acenaphthylene	8270D	10	330	NL
Acetophenone	8270D	10	330	NL
Anthracene	8270D	10	330	50
Atrazine	8270D	10	330	7.5
Benzo(a)anthracene	8270D	10	330	0.002
Benzo(a)pyrene	8270D	10	330	ND
Benzo(b)fluoranthene	8270D	10	330	0.002
Benzo(g,h,i)perylene	8270D	10	330	NL
Benzo(k)fluoranthene	8270D	10	330	0.002
Benzaldehyde	8270D	10	330	NL
bis(2-Chloroethoxy) methane	8270D	10	330	5
bis(2-Chloroethyl) ether	8270D	10	330	1
bis(2-ethylhexyl)phthalate	8270D	10	330	5
Butyl benzyl phthalate	8270D	10	330	50
Caprolactum	8270D	10	330	NL
Carbazole	8270D	10	330	NL
Chrysene	8270D	10	330	0.002
Di-n-butyl phthalate	8270D	10	330	50
Di-n-octyl phthalate	8270D	10	330	NL
Dibenz(a,h)anthracene	8270D	10	330	NL
Dibenzofuran	8270D	10	330	NL
Diethyl phthalate	8270D	10	330	50
Dimethyl phthalate	8270D	10	330	50
Fluoranthene	8270D	10	330	50
Fluorene	8270D	10	330	50
Hexachlorobenzene	8270D	10	330	0.4
Hexachlorobutadiene	8270D	10	330	0.5
Hexachlorocyclopentadiene	8270D	50	1600	5
Hexachloroethane	8270D	10	330	5
Indeno(1,2,3-cd)pyrene	8270D	10	330	0.002
Isophorone	8270D	10	330	50
N-Nitroso-n-propylamine	8270D	10	330	50
N-nitrosodiphenylamine	8270D	10	330	50
Naphthalene	8270D	10	330	10
Nitrobenzene	8270D	10	330	0.4
Pentachlorophenol	8270D	50	1600	1
Phenanthrene	8270D	10	330	50
Phenol	8270D	10	330	1
Pyrene	8270D	10	330	50

ND = Non-detect

NL = Not Listed

Note: RLs and MDLs are subject to change due to % moisture, matrix interference, and dilution factors

Table 5C
Project Quantitation Limits
Soil, Sediment and Groundwater PCBs, Metals and Cyanide, Pesticides, and Herbicides

Analysis/Compound	Method	Quantitation Limits		New York State Standard or Guidance Values
		Water (µg/L)	Soil/Sediment (mg/kg)	Water (µg/L)
Metals				
Antimony	6010B	10	1	3
Arsenic	6010B	10	1.0	25
Barium	6010B	200	2.00	1,000
Beryllium	6010B	4	0.40	3
Cadmium	6010B	5	0.50	5
Chromium	6010B	5	0.50	50
Copper	6010B	25	2.5	200
Lead	6010B	3	0.3	25
Mercury	7470A/7471A	0.2	0.037	0.7
Nickel	6010B	40	4.00	100
Selenium	6010B	5	0.5	10
Silver	6010B	5	0.50	50
Thallium	6010B	10	1.0	0.5
Zinc	6010B	20	2.0	2,000
Vanadium	6010B	50	5.00	NL
Cobalt	6010B	50	5.00	NL
Aluminum	6010B	200.00	20	NL
Calcium	6010B	5000.0	500	NL
Iron	6010B	100.00	10	300
Magnesium	6010B	5000.0	500	35,000
Manganese	6010B	15	1.50	300
Potassium	6010B	5000.0	500	NL
Sodium	6010B	5000.0	500	20,000
Cyanide (Total)	9012A	10	1.0	200
Free Cyanide	9016	1.1	0.62	NA

Analysis/Compound	Method	Water (µg/L)	Soil/Sediment (mg/kg)	Water (µg/L)
PCBs				
Aroclor 1016	8082	0.176	0.049	0.09
Aroclor 1221	8082	0.176	0.049	0.09
Aroclor 1232	8082	0.176	0.054	0.09
Aroclor 1242	8082	0.176	0.540	0.09
Aroclor 1254	8082	0.25	0.049	0.09
Aroclor 1260	8082	0.25	0.117	0.09
Aroclor 1262	8082	0.25	0.529	0.09
Aroclor 1268	8082	0.25	0.053	0.09

Table 5C
Project Quantitation Limits
Soil, Sediment and Groundwater PCBs, Metals and Cyanide, Pesticides, and Herbicides

		Quantitation Limits		New York State Standard or Guidance Values
Analysis/Compound	Method	Water (µg/L)	Soil/Sediment (mg/kg)	Water (µg/L)
Pesticides				
4,4'-DDD	8081A	0.05	0.0016	0.15
4,4'-DDE	8081A	0.05	0.0016	0.10
4,4'-DDT	8081A	0.05	0.0016	0.10
Aldrin	8081A	0.05	0.0016	NA
alpha-BHC	8081A	0.05	0.0016	0.20
alpha-Chlordane	8081A	0.05	0.0016	NL
beta-BHC	8081A	0.05	0.0016	NL
delta-BHC	8081A	0.05	0.0016	NL
Dieldrin	8081A	0.05	0.0016	0.002
Endosulfan I	8081A	0.05	0.0016	42
Endosulfan II	8081A	0.05	0.0016	42
Endosulfan sulfate	8081A	0.05	0.0016	42
Endrin	8081A	0.05	0.0016	NA
Endrin aldehyde	8081A	0.05	0.0016	NA
Endrin ketone	8081A	0.05	0.0016	NA
gamma-BHC (Lindane)	8081A	0.05	0.0016	0.20
gamma-Chlordane	8081A	0.05	0.0016	NL
Heptachlor	8081A	0.05	0.0016	0.40
Heptachlor epoxide	8081A	0.05	0.0016	0.2
Methoxychlor	8081A	0.05	0.0016	40
Chlordane (technical)	8081A	0.5	0.0167	NL
Toxaphene	8081A	0.5	0.0167	3
Analysis/Compound	Method	Water (µg/L)	Soil/Sediment (mg/kg)	Water (µg/L)
Herbicides				
2,4,5-T	8151A	0.5	0.0167	35
2,4-D	8151A	0.5	0.0167	70
Dalapon	8151A	0.5	0.0167	NA
Dichlorprop	8151A	0.5	0.0167	NA
Dinoseb	8151A	0.5	0.0167	0.007
Pentachlorophenol	8151A	0.5	0.0167	1
Picloram	8151A	0.5	0.0167	0.5
Silvex (2,4,5-TP)	8151A	0.5	0.0167	0.05

Table 6
TCLP
Practical Quantitation Limits (PQLs)

TCLP VOLATILE	SW-846 Analysis	Water (ug/L)
Benzene	8260C	5
Carbon Tetrachloride	8260C	5
Chloroform	8260C	5
1,2-Dichloroethane	8260C	5
1,1-Dichloroethene	8260C	5
2-Butanone	8260C	100
Tetrachloroethene	8260C	5
Trichloroethene	8260C	5
Vinyl Chloride	8260C	100

TCLP SEMIVOLATILE	SW-846 Analysis	Water (ug/L)
2-Methylphenol	3510 / 8270D	10
3 & 4-Methylphenol	3510 / 8270D	10
1,4-Dichlorobenzene	3510 / 8270D	10
2,4-Dinitrotoluene	3510 / 8270D	10
Hexachlorobutadiene	3510 / 8270D	10
Hexachloroethane	3510 / 8270D	10
Hexachlorobenzene	3510 / 8270D	10
Nitrobenzene	3510 / 8270D	10
Pentachlorophenol	3510 / 8270D	50
Pyridine	3510 / 8270D	ND
2,4,5-Trichlorophenol	3510 / 8270D	10
2,4,6-Trichlorophenol	3510 / 8270D	10

TCLP METALS	SW-846 Analysis	Water (mg/L)
Arsenic	3010 / 6010	0.05
Barium	3010 / 6010	0.002
Cadmium	3010 / 6010	0.004
Chromium	3010 / 6010	0.007
Lead	3010 / 6010	0.04
Selenium	3010 / 6010	0.07
Silver	7760 / 6010	0.007
Mercury	7470	0.0002

ND - Not Determined

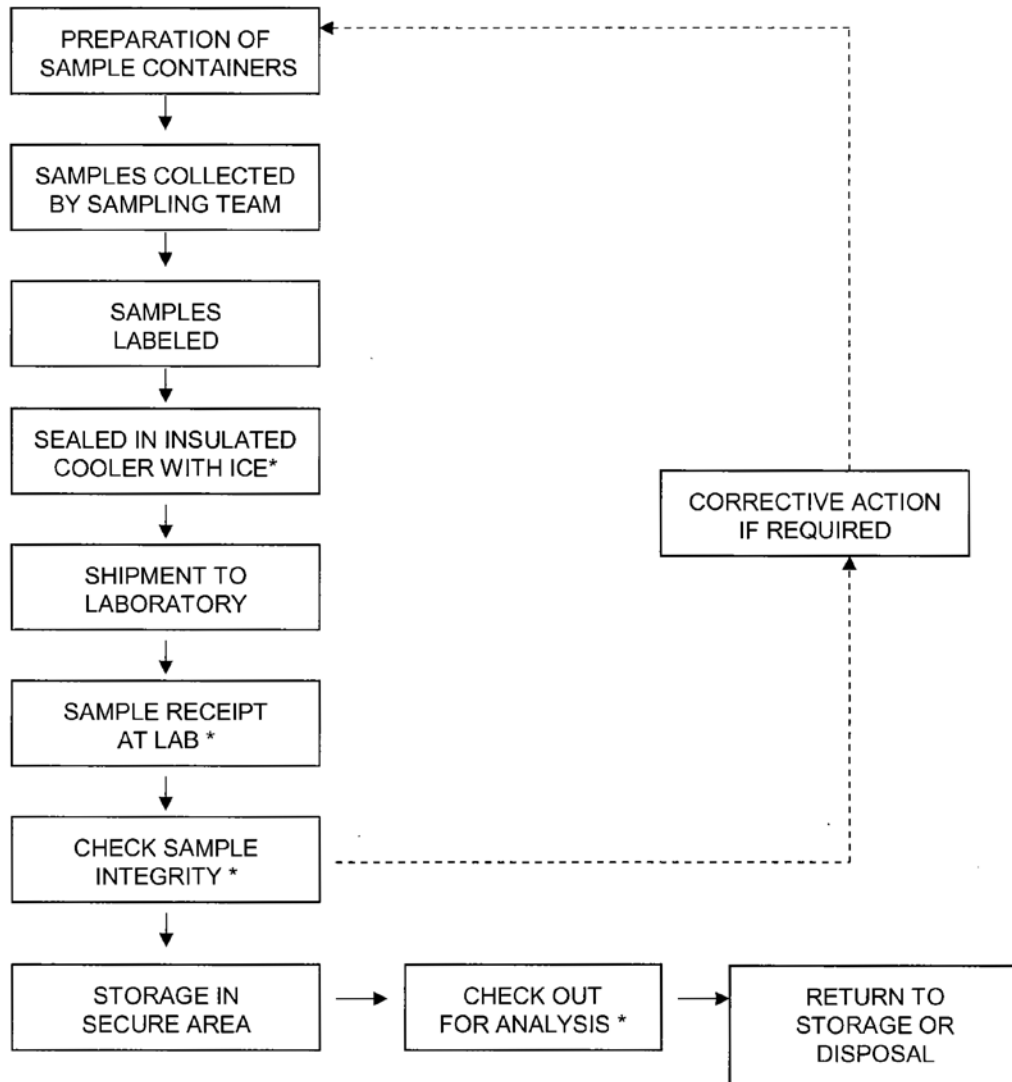
Table 7
Field and Character Lengths for Disk Deliverable

Description	Length	Format
Field Sample ID (as shown on COC)	15	Character
CAS. No. (including -'s)	10	Character
Parameter Name	31	Character
Concentration	13	Numeric
Qualifier	4	Character
Units	8	Character
SDG	8	Character
Lab Sample ID	15	Character
Date Sampled (from COC)	D	Date
Matrix (soil/water/air)	5	Character
Method Detection Limit	13	Numeric
Method Code	8	Character
Lab Code	6	Character

Figures

FIGURE 1

SAMPLE CUSTODY



* REQUIRES SIGN-OFF ON CHAIN-OF-CUSTODY FORM

FIGURE 3 Corrective Action Request

CORRECTIVE ACTION REQUEST					
Number: _____		Date: _____			
TO: _____ You are hereby requested to take corrective actions indicated below and as otherwise determined by you to (a) resolve the noted condition and (b) to prevent it from recurring. Your written response is to be returned to the project quality assurance manager by _____					
CONDITION:					
REFERENCE DOCUMENTS:					
RECOMMENDED CORRECTIVE ACTIONS:					
_____	_____	_____	_____	_____	_____
Originator	Date	Approval	Date	Approval	Date
RESPONSE					
CAUSE OF CONDITION					
CORRECTIVE ACTION					
(A) RESOLUTION					
(B) PREVENTION					
(C) AFFECTED DOCUMENTS					
C.A. FOLLOWUP:					
CORRECTIVE ACTION VERIFIED BY: _____ DATE: _____					

Figure 4
GEI Resume – QAO
TBD

Appendix G

NAPL Contingency Plan

NAPL Contingency Plan Bath Former MGP Site

If DNAPL is encountered during drilling at the site, this section specifies the procedures to be followed to limit the potential for remobilization and downward migration of DNAPL. These procedures apply to the soil borings and monitoring wells to be completed for the SC.

Procedures during Drilling

Soil samples will be taken continuously during drilling. Sampling procedures and soil-characterization requirements are outlined in the SOPs (Appendix C). These procedures include geologic descriptions and field-screening photoionization detector (PID) measurements to gauge the relative concentrations of organic vapors in soil samples. In addition, the field geologist will carefully review each sample for the presence of sheens, staining, and NAPL. Indications that soil may be MGP-impacted will be documented in the field notes.

If NAPL is observed, the field staff will first judge if the NAPL is lighter or denser than water (LNAPL or DNAPL). If an easy determination cannot be made, a representative sample will be selected for a shake test. To perform a shake test, the field staff will place a small sample of NAPL-containing soil in a clear jar. The jar will then be filled $\frac{3}{4}$ full with water, closed, and manually shaken for several seconds. The jar will then be allowed to sit for up to five minutes, if needed, to allow any potential emulsions to settle. Determination of light or dense NAPL can be made by observing whether the NAPL floats or sinks.

If the NAPL is judged to be denser than water, the field staff will make a qualitative judgment whether the apparent quantity of DNAPL represents a mobilizable volume or is immobile (residual) DNAPL. The presence of a DNAPL pool would be suggested by an apparent DNAPL volume of greater than 5% to 10% of the total soil sample volume.

If a DNAPL pool is interpreted, drilling may continue through the DNAPL-impacted interval to determine the approximate vertical extent, except where continued drilling would risk breaching a confining unit or MGP-related structure (confining with respect to DNAPL). If DNAPL is encountered immediately above a potential confining unit or MGP structure and the confining unit/structure has been identified through soil sampling, then one of the following four possible actions will be taken upon consultation with BEGWS and the NYSDEC:

- 1) If deeper drilling and characterization are desired at such locations where a confining unit is identified, the borehole may be properly abandoned and an alternate nearby location will be selected. A change order will be submitted to continue drilling with a hollow stem auger drill rig. Drilling will proceed at the alternate location by casing off the interval from the bottom of the probable DNAPL pool to the land surface by grouting a casing in place. (Should the borehole diameter of the original boring be adequate for installing casing and grout, an alternate drilling location would not be required.) Drilling will resume inside the casing once the grout has set (after a minimum of 24-hours). If a DNAPL pool is identified

below the potential confining unit, and no deeper confining unit has been identified in which an outer casing may be set, the borehole will be abandoned and grouted.

- 2) If deeper drilling and characterization are desired at such locations where a former MGP-related structure is identified (e.g., gas holder floor) with significant accumulations of NAPL above the structure, the borehole will be properly abandoned and an alternate nearby location will be selected immediately outside of the footprint of the former structure.
- 3) If deeper drilling and characterization are not desired at such locations, the borehole should be properly abandoned by tremie-grouting from the bottom of the borehole to land surface.
- 4) If NAPL characterization data or NAPL recovery are desired at such locations, a monitoring well may be installed inside the borehole with a grouted-in, 2-foot sump (at a minimum).

If a confining unit or former MGP-related structure is not observed, drilling should be discontinued when approximately 5 feet of visually clean soil (or the top of bedrock) has been observed below the DNAPL-impacted interval. One of the four actions discussed above will be taken under this scenario.

Procedures during Test Pit Excavations

The general procedures described above for drilling will also be employed during the excavation of the test pits at the site. If NAPL is observed in the overburden above a potentially confining unit at the site, the test pit excavation will be immediately terminated in order to prevent full penetration of the confining unit and the potential release of NAPL to the units below.

NAPL Monitoring

If intervals containing potentially free-phase NAPL are encountered while drilling, NAPL monitoring wells may be installed at these locations, based on the boring's location and the nature of the NAPL-impacted interval. The determination of potentially free-phase NAPL at boring locations will be made by visual and olfactory observations, as well as by completing a shake test on selected soil samples (as specified above).

The length and slot size of NAPL-monitoring-well screens will depend on the nature of the stratigraphic interval containing NAPL. Per NYSDEC requirements, the default slot size for NAPL monitoring wells at MGP sites is 0.020 inches (20-slot). If NAPL accumulates in a monitoring well, then recovery tests can be performed to assess the recoverability of the NAPL. The schedule and procedures for NAPL recovery (if required) will be agreed upon by BEGWS and the NYSDEC should it become necessary. For groundwater monitoring wells that contain NAPL, the groundwater phase within the well will not be collected and analyzed during the first sampling event unless such data is needed to aid in characterization of site conditions.