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Transmittal Letter

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From:
Jason Brien, P.E.

Date:
February 2, 2010

Subject:
NYSEG Clark Street Former MGP Site

ARCADIS Project No.:
B0013091

We are sending you:
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1	February 2010	Remedial Design Work Plan	FA

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Comments: Please find attached, the referenced document for your approval. An electronic version of the document has been included on the CD located on the inside front cover of the document. Please contact John Ruspantini by telephone at 607.762.8787 or by email at JJRuspantini@nyseg.com with any questions or comments.

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NYSEG

Remedial Design Work Plan

Clark Street Former Manufactured Gas Plant Site
Auburn, New York

February 2010

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1. Introduction

This *Remedial Design Work Plan* (RDWP) has been prepared by ARCADIS on behalf of NYSEG (New York State Electric & Gas Corporation) to present the proposed activities associated with the preparation of the remedial design for the New York State Department of Environmental Conservation- (NYSDEC-) selected remedy for the Clark Street Former Manufactured Gas Plant (MGP) site (the site) located in Auburn, New York. The selected remedy to address environmental impacts identified at the site is presented in the March 2009 Record of Decision (ROD) (NYSDEC, 2009).

NYSEG entered into an Order on Consent with the NYSDEC in March 1994 to investigate and, where necessary, remediate 33 former MGP sites in New York State. The Clark Street Former MGP site (Site No. 7-06-008) is included on this list of 33 sites. Section VI of the Order on Consent indicates that NYSEG shall submit to the NYSDEC a remedial design to facilitate implementation of the selected remedial alternative for the site. This RDWP describes the pre-design investigation (PDI) activities required to support the remedial design, as well as the anticipated components of the remedial design.

1.1 RDWP Organization

This RDWP has been organized into sections as described in the following table.

Section	Description
Section 1 – Introduction	Presents site background information, a summary of the remedial investigation, potentially applicable SCGs, remedial goals identified for the site, and a summary of the NYSDEC-selected remedy.
Section 2 – Pre-Design Investigation	Presents the scope and rationale for the PDI activities to be completed in support of the remedial design.
Section 3 – Remedial Design	Presents a description of the remedial design activities to be completed in support of the remedial construction.

Section	Description
Section 4 – Permits and Approvals	Identifies the permits and approvals necessary to conduct the PDI activities and implement the remedial action.
Section 5 – Remedial Design Documents	Identifies the remedial design documents to be prepared in support of the remedial action.
Section 6 – Remedial Design Schedule	Presents the anticipated project schedule for implementing the pre-design investigation and preparing the remedial design.
Section 7 – References	Presents a list of documents used to support the preparation of this RDWP.

1.2 Background Information

This section presents a summary of site background information, including a description of the site location and physical setting, as well as a brief site history.

1.2.1 Site Location and Physical Setting

The Clark Street Former MGP site is located at the east end of Clark Street near US Route 20 in Auburn, New York (see Figure 1). The site consists of an upland area and the portion of the Owasco Lake Outlet (outlet) immediately adjacent to the NYSEG property that comprises a triangular-shaped, approximately 3-arce area. The upland area is occupied by a NYSEG electrical substation and natural gas regulator building (see Figure 2). Subsurface natural gas distribution lines are present in the southeastern portion of the site and a gas line crosses outlet in an east/west direction in the eastern portion of the site. Access to the property is restricted by a locked gate at the Clark Street entrance and a cable fence along the southern property line. A majority of the property is covered with gravel and surrounding areas are vegetated with trees and grass. Surrounding land use includes a vehicle maintenance shop to the southwest and a CSX railroad right-of-way and US Route 20 to the south of the site. The outlet borders the upland area to the east and north, with the upland area forming a peninsula into the outlet. Ground surface elevations at the site generally slope downward toward the outlet (URS, 2009).

The outlet is a Class C water body that conveys water from Owasco Lake to the Seneca River. The outlet has a peak flow rate of approximately 1,200 cubic-feet per second (cfs) and the outlet width varies from 30 to 80 feet adjacent to the site (NYSDEC, 2009). Flow within the outlet can be regulated by the City of Auburn Department of Municipal Utilities through a series of dams within the outlet both upstream and downstream from the site. The City of Auburn utilizes these dams to both control the Owasco Lake elevation and to regulate the flow of the outlet to facilitate electrical power generation during certain times of the year. Average flows within the outlet range from 90 cubic-feet per second (cfs) to 600 cfs. The lowest flows typically occur from July through October and the highest flows typically occur November through April (USGS Surface Water Data, USGS 04235440 Owasco Outlet as Genesee Street, Auburn, New York, monthly mean flows 1998-2009).

Land use on the south side of the outlet near the site is mainly commercial while land use on the north side of the outlet (i.e., across from the site) is primarily residential.

1.2.2 Site History

MGP operations reportedly began in 1901 when operations included a gashouse (consisting of an engine room, purifier room, meter room, generator room, and boiler room), an oil tank, a shed, a 204,000 cubic-foot (cf) holder (gas holder #2), and a 75,000 cf holder (gas holder #3). A 491,000 cf holder (gas holder #1) was constructed at some point later in the early 1900s at the location of the oil tank. In 1943 gas holders #2 and #3 and a tar tank were removed and a coal storage area and tar shed were added. Gas operations ceased in 1946, when portions of the gas house were converted to a carpenter shop, storage area, regulator room, fireproof regulator room, and a booster room. Gas holder #1 was removed in 1958 when the electrical substation was constructed. The gashouse was demolished in 1961 with the exception of the existing gas regulator building (URS, 2009).

During operation of the MGP, coal was transported to the site via the railroad located south of the site. The plant manufactured gas utilizing the carbureted water gas (CWG) process. Gas holders #2 and #3 were water seal holders constructed around subsurface pit foundations. These types of structures utilized water in the bottom of the holders to create a seal at the bottom to prevent manufactured gas from escaping. Gas holder #1 is believed to have been an at-grade waterless holder.

1.3 Standards, Criteria, and Guidelines

Potentially applicable SCGs were previously identified by URS in Table 1-1 of the Feasibility Study (URS, 2009). The following SCGs were utilized to determine the extent of impacts to environmental media:

- Groundwater, drinking water, and surface water SCGs based on NYSDEC's *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (TOGS 1.1.1) and Part 5 of the New York State Sanitary Code.

- Soil SCGs based on Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-6 (6NYCRR Part 375-6) and Technical Administrative Guidance Memorandum (TAGM) 4046.

- Sediment SCGs based on the NYSDEC document titled *Technical Guidance for Screening Contaminated Sediments.*

- Soil vapor and indoor air SCGs based on typical background levels of VOCs in indoor and outdoor air using the background levels provided in the NYSDOH guidance document *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*.

A complete list of potentially applicable SCGs, as identified in URS Table 1-1, has been included as Appendix A to this RDWP.

1.4 Summary of Remedial Investigations

Previous investigation activities consisted of site screening conducted by Atlantic Environmental Services, Inc. (AES) in 1991, a remedial investigation conducted by Blasland, Bouck & Lee, Inc. (BBL) (now ARCADIS) in 1994, and a supplemental remedial investigation conducted by URS Corporation (URS) from 2004 to 2006. The results of these investigations were summarized in the Feasibility Study (FS) (URS, 2009). A brief description of the site geology, hydrogeology, and nature and extent of impacts based on the interpretations presented in the FS, is presented in the following subsections.

1.4.1 Geology

The stratigraphy in the Auburn area consists of unconsolidated overburden overlying bedrock. Geologic cross-sections and a cross-section location map prepared by URS are included in Appendix A.

The overburden at the site generally consists of 5 to 10 feet of fill overlying 8 to 10 feet of brown and alluvial deposits. An isolated area of glacial till was observed beneath the alluvial deposits near the eastern end of the substation. The till was observed to range from approximately 6.5 to 12 feet in thickness. The overburden thickness increases to greater than 30 feet west and south of the site as the ground elevation rises.

Based on the Supplemental Remedial Investigation (SRI), bedrock beneath the overburden is a limestone (Onondaga Formation), which is estimated to be approximately 65 feet thick in the vicinity of the site (URS, 2008).

1.4.2 Hydrogeology

Groundwater at the site is encountered at approximately 4 to 6 feet below ground surface (bgs). Hydrostratigraphic zones identified in the SRI Report (URS, 2008) consisted of an overburden, shallow bedrock (upper 15 to 30 feet of bedrock) and deep bedrock. Groundwater within the overburden and shallow bedrock units flows toward the outlet and is hydraulically dependent on the water level in the outlet. Hydrogeologic data collected during the SRI completed by URS suggest that at different times of the year, the outlet can be either slightly gaining water from or losing water to the bedrock. The hydraulic gradient of the deep bedrock is relatively flat and therefore, groundwater flow direction in the deep bedrock is difficult to ascertain. Based on in-situ testing, a zone of lower conductivity is present beneath the site at depths between 50 and 80 feet below grade within the lower Onondaga Limestone and Manlius Formations.

1.4.3 Nature and Extent of Impacts

This subsection describes the nature and extent of the environmental impacts identified at the site. The primary MGP byproduct impacting site media is coal tar, or dense non-aqueous phase liquid (dense NAPL or DNAPL). The terms coal tar, DNAPL and NAPL are used interchangeably for the remainder of this report. Principal components of coal tar include benzene, toluene, ethylbenzene, and xylene (BTEX) which are volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) which are semi-volatile compounds (SVOCs). Based on the limited number of samples and relatively insignificant concentrations of polychlorinated biphenyls (PCBs) and inorganic constituents (i.e., metals and cyanide), these constituents are not considered a concern for the site. A summary of environmental impacts, by media type, is presented below.

<u>Coal Tar</u>

Coal tar has been observed in the overburden throughout a majority of the site, primarily in the vicinity of former gas holders #2 and #3 and extending to the outlet to the north and northwest. DNAPL has not been observed in the eastern third of the property which is generally the portion of the site east of the natural gas distribution piping. DNAPL also has been observed in bedrock beneath the site and extends off-site in bedrock beneath the outlet. Measureable amounts of DNAPL have accumulated in a total of five bedrock monitoring wells including four on-site wells (MW-04B, MW-04D, MW-05B, and MW-06B) and one off-site well (MW-09D).

<u>Surface Soil</u>

As indicated above, the majority of the site is covered with gravel. A total of 15 on-site surface soil samples (0 to 6 inch sampling interval) were collected below the gravel or within vegetated areas and submitted for laboratory analysis for PAHs as part of site investigation activities. PAHs were detected in each of the surface soil samples at concentrations greater than laboratory detection limits with the highest concentrations detected in surface soil sample SF-04 (1,528 ppm total PAHs). Surface soil sample SF-04 was collected in 1992 approximately 40 feet west of the gas regulator building.

<u>Subsurface Soil</u>

A total of 57 subsurface soil samples were collected and submitted for laboratory analysis for BTEX and PAHs as part of site investigation activities. Total BTEX was detected in 43 of the 57 samples with highest concentration (532 ppm) detected in soil sample TB-12 (8-10’) located in the central portion of the site near a former tar pump and tank. Additionally, 16 of the subsurface soil samples contained total BTEX at concentrations greater than the TAGM 4046 guidance values of 10 ppm. Total PAHs were detected in 55 of the 57 samples with the highest concentration (47,912 ppm) detected in soil sample TP-04 (3’) collected within the limits of former gas holder #2. Additionally, 13 of the samples contained total PAHs at concentrations greater than 500 ppm. In general, the most elevated BTEX and PAH concentrations were detected in subsurface soil samples that coincided with locations where NAPL was encountered (i.e., near the former gas holders, the former tar tank, and in the north-central portion of the site).

<u>Groundwater</u>

Overburden groundwater samples were collected at the site as part of the SRI during two separate monitoring events (December 2004 and November 2005/March 2006). During these two monitoring events, individual BTEX and PAH compounds were detected at concentrations exceeding NYSDEC Class GA standards and guidance values in monitoring wells MW-4 through MW-6. The most elevated concentrations of BTEX and PAHs were detected in groundwater samples collected from monitoring well MW-6 located in the northeastern portion of the site. The groundwater sample collected from MW-6 during March 2006 contained total BTEX and total PAHs at concentrations of 3,110 parts per billion (ppb) and 10,017 ppb, respectively. It should be noted, that monitoring well MW-6 is located in an area where NAPL has been observed and measurable quantities of NAPL were recovered from MW-6 as part of the SRI.

BTEX and PAHs were also detected at concentrations greater than NYSDEC Class GA groundwater standards and guidance values in groundwater samples collected from each of the on-site shallow bedrock monitoring wells. BTEX compounds were detected at concentrations greater than NYSDEC Class GA standards and guidance values in the groundwater sample collected from on-site deep bedrock monitoring well MW-04D.

BTEX and PAHs were not detected at concentrations greater than NYSDEC Class GA standards and guidance values in off-site overburden monitoring wells. BTEX compounds and individual PAHs were detected at concentrations greater than NYSDEC Class GA standards and guidance values in groundwater samples collected from the four off-site deep bedrock monitoring wells (monitoring wells MW-08D through MW-11D) located on the opposite side of outlet. Subsequently, additional monitoring wells were installed downgradient of these wells to determine the extent of groundwater impacts within the bedrock. Groundwater samples collected from these additional off-site deep bedrock monitoring wells indicated the presence of toluene in the groundwater sample collected at monitoring well MW-17D and benzene in the groundwater sample collected from monitoring well MW-12D at concentrations greater than NYSDEC Class GA standards and guidance values. NAPL was observed during bedrock coring conducted at off-site bedrock monitoring wells MW-09D (shallow), MW-

11D (shallow), MW-12D (shallow), and MW-14D (deep) with measureable amounts of NAPL accumulating in monitoring well MW-9D following well installation.

Surface Water

BTEX and PAH compounds were not detected in the 10 surface water samples collected as part of the remedial investigation activities.

Sediment

As indicated above, a natural gas line crosses the outlet in an east/west direction in the eastern portion of the site. Installation of this crossing was originally attempted in July 1995 in the northern portion of the site. However, during the excavation for the utility crossing in the northern portion of the site, a small amount of material that appeared to be coal tar was encountered and the crossing was relocated to the eastern portion of the site.

Sediment investigation activities included sediment probing at approximately 106 locations, collecting 26 surface sediment samples (i.e., 0 to 6 inch depth interval) from locations ranging from approximately 500 feet upstream to 900 feet downstream of the site, and completing forensic analyses of compounds detected in select sediment samples. NAPL was not observed during the probing. However, undifferentiated sheens were produced by probing at five locations adjacent to the site (near former gas holders #1 and #3 along transects T-05, T-06, and T-07), at four locations downstream of the site (along transects T-01, T-03, and T-04), and two locations upstream of the site (along transects T-12[II] and T-15[II]).

Total BTEX was detected in surface sediment samples at concentrations less than chronic toxicity criteria for the protection of benthic aquatic life. Total PAHs were detected immediately upstream, adjacent to, and downstream of the site at concentrations up to 53 ppm, 172 ppm, and 335 ppm (respectively). Based on the results of the forensic analyses, only sediment samples SED-09 and SED-12 located along the northern and eastern near-shores of the site (respectively) contained some PAH characteristics similar to those observed in on-site soil and NAPL samples; the other detected PAHs exhibited different PAH compositions and were attributed to sources other than the Clark Street site. It should be noted, that sheens were not observed at either of these locations (SED-09 or SED-12) during the probing activities described above.

Soil Vapor/Sub-Slab Vapor/Air

A total of six soil vapor samples and one ambient air sample were collected from the off-site residential area north of the site, across outlet. Soil vapor samples contained BTEX compounds, other fuel-related hydrocarbons, and chlorinated hydrocarbons not related to site impacts. Indoor air and sub-slab vapor samples were collected from two private residences. VOCs were detected in the samples, but at concentrations consistent with levels commonly found in homes heated with fuel oil. Based on a review of these analytical results, NYSDEC and NYSDOH have determined that no remedial alternatives need to be evaluated for this medium.

1.5 Remedial Goals

As presented in the NYSDEC ROD, the selected remedy must eliminate or mitigate all significant threats to public health and/or the environment. To achieve this objective, the following remedial goals have been established for the site (NYSDEC, 2009).

Remedial Goals for Soil

- Prevent ingestion/direct contact with contaminated soil
- Prevent inhalation of contaminants from the soil
- Prevent migration of contaminants that would result in groundwater or surface water contamination
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain

Remedial Goals for Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards
- Prevent contact with contaminated groundwater
- Prevent inhalation of contaminants from groundwater
- Prevent discharge of contaminated groundwater to surface water
- Restore the groundwater aquifer to meet ambient groundwater quality criteria to the extent practicable

Remedial Goal for Soil Vapor

- Mitigate impacts to public health resulting from the potential for soil vapor intrusion into future buildings at the site

Remedial Goals for Sediment

- Prevent direct contact with contaminated sediment
- Prevent releases of MGP-related contaminants from sediment that would result in surface water levels in excess of ambient water quality standards
- Prevent impacts to biota from ingestion/direct contact with MGP-related sediments causing toxicity and impacts from bioaccumulation through the aquatic food chain
- Restore, to the extent practicable, MGP-impacted sediment to site background conditions

1.6 Description of Selected Remedy

As presented in the NYSDEC ROD, the NYSDEC-selected remedy for the site consists of the following remedial components:

- A remedial design program will be implemented to provide details necessary for the construction, operation, maintenance, and monitoring of the remedial program.

- Excavation of all soil containing PAH concentrations greater than 500 parts per million (ppm) or soil containing visual tar or NAPL (approximately 17,000 cubic-yards) to the top of bedrock. The existing electrical substation structures will be removed from the site to facilitate soil excavation. Soil exhibiting odors, staining or sheens only will not be considered for removal as visual tar or NAPL. Soils exhibiting odors, staining or sheens will however be removed if found to exceed the 500 ppm criteria. Excavated soil that does not contain visual indications of tar or NAPL and contains PAHs at concentrations less than 500 ppm will be stockpiled and reused as backfill below a demarcation layer (described in the following paragraph).

- Excavated soil that is not able to be reused as fill material will be treated and/or disposed off-site. Following excavation and placement of fill material that was originally excavated from the site, but prior to placement of imported backfill, a fabric "demarcation" layer will be placed to mark the limits of soil removal. Imported soil for backfill, including soil returned to the site following appropriate treatment, will satisfy the Soil Cleanup Objectives (SCOs) for the lower of 6NYCRR Part 375-6 restricted use SCOs for commercial future use or for the protection of groundwater.

- The entire site will be covered with at least one foot of backfill material that satisfies the SCOs for restricted commercial use and the protection of groundwater. Asphalt paving or stone could be utilized, as needed, to provide site access. An ecological buffer zone will be constructed along the southern edge of the outlet. The ecological buffer zone will be approximately 25 feet wide as measured laterally from the high water level. The top two feet of soil in this zone will consist of soils that meet the 6NYCRR Part 375-6 SCOs for protection of ecological resources, and will be vegetated. As indicated above, imported fill material will be placed on top of a fabric demarcation layer.

- A bedrock NAPL collection program will be undertaken. An estimated fourteen NAPL recovery wells will be designed and strategically placed with the goal of maximizing the recovery of NAPL from the bedrock. Additional wells will be provided as needed until determined that any further wells will only marginally increase NAPL recovery.

- Approximately 100 cubic-yards of sediment will be removed at sample locations SED-09 and SED-12. In addition, a sampling program will be undertaken in the outlet to delineate contamination in the sediment area of concern to the bedrock. Sediments which contain visible tar, produce a tar-related sheen when agitated in water, or which contain site-related PAH compounds at levels above upstream background levels will be removed. Removed sediment will be disposed off-site. Following sediment excavation, the streambed will be restored to 6NYCRR Part 608 requirements. Where the stream bank is disturbed, it will also be restored to 6NYCRR Part 608 requirements.

- Development of a site management plan which will include the following institutional and engineering controls: (a) management of the final cover system to restrict excavation below the soil cover's demarcation layer, pavement, or buildings. Excavated soil will be tested, properly handled to protect health and safety of workers and the nearby community, and will be properly managed in a manner acceptable to NYSDEC; (b) continued evaluation of the potential for vapor intrusion for any buildings developed on the site, including provision for mitigation of any impacts identified; (c) monitoring of groundwater; (d) identification of any use restrictions on the site; and (e) fencing or other means to control site access.

- Imposition of institutional controls in the form of an environmental easement that will require: (a) limiting the future property use/development for commercial or industrial purposes; (b) complying with a NYSDEC-approved site management plan; (c) prohibiting the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH; and (d) NYSEG to complete and submit to NYSDEC a periodic certification of institutional and engineering controls.

- NYSEG will provide a periodic certification of institutional and engineering controls, prepared and submitted by a professional engineer or such other expert acceptable to NYSDEC, until NYSDEC notifies NYSEG in writing that this certification is no longer needed. This submittal will: (a) contain certification that the institutional controls and engineering controls put in place are still in place and are either unchanged from the previous certification or are compliant with NYSDEC-approved modifications; (b) allow NYSDEC access to the site; and (c) state that nothing has occurred that will impair the ability of the control to protect public health or the environment, or constitute a volition or failure to comply with the site management plan unless otherwise approved by NYSDEC.

2. Pre-Design Investigation

This section describes the PDI activities to be conducted at the site to address additional data needs necessary to support the remedial design activities described in Section 3. As required by the ROD, the PDI activities include a sediment sampling program to delineate the extent of MGP-related impacts in subsurface sediment and field activities to determine optimal placement and design for the NAPL collection wells. The results of these and the additional proposed PDI activities will support the development of the remedial design for the NYSDEC-selected remedy. PDI activities will include the following:

- PDI Task 1 – Site Reconnaissance and Coordination with Utilities
- PDI Task 2 – Soil Investigation
- PDI Task 3 – Sediment Investigation
- PDI Task 4 – NAPL Collection Well Placement Study
- PDI Task 5 – Groundwater Treatability Sampling
- PDI Task 6 – Site Survey
- PDI Task 7 – PDI Documentation

Methodologies and protocols to be followed during the completion of the PDI activities are presented in the Field Sampling Plan (FSP) included as Appendix B. Analytical procedures and requirements to be followed for the laboratory analysis of samples collected during investigation activities are presented in the Quality Assurance Project Plan (QAPP) included as Appendix C. Health and safety protocols to be followed by field personnel during investigation activities are presented in the Health and Safety Plan (HASP) included as Appendix D.

A description of each task associated with the PDI is presented below. For the purpose of developing the PDI activities, the site is described in two portions: the upland portion of the site (which consists of the NYSEG property) and the outlet.

2.1 PDI Task 1 – Site Reconnaissance and Coordination with Utilities

PDI Task 1 consists of coordinating with NYSEG and other parties (as appropriate) to determine the presence and location of utilities that may impact the construction of the selected remedy.

Current known utilities at the site include overhead electrical transmission lines, the electrical substation, a gas regulator building, and subsurface natural gas distribution lines. ARCADIS will coordinate with a private utility locator (as necessary) and NYSEG to assess the presence of additional subsurface utilities at the site. As part of this effort, the locations of the sanitary sewer line north of the outlet will be identified in accordance with Response 6 of the NYSDEC ROD Responsiveness Summary. All identified subsurface utilities will be marked at the ground surface and surveyed for location. Utility drawings will be obtained from each owner (if available). The presence, location, purpose, depth, and size of subsurface utilities will be considered during the evaluation and development of excavation support systems under RD Task 1 – Soil Excavation (Section 3.1) and as part of the overall design to implement the remedy and restore the site.

Additionally, ARCADIS will coordinate with the City of Auburn to determine the nearest sanitary sewer manhole and discharge criteria for the potential discharge of groundwater removed from the excavation area and pre-treated on-site. Discharge/disposal options for treated groundwater will be evaluated as part of RD Task 3 – Temporary Water Treatment System (Section 3.3).

2.2 PDI Task 2 – Soil Investigation

PDI Task 2 consists of conducting soil investigations to support the development of soil excavation plans. The approximate extent of soil removal is defined in the Feasibility Study and associated NYSDEC ROD for this site. However, additional soil investigations are necessary in order to:

- Confirm the horizontal limits of soil removal based on the criteria presented in the NYSDEC ROD.

- Obtain geotechnical data necessary to evaluate and design soil excavation support systems.

- Delineate shallow foundations and obstructions within the soil removal area.

Proposed PDI activities to be completed under this task are presented in the following subsections. During these activities, trees and brush will be cleared, as necessary, to access the proposed investigation locations. The final soil boring and test pit locations may be repositioned in the field based on accessibility, obstructions encountered, or other factors.

2.2.1 PDI Task 2a – Soil Delineation Sampling

A more detailed delineation of the horizontal limits of soil containing NAPL and PAHs at concentrations greater than 500 ppm in the eastern and southern portions of the site is required for remedial design. Additionally, soil quality and depth to bedrock information beneath the electrical substation is also needed to assist in the remedial design. A minimum of four soil borings (SB-01 through SB-04) will be drilled to confirm the extent of MGP-impacted soil in the eastern and southern portion of the upland area and up to five additional soil borings (SB-05 through SB-09) will be completed beneath the electrical substation following removal of the substation equipment (planned for 2010). The additional soil borings will be completed at the approximate locations shown on Figure 3. Soil borings will be completed using hollow-stem auger (HSA) methods as described in the FSP included as Appendix B. Soil samples will be collected continuously to the top of bedrock. Each soil sample will be visually characterized for soil type and the presence of visible staining, sheen, NAPL, and obvious odors. If no visibly NAPL-impacted materials are encountered at a particular boring location, a soil sample will be collected from that boring and submitted for laboratory analysis for PAHs. If MGP-related visual impacts are encountered or if results obtained for the analysis of a soil sample collected at a particular boring meet the removal criteria presented in the ROD (i.e., soil containing visual tar or NAPL or total PAHs exceeding 500 ppm), additional “step-out” borings will be completed as needed to determine the extent of impacts.

Soil cuttings will be staged on-site in an appropriate container (i.e., roll-off, drum). Soil cuttings will be field screened for the presence of volatile organic vapors using a photoionization detector (PID). Composite samples from the investigation-derived waste (IDW) will be submitted for laboratory analysis for waste characterization/ disposal purposes. Soil cuttings (and other IDW) will be managed and disposed of in accordance with applicable rules and regulations.

2.2.2 PDI Task 2b – Geotechnical Soil Sampling

Additional geotechnical data is needed to facilitate the design or evaluation of the excavation support system. Soil borings will be completed to obtain geotechnical data to support the design of an excavation support system for the upland soil removal portion of the site remedy. Up to six geotechnical soil borings (SB-10 through SB-15) will be completed around the perimeter of the upland excavation area at the approximate locations shown on Figure 3. Geotechnical borings will be drilled using HSA or mud rotary drilling methods. Drilling field procedures are described in the FSP included as Appendix B. Soil sampling will be performed continuously at each boring to the top of bedrock using 2-inch diameter split spoon sampling devices. Standard Penetration Testing (SPT) will be conducted for most intervals following ASTM D1586. If cohesive materials are encountered, the field crew will attempt to collect up to two undisturbed samples using a thin-walled sampler (i.e., Shelby tube). Select soil samples will be submitted for the following geotechnical testing:

- Moisture content as a percentage of dry weight (ASTM D2216)
- Atterberg limits (ASTM D4318)
- Grain-size analysis with hydrometer (ASTM D422)
- Grain-size analysis with #200 wash (ASTM D422 and ASTM D1140)
- Specific gravity (ASTM D4767)
- Flex-wall permeability (ASTM D5084)
- CU tri-axial shear test (ASTM D4767)
- Direct-shear test (ASTM D3080)

The number of samples to be submitted for testing will be determined by the project geotechnical engineer upon completion of the drilling program. Additionally, a minimum of five feet of rock coring will be completed at up to three boring locations to evaluate rock strength for the development of potential excavation support systems. Rock cores will be evaluated for Rock Quality Designation (RQD) in accordance with ASTM D6032. If MGP-related impacts are observed in the soil delineation borings completed as part of PDI Task 2a, additional geotechnical borings may be completed in southeastern portion of the upland area. An ARCADIS geotechnical engineer or geologist will observe the completion of the geotechnical borings and record the information necessary to complete the remedial design tasks described in Section 3.

2.2.3 PDI Task 2c – Test Pits

Test pits will be completed to identify shallow foundations and obstructions (including materials of construction, thickness, depth, etc.) that may potentially impact implementation of the remedy (i.e., installation of excavation support systems and soil excavation). Test pits will be completed at the general locations shown on Figure 3 using a rubber-tired backhoe or small excavator. Excavated material will be staged on polyethylene sheeting adjacent to the test pits. The location and elevation of subsurface foundations and obstructions will be surveyed. Each test pit will be backfilled by replacing the excavated material in the reverse order that it was removed. The locations of test pits will be selected to target former MGP structures. Test pitting procedures are described in the FSP included as Appendix B.

2.3 PDI Task 3 – Sediment Investigation

PDI Task 3 consists of activities to conduct a sediment investigation within the outlet. The investigation will consist of establishing background PAH concentrations upstream of the site, identifying the potential presence and lateral/vertical extent of MGP-impacted sediments, and obtaining geotechnical information to support the design of sediment removal support systems, if required, to implement remedial construction activities. A description of the sediment investigation components is presented in the following sections.

2.3.1 PDI Task 3a – PAH Background Sampling

Prior to conducting sediment sampling adjacent to and downstream from the former MGP site, sediment sampling will be conducted to determine background PAH concentrations in the outlet sediment. PAH background sampling will consist of collecting up to 20 surface (0 to 6 inches) and subsurface sediment samples upstream of the site (i.e., upstream from SRI transect T-13). Background sampling locations will be selected based on pre-sampling reconnaissance to identify fine-grained sediment deposition areas upstream from the site. Background samples will be collected downstream of the dam located near NYSEG's McMaster Street former MGP site and samples will not be collected of obvious outfall material. Field personnel will attempt to collect sediment cores using manually-driven sampling tubes (i.e., Lexan tubing) as described in the FSP (see Appendix B). If samples cannot be collected using sampling tubes (due to coarse-grained material at the streambed surface), samples will be collected via alternative manual methods (e.g., shovel) or using drilling techniques similar to those described in the following section. Background sediment samples will be submitted for laboratory analysis for the 17 priority pollutant PAHs using SW-846 Method 8270 (PAH-17).

2.3.2 PDI Task 3b –Sediment Delineation Sampling

As presented in the SRI Report, a surface sediment investigation was conducted in the outlet in the vicinity of the site. NAPL was not observed at any of the probing locations during the investigation; however, undifferentiated sheens were produced at several locations when probing subsurface sediment (i.e., deeper than 6 inches).

As indicated in Section 1, surface sediment samples were submitted for laboratory analysis for total PAHs and forensic analyses were conducted to determine the potential source of the PAHs. Based on the results of the forensic analyses, URS concluded that with the exception of two surface sediment samples (SED-09 and SED-12) there is a clear difference between the nature of the PAHs in the sediment samples and MGP-impacted soils/NAPL. Sediment samples SED-09 and SED-12, located adjacent to the site, indicated some of the characteristics observed in the on-site soil/NAPL samples. As indicated in the NYSDEC ROD (NYSDEC, 2009), the minimum extent of sediment removal includes the areas in the vicinity of surface sediment sampling locations SED-09 and SED-12.

The objective of this PDI task is to further characterize surface and subsurface sediment in the outlet upstream, adjacent to, and downstream from the site. The outlet immediately upstream and adjacent to the former MGP property is primarily characterized as a high energy environment with riffles, swift current and shallow water depths. Downstream from the former MGP property (i.e., between SRI sediment transect T-06 and T-03), the outlet is primarily characterized as a depositional environment with deeper water depths and slower water velocities. The outlet characteristics downstream of SRI transect T-03 generally remain depositional. Based on these conditions, the proposed sediment investigation will be conducted between SRI transects T-01 and T-12 and T-17 to T-19. The approximate locations of these transects are shown on Figure 4.

Surface and subsurface sediment sampling will be completed at a total of 16 transects, each oriented perpendicular to the flow of the outlet. Fifteen of these transect locations will correspond with SRI transects T-01 through T-12 and T-17 through T-19 (to the extent possible based on field conditions). An additional transect (T-10a) located near SRI sediment sampling location SED-12, where elevated concentrations of PAHs containing some MGP characteristics were detected, has also been included. Note that transect T-07 will be shifted to correspond with the location where NYSEG previously encountered a small amount of what appeared to be coal tar while attempting to install the natural gas distribution line outlet crossing conducted in July 1995. The resulting sediment investigation will cover an approximately 0.35-mile stretch of the creek extending from approximately 150 feet upstream from the site to the flow control structure located approximately 1,000 feet downstream from the site. The proposed investigation area was developed to correspond with an “area of concern” presented in NYSDEC’s December 26, 2008 comments on the draft FS.

With the exception of transects T-11 and T-12, sediment borings will be conducted at up to three locations along each transect: near-shore (the shore along the upland portion of the site);mid-stream; and far-shore. Transects T-11 and T-12 will each include up to four sampling locations due to the presence of the island in the outlet:

near-shore, near-mid-stream, far-mid-stream, and far-shore. Sampling will be conducted in an iterative manner using the following general protocol:

1) Near-shore sediment borings will be advanced at each of the 16 proposed transect locations.

2) Mid-stream and far-shore borings will be completed at alternating transect locations.

3) If a mid-stream boring contains visual impacts potentially associated with the former MGP site, borings will be completed at a mid-stream location on both adjacent transects and a far-shore location on the given transect. Similarly, if a far-shore boring contains visual impacts potentially associated with the former MGP site, borings will be completed at a far-shore location at both adjacent transects and a mid-stream location on the given transect..

It is anticipated that sediment borings will be advanced using a float-mounted portable drill rig and/or an all-terrain vehicle- (ATV-) mounted drill rig, similar to the setups shown below. An oil absorbent boom will be placed around the float-mounted drill rig and ATV-mounted drill rig while conducting investigation activities that will disturb sediment.

Figure 2.1 – Typical setups for sediment sampling in shallow water

The drill rig will initially attempt to collect sediment samples using drive and wash methods with a 2- or 3-inch diameter split spoon sampling device driven in front of flush-jointed casing. If necessarily, the drilling rig will use a rotary bit to advance borings through potential obstructions. For shallow water and/or near shore locations, the ATV-mounted drill rig may be utilized to drill the soil boring using HSA techniques. Each boring will be advanced until the bedrock surface has been reached (i.e., refusal). In addition to visual indications from drill cuttings, sample materials, drill pressures, etc., existing top of bedrock elevation information near the north and south outlet banks will be used to confirm that the drill casing and the sample cores are advanced to the top of bedrock at each sampling locations. Based on information presented in the SRI Report, the bedrock surface is anticipated to be encountered at approximately 0 to 5 feet below the sediment surface. Procedures for collecting sediment samples are described in the FSP (see Appendix B). Sediment samples will be visually characterized for color, composition, and presence/absence of MGP-related impacts (i.e., NAPL/tar, sheens, staining, or odors).

A minimum of one sediment sample from each boring will be submitted for laboratory analysis. Subsurface sediment sampling depths will be determined based on the thickness and composition of the sediment encountered. Surface sediment samples will be submitted for laboratory analysis from selected locations were visual impacts (i.e., sediments containing visible tar or producing an MGP-related sheen when disturbed) are observed in subsurface sediment. If no visual evidence of potentially MGP-related material is encountered in the subsurface sediment of a given boring, surface sediment samples will be selected for analysis to provide spatial coverage across the sediment investigation area with focus in the areas immediately adjacent to and immediately downstream from the former MGP site.

Sediment samples will be submitted for analysis for the 17 priority pollutant PAHs using SW-846 Method 8270 (PAH-17). Additionally, a duplicate of each sample submitted for PAH analysis will be frozen for potential forensic analysis pending the findings of the initial sediment evaluation. The initial evaluation will include the activities listed below to identify potential similarities and differences in the PAH composition of the sediment samples and “group” samples containing similar characteristics.

- Reviewing the total ion chromatograms (TICs) generated by the 8270 priority pollutant PAH analysis

- Calculating PAH diagnostic ratios (e.g., fluoranthene/pyrene and benzene/chrysene)

- Comparing sediment sample PAH concentration ranges to known PAH compositional characteristics (e.g., No. 2 fuel, coal tar, etc.)

- Assessing the spatial relationship and PAH concentrations of the collected samples

Based on this initial evaluation of priority pollutant PAH analytical results, a forensic analysis will be conducted on a select number of duplicate samples frozen at the time of sample collection. Rationale for sample selection will be discussed with NYSDEC prior to the forensic analysis. The forensic analysis will be consistent with methods used as part of the SRI and will include laboratory analysis for approximately 50 parent and alkyl group PAHs (i.e., forensic PAHs) by modified Method 8270C and total petroleum hydrocarbon (TPH) analysis by modified Method 8015.

Areas for potential sediment removal will be delineated based on the presence of visual site-related impacts and the results of the evaluations conducted for the sediment samples analytical results (i.e., initial evaluation, comparison to PAH background concentrations, and forensic analysis).

2.3.3 PDI Task 3c –Geotechnical Sediment Sampling

The scope for conducting geotechnical sediment sampling will be dependent upon the results of PDI Task 3b – Sediment Delineation Sampling. At a minimum, sediment samples will be collected from the two proposed sediment removal areas near SED-09 and SED-12 (i.e., sediment sampling locations SD-01 and SD-02 shown on Figure 3). These sediment samples will be submitted for particle grain-size analysis to evaluate potential sediment dewatering and material handing requirements.

However, if the sediment investigation activities to be conducted as part of PDI Task 3b indicate that the depth of sediment removal for areas defined by SED-09 and SED-12 is greater than anticipated or the areas containing MGP-impacted sediment are more wide-spread, additional geotechnical sediment sampling will be conducted during a subsequent mobilization to aid in evaluating and developing potential sediment excavation support systems (e.g., cofferdams, diversion structures). Once the scope of additional sediment removal activities are defined, additional geotechnical activities will be defined and submitted to NYSDEC for approval.

2.4 PDI Task 4 – NAPL Collection Well Placement Study

PDI Task 4 consists of conducting a NAPL monitoring program prior to remedial construction to aid in the evaluation of potential locations for new NAPL collection wells that will be installed following upland excavation and site restoration activities.

Each existing monitoring well will initially be gauged for the presence of NAPL and to measure groundwater elevations at each location to establish base-line conditions.

Existing monitoring well locations are shown on Figure 5. Well gauging procedures are described in the FSP included as Appendix B. In general, gauging activities will be completed using an oil-water interface probe (to be decontaminated after use at each monitoring well to minimize the potential for cross-contamination of wells). If NAPL is encountered at a measureable thickness in any of the monitoring wells during the first monitoring event, the NAPL will be removed (to the extent practicable) using disposable polyethylene bailers and containerized for subsequent characterization, off-site transportation, and disposal at an appropriate facility by NYSEG's waste transportation/disposal subcontractor. Each well where NAPL is encountered would be regauged the following day and one week following the initial gauging event. Based on the results of these gauging events, monitoring wells where measurable quantities of NAPL are encountered would be monitored on a monthly basis for twelve months. Monitoring frequencies may be altered based on the rate of NAPL infiltration into the wells and the capacity of the well sumps (if present).

Additional information regarding the placement and construction of NAPL collection wells will be based on observations made during soil excavation activities to identify locations where NAPL is likely to pool, such as low depressions, areas of weathered bedrock, zones of increased fracture frequency or greater fracture apertures, and any other areas of pooled NAPL on top of the bedrock surface. This evaluation effort is discussed further under RD Task 5 – NAPL Collection Wells (Section 3.5).

2.5 PDI Task 5 – Groundwater Treatability Sampling

PDI Task 5 consists of collecting and submitting groundwater samples for laboratory analysis to support the design of a temporary water treatment system. ARCADIS anticipates the need for a temporary water treatment system to support soil excavation activities based on the elevation of the water table and a review of the existing soil characteristics. Up to 10 groundwater samples will be collected from overburden and shallow bedrock monitoring wells within the proposed excavation limits to characterize groundwater quality within the excavation area. Groundwater sampling procedures are described in the FSP (see Appendix B). Groundwater samples will be submitted for the following treatability parameters:

- Total Toxic Organics (TTO)
- Target Analyte List (TAL) inorganics and cyanide (filtered and unfiltered samples)
- Oil and grease
- Total suspended solids (TSS)
- Total dissolved solids (TDS)

- 5-Day biological oxygen demand (BOD5)
- Chemical oxygen demand (COD)
- Bioactivity (via iron-reducing, sulfate-reducing, and slime-forming bacteria)
- Total kjeldahl nitrogen (TKN)
- Hardness
- pH

The parameters identified above may be modified (i.e., parameters may be added) based on criteria for discharging to the sanitary sewer. Analytical results will be used to evaluate and select components of a temporary water treatment system that will treat groundwater removed from the excavation area. Additional information regarding the design of the temporary water treatment system is discussed under RD Task 3 – Temporary Water Treatment System (Section 3.3)

2.6 PDI Task 6 – Site Survey

PDI Task 6 consists of conducting a site survey to document the location of PDI sampling activities and utilities described in Section 2 and to facilitate preparation of the remedial design as described in Section 3. Additional site survey information will be generated as part of the PDI to identify the PDI sampling locations in both the upland portion of the site and within the outlet. The additional survey will be used during the remedial design process to determine pre-existing conditions in order to restore the site to the approximate pre-construction lines and grades following implementation of the remedy. A description of the proposed survey activities is presented in the following subsections.

2.6.1 PDI Task 6a – Upland Survey

Following the completion of upland investigation activities (i.e., soil borings, test pits, etc.), a survey will be completed to identify the location and ground surface elevation for each of the upland PDI locations. In addition, utilities identified during the PDI activities will be surveyed so protection of these utilities can be considered during preparation of the remedial design. Additional topographic survey information will also be obtained following the removal of the existing substation to obtain a pre-construction baseline to facilitate restoration of the site to pre-construction conditions following the completion of remedial activities. The topographic survey will be completed to facilitate generation of one-foot site contours.

2.6.2 PDI Task 6b – Outlet Bathymetric Survey

During the completion of sediment investigation activities, location and elevation of each of the outlet PDI locations will be surveyed. Additionally, a bathymetric survey will be completed to support the design of sediment removal/excavation systems/methods. The bathymetric survey will be conducted for the portion of the outlet generally extending from sediment sampling transects T-01 to T-12 and T-17 to T-19 (or further if additional transects are sampled as part of the PDI Task 3b described above).

Bathymetric survey data will be collected manually using conventional land-based survey methods. As necessary, based on water depths and flow conditions, portions of the survey may be performed from a boat. Survey data will be collected at regular ten foot intervals across new transects to be established along the outlet. Additional data will be collected at significant or irregular grade changes along each transect, and may require establishment of additional transects if there are other such changes (i.e., ledges, depressions) observed between adjacent transects. The location and elevations of any significant channel obstructions (e.g., snags, debris) or structures (e.g., outfalls) will also be recorded. Location of the thalweg line, bank toe of slope and current water line will be documented. The survey information will be used to prepare a figure depicting the bathymetry of the outlet bottom.

2.7 PDI Task 7 – PDI Documentation

Under PDI Task 7, the results from the PDI will be documented in a PDI Summary Report. Those results, along with existing site information, will support the basis for the remedial design. The PDI Summary Report will include the following:

- A summary of the PDI activities including health and safety monitoring, field observations, sampling results, problems encountered, and other pertinent information necessary to document that the site activities were performed pursuant to this RDWP.

- Documentation of utilities in the anticipated remedial construction area.

- Boring logs.

- Summary tables presenting the geotechnical and analytical testing results.

- An updated site plan showing the locations of the soil borings, sediment sampling locations, and the locations of the identified above- and below-ground utilities.

- Site drawing depicting the location of MGP impacts

- An updated schedule for the completion of the remedial design.

3. Remedial Design

This section presents a description of the remedial design activities to be completed to prepare the design for the selected site remedy. Work activities associated with preparing the remedial design will be conducted under the following tasks:

- RD Task 1 – Soil Excavation
- RD Task 2 – Sediment Removal
- RD Task 3 – Temporary Water Treatment System
- RD Task 4 – Backfill
- RD Task 5 – NAPL Collection Wells
- RD Task 6 – Site Restoration

A description of each task associated with the preparation of the remedial design is presented below. It should be noted that one element of the site remedy is relocation of the electrical substation. Substation relocation will be performed by NYSEG and therefore is not included in this RD.

3.1 RD Task 1 – Soil Excavation

RD Task 1 consists of designing the necessary support systems to complete the soil removal activities to the limits depicted in the NYSDEC ROD (or revised limits based on the PDI tasks described in Section 2).

3.1.1 RD Task 1a – Excavation Support

As indicated in the NYSDEC ROD, approximately 17,000 cubic-yards of soil containing total PAHs at concentrations greater than 500 ppm or soil containing visual tar or NAPL (not including soils exhibiting odors, staining, or sheens) will be removed from the site. The approximate excavation limits are depicted on Figure 3 and URS Feasibility Study Figure 6-1 included in Appendix A. Soil excavation limits and approximate quantities will be finalized based on the results of PDI Task 2a – Soil Delineation Sampling (Section 2.2.1).

Potential excavation support systems (e.g., engineered slopes, sheet pile walls, cofferdams, king piles, etc.) will be evaluated based on the results of the soil PDI activities to be conducted under PDI Task 2, respectively. The geotechnical data obtained as part of the PDI will then be used to design an appropriate excavation support system to facilitate soil removal and backfilling activities at the site. The excavation support system will be designed in manner that will accomplish the following:

- Protect the natural gas distribution lines (and other potential utilities) that may be affected by excavation and backfill activities.
- Maintain the alignment of the outlet during excavation and backfilling activities.
- Protect structures, utilities, and slopes located in proximity to the excavation area.
- Control groundwater and surface water flow into the excavation during excavation and backfilling activities.

As indicated in Section 5, the final type, locations, and design of the excavation support system will be presented in the remedial design documentation.

3.1.2 RD Task 1b – Excavation Area Dewatering

Soil excavation will be completed to the top of bedrock, which is located at depths between 10 and 15 feet bgs. Groundwater at the site is generally encountered at depths between 4 and 6 feet bgs. Therefore, at least some level of groundwater removal will be required to facilitate excavation of the upland soils. A MODFLOW groundwater model will be utilized to evaluate the volume and rate of groundwater removal that would be necessary to dewater the excavation area during soil removal and backfilling activities. The model will be developed utilizing existing site hydrogeologic data included in the soil boring logs and the results of hydraulic testing conducted as part of the SRI activities. Model layers will include the overburden and bedrock geologic units. Additional hydraulic influences including the outlet and the selected excavation support system will also be incorporated into the model.

The MODFLOW model will be used to simulate hydrogeologic site conditions and evaluate groundwater extractions rates to complete soil excavation and backfilling activities. Groundwater extraction rates will be used to aid in the design of a temporary water treatment system under RD Task 3 – Temporary Water Treatment System (Section 3.3).

3.2 RD Task 2 – Sediment Removal

RD Task 2 consists of design methods and means to conduct sediment removal within the outlet. As indicated above, the current selected remedy presented in the NYSDEC ROD includes surface sediment removal in the vicinity of SRI sediment sampling locations SED-09 and SED-12. Assuming removal of these areas alone, the need for support systems is not considered necessary as the sediment removal is shallow (i.e., less than 2 feet) and can be completed in a relatively short duration. Sediment management practices for these removal areas (e.g., installation of silt curtains, temporary barriers to divert outlet flow) may be employed. However, additional sediment removal areas may be identified based on the results of PDI Task 3b – Sediment Delineation Sampling. Depending on the extent of sediment removal required following completion of the PDI activities, the sediment removal may be addressed in a separate remedial design from the upland remedial design to facilitate implementation of the upland and sediment components of the remedy as separate phases. The additional sediment removal efforts (if necessary) may require more extensive excavation support methods ranging from porta-dams or other similar temporary retaining systems to more robust sediment excavation support systems (i.e., sheet piling, cofferdams, rock-pinned support systems, etc.). Additional sediment removal design components could include management of surface water within outlet via diversions; bypass pumping, or dewatering and treatment of surface water. Potential excavation support systems and water management requirements/methods will be evaluated and designed based on the results of the sediment PDI activities to be conducted under PDI Task 3.

3.3 RD Task 3 – Temporary Water Treatment System

RD Task 3 will consist of designing a temporary water treatment system to treat groundwater removed from the excavation area during excavation and backfilling activities. As indicated in Section 2.5, groundwater samples will be collected and submitted for laboratory analysis for various treatability parameters to evaluate and select appropriate treatment system components. Treatment system components will be sized to meet the groundwater extraction rates determined based on the results of the RD Task 1b – Excavation Area Dewatering.

The major temporary water treatment system components are anticipated to include an oil-water separator unit for removal of free-phase oils, sand filter and bag filter vessels for removal of suspended solids, an organoclay vessel for removal of residual oils, and granular activated carbon vessels for removal of organic constituents. Additionally, one (or more) frac tanks will be used to store water to facilitate pre-discharge sampling and to provide a backwash water supply. Post-treatment management of the water will also be evaluated under this RD task. Post-treatment water management options include the following:

- Discharge to the local publicly-owned treatment works (POTW) via a nearby sanitary sewer.
- Discharge to outlet under a NYSDEC-State Pollutant Discharge Elimination System (SPDES) permit.
- Containerization and transportation to a privately or publicly-owned treatment facility, although based on the anticipated volume of water to be generated, this alternative is not likely to be used in the RD.

The final discharge/treatment method will be selected based on the feasibility of implementing each option and a comparison of the relative costs for implementing the options and may include use of one or a combination of the above-identified options.

3.4 RD Task 4 – Backfill

RD Task 4 consists of identifying appropriate materials to be used as backfill following soil excavation and sediment removal activities to be completed as part of the site remedy.

3.4.1 RD Task 4a – Upland Backfill

As indicated in the NYSDEC ROD, excavated soil that does not contain visual indications of tar or NAPL and total PAHs at a concentration less than 500 ppm may be staged on-site and reused as subsurface backfill. All excavated material would be segregated based on the presence/absence of visual impacts and staged to facilitate sampling and analysis for total PAHs and BTEX to evaluate treatment and disposal requirements and assess potential reuse as subsurface fill at the site. Following placement of previously excavated site material suitable for reuse, a fabric demarcation layer (i.e., geotextile or other highly visible fabric) will placed over existing site material within the excavation to delineate imported fill from existing site material. Material specifications for the demarcation layer will be developed and included as part of the remedial design.

As indicated in the NYSDEC ROD, the remaining excavation areas will be backfilled with imported material that meets the SCOs for the lower of 6NYCRR Part 375-6 restricted use soil cleanup objectives for commercial future use or for the protection of groundwater. Additionally, the final site surface cover will consist of a two-foot thick ecological buffer along the southern edge of the outlet, measured approximately 25 laterally from the high water level. Soil in this zone will meet the 6NYCRR Part 375-6 SCOs for protection of ecological resources and will be vegetated.

The remedial design will include specifications (i.e. gradations, material types, and analytical criteria) for imported fill materials to reflect existing site soils, as appropriate. Review of previously collected geotechnical data, as well as the geotechnical data collected as part of the PDI activities will be used to specify the fill material. Backfilling protocols (e.g., lift thickness, compaction requirements, etc.) and grading will also be specified in the remedial design.

3.4.2 RD Task 4b – Owasco Lake Outlet Backfill

Remedial design components regarding the backfilling of the outlet will depend on the extent of sediment requiring removal. If no additional sediment removal is required beyond the current areas (i.e., the areas near SED-09 and SED-12) defined in the ROD, the remedial design will incorporate protocols for the type and volume of fill material and the methodologies for placing the fill material. However, if more extensive sediment removal is required based on the results of PDI Task 3b – Sediment Delineation Sampling, a more extensive outlet backfill design will be required. Under this scenario, the outlet backfill design may be addressed in a separate remedial design from the upland remedial design. Components of the design will include restoring the outlet with imported materials to meet the pre-construction lines and grades as documented as part of PDI Task 6b – Bathymetric Survey (Section 2.6.2). Imported sediment backfill materials will be selected such that imported materials are similar to existing outlet sediment, as appropriate. The remedial design will include sediment backfill material specifications (e.g., gradation, material type, and analytical criteria). Review of previously collected geotechnical data, as well as the geotechnical data (potentially) collected as part of the PDI activities will be used to specify the fill material. Backfilling protocols (e.g., lift thicknesses, compaction requirements, etc.) and grading will also be specified in the remedial design.

3.5 RD Task 5 – NAPL Collection Wells

RD Task 4 consists of evaluating the locations and construction details of future NAPL collection wells. As indicated in Section 2.4, a PDI NAPL monitoring program will be implemented to evaluate potential locations of new NAPL collection wells to be installed following soil excavation and site restoration activities. Additionally, bedrock characteristics will be observed during soil excavation activities to identify locations where NAPL is likely to pool such as low depressions, areas of weathered bedrock, zones of increased fracture frequency or greater fracture apertures, and any other areas of pooled NAPL on top of the bedrock surface. These areas will be surveyed to document additional potential locations for new NAPL collection wells. The information obtained during the NAPL monitoring program (i.e., locations of recoverable amounts of NAPL and the rate of NAPL recovery), the construction details of the existing monitoring wells at locations where NAPL consistently accumulates, and the visual observations of during upland soil removal will be used to select NAPL collection well locations and construction type.

As indicated in the NYSDEC ROD, an estimated 14 NAPL collection wells will be installed as part of the site remedy. Following soil excavation and site restoration activities, up to half of these wells will be installed at the locations selected based on the PDI NAPL monitoring program and observations made during the upland soil removal activities. Following installation, an additional NAPL monitoring program will be conducted to assess the effectiveness of these new wells at collecting NAPL. Following completion of the NAPL monitoring program, the remainder of the NAPL collection wells will be installed at locations that may enhance NAPL recovery.

The remedial design will include specifications for NAPL collection well construction and a proposed NAPL monitoring program for the initial set of NAPL collection wells to be installed following upland soil removal activities.

3.6 RD Task 6 – Site Restoration

RD Task 6 consists of developing the final surface restorations to be completed at the site. The final surface cover for the excavation area will be selected and specified (i.e., type and gradation) as part of the remedial design. Final surface covers are anticipated to consist of either asphalt pavement or gravel to provide access to the gas regulator building. Remaining surfaces will be vegetated, as appropriate, to prevent soil erosion and sedimentation. Final surfaces will meet the pre-construction lines and grades as documented as part of PDI Task 6a – Upland Survey (Section 2.6.1).

4. Permits and Approvals

The remedial design will be developed to meet applicable SCGs, permits and approvals. In addition to NYSDEC approval of the remedial design, permits and approvals will be necessary to conduct the PDI field activities and to implement the NYSDEC-selected remedy.

4.1 PDI Permits and Approvals

Permits and approvals necessary to complete PDI activities consist of the following:

- Access agreements to conduct NAPL monitoring activities. Monitoring wells MW-08S, MW-08D, MW-09S, MW-09D, MW-10S, MW-10D, MW-11S, MW-11D, MW-12D, MW-13B, MW-14D, MW-15D, MW-16D, MW-17D, and MW-18D are located on properties not owned by NYSEG. NYSEG will need to secure access agreements with the owners of the properties prior to conducting the NAPL monitoring program.

- Nationwide Permit (NWP) 6 for conducting work within outlet. If sediment sampling cannot be completed by hand-driven methods as described in Section 2.3.1 and mechanical methods are required to complete the sampling, a United States Army Corp of Engineers (USACE) NWP6 may be required. NYSEG will coordinate with the USACE to obtain the permit, as necessary.

4.2 RD Permits and Approvals

Permits and approvals necessary to complete the remedial construction activities include (but are not limited to) permits for the final discharge/treatment of groundwater removed from the excavation area and approval from and coordination with the City of Auburn and the USACE.

As indicated in Section 3.3, treated water may potentially be discharged to the local POTW or to outlet. Treated groundwater would have to meet the requirements of a temporary discharge permit issued by the POTW if water is discharged to the sanitary sewer. Treated water discharged to outlet would have to meet the requirements of a NYSDEC SPEDS permit. As indicated in Section 3.3, the final disposal/treatment method for treated groundwater will be evaluated as part of the remedial design.

Removal of MGP-impacted sediment will likely be conducted in accordance with USACE approval and oversight and NYSEG will likely be required to obtain a Joint Permit for Protection of Waters from the NYSDEC and the USACE to complete any remedial activities within outlet. Additionally, the City of Auburn Department of Municipal Utilities controls the series of dams along outlet within the city. Remedial construction activities would have to be coordinated with the City of Auburn to ensure releases from upstream dams or backups at downstream dams do not jeopardize the stability of soil or sediment excavation support systems or the health and safety of remedial construction workers at the site. A final list of permits necessary to implement the remedy will be identified in the RD.

5. Remedial Design Documents

Consistent with the requirements set forth in DER-10 (NYSDEC, 2002), and the Order, the following remedial design submittals will be prepared:

- Preliminary (50%) Design Report
- Final Design Report

The contents of each remedial design document are presented below. As identified above in Section 3, the RD may be broken into two separate phases if additional sediment removal is required based on the results of the PDI activities. If additional sediment removal is required, the initial RD would address the upland portion of the site and a second RD would address the outlet sediments.

5.1 Preliminary (50%) Remedial Design Report

It is anticipated that the Preliminary (50%) Remedial Design Report will include the following information:

- An introductory section that will provide a brief overview of the remedial design, site background information, design report objectives and report organization.
- A summary of the PDI activities, including the results obtained for the PDI activities.
- A summary of the remedy with a basis of design that describes the proposed remedial design and presents information used to develop the design and construction components of the project. Design calculations will also be included, where appropriate, to support the basis of design.
- A description of site controls for protecting the public health, safety, welfare and environment and to maintain the effectiveness of the remedial action.
- The regulatory and permitting requirements associated with implementing the activities described in the Preliminary and Final Design Reports.
- A general description of the various components associated with completing the remedial construction activities.

- A set of engineering design drawings that represent an accurate identification of existing site conditions and an illustration of the work proposed. Each engineering design drawing will include a north arrow (where applicable), scale, legend, definitions of all symbols and abbreviations and sheet number. It is anticipated that the engineering design drawings will include, at a minimum, the following:

  – Title Sheet – to include at least the title of the project, key map, date prepared, sheet index and NYSDEC project identification.

  – Existing Site Conditions – to include pertinent property data including owners of record for all properties adjacent to the site (as necessary); site survey including the distance and bearing of all property lines that identify and define the project site; all easements, right-of-ways and reservations (as necessary); existing buildings and structures, wells, facilities and equipment; a topographic survey of existing contours and spot elevations within the project limits of disturbance, based on United States Geological Survey datum; all known existing underground and aboveground utilities; and location and identification of significant natural features, including, among other things, wooded areas, water courses, wetlands and flood hazard areas.

  – Site Remediation Plan – to include minimum requirements for temporary erosion and sedimentation controls; site facilities (parking areas, decontamination area, equipment/material lay down area and adjacent properties that will be used for access); limits of excavation; excavation support limits; and relocation of utilities (if any).

  – Restoration Plan – to include final topographic survey (proposed contours and spot elevations) of the site, limits of the final surface covers, location of new structures and/or wells, final surface restoration for disturbed adjacent properties and other final restoration features.

  – Excavation Support Profile and Details – to include a profile of excavation support, structural details related to the type of excavation support to be used and other miscellaneous details related to the excavation support.

  – Temporary Water Treatment System Details – to include a piping and instrumentation diagram of the temporary water treatment system and treatment system component specifications.

  - Miscellaneous Details – to include details related to the surface cover profiles, temporary erosion and sedimentation controls, decontamination area, final surface water runoff, and NAPL collection wells.

- Technical specifications (table of contents only).

- A storm water pollution prevention plan (SWPP) to provide a plan to minimize soil erosion in disturbed areas of the site and minimize the discharge of sediment in storm water runoff.

- A waste management plan (WMP) that describes the characterization, handling, treatment, and disposal requirements for various waste materials to be generated as a result of the remedial activities.

- A community air monitoring plan (CAMP) that describes the monitoring activities that will be conducted to detect potential airborne releases of constituents of concern during the implementation of remedial activities.

- A construction quality assurance plan (CQAP) that describes the materials, procedures, and testing necessary for proper construction, evaluation, and documentation during remedial activities.

- A description of operation, maintenance, and monitoring activities to be undertaken after the NYSDEC has approved construction of the remedial design, including the number of years during which such activities will be performed.

5.2 Final Remedial Design Report

In addition to the items identified for the Preliminary (50%) Design Report, the Final Design Report will include the following information:

- Revisions to the Preliminary (50%) Remedial Design Report based on NYSDEC comments, as appropriate.

- Remedial Action Schedule (Preliminary), which presents the preliminary anticipated schedule for implementation of the remedial activities.

- Final Engineering Design Drawings and Technical Specifications.

- A HASP for the protection of persons at the site during construction. This plan shall be prepared in accordance with 29 Code of Federal Regulations 1910 by a certified health and safety professional.

- A Citizen Participation Plan which incorporates appropriate activities outlined in the NYSDEC's, "*Draft Citizen Participation Handbook for Remedial Programs*", dated August 2008.

6. Remedial Design Schedule

Presented below is the anticipated schedule for completing the PDI activities identified in this Work Plan and a preliminary schedule for completion of the remedial design and construction of the selected remedy for the site.

- February 2010: NYSDEC approval of this RDWP
- Spring 2010: Obtain Nationwide permit and access agreements
- Summer 2010: Implement field activities associated with the sediment PDI activities described in this work plan
- Fall 2010: Submit Data Summary for sediment investigation
- 2011: Implement upland PDI activities (following removal of the electrical substation)
- Mid 2012: 50% Remedial Design (which will include a summary of the PDI results)
- Late 2012: Final Remedial Design
- Late 2012/Early 2013 Bidding for remedial construction
- Spring 2013: Implement remedial action

NYSEG intends to complete electrical substation removal activities and install/construct new utility poles(s)/tower(s) and overhead transmission lines late 2010 or early 2011. Based on the above PDI schedule, the tentative schedule for preparing the remedial design for the selected site remedy is 2012 to facilitate NYSDEC review and approval, bidding and review of project submittals over the winter of 2012/2013 to accommodate remedial construction to be initiated during the 2013 construction season. If the scope of the sediment removal activities expands based on the PDI activities, the sediment removal may be addressed in a separate remedial design from the upland. A schedule for submitting this additional remedial design (if necessary) will be established with NYSDEC.

7. References

NYSDEC. 2002. *Draft DER-10 Technical Guidance for Site Investigation and Remediation*. December 25, 2002.

NYSDEC, 2009. *Record of Decision, NYSEG Clark Street – Auburn MGP Site.* Site Number 7-06-008. March 2009.

URS, 2008. *Supplemental Remedial Investigation Report*, prepared for the NYSEG Clark Street Former Manufactured Gas Plant, Auburn, New York. June 2008.

URS, 2009. *Feasibility Study*, prepared for the NYSEG Clark Street Former Manufactured Gas Plant, Auburn, New York. February 2009.

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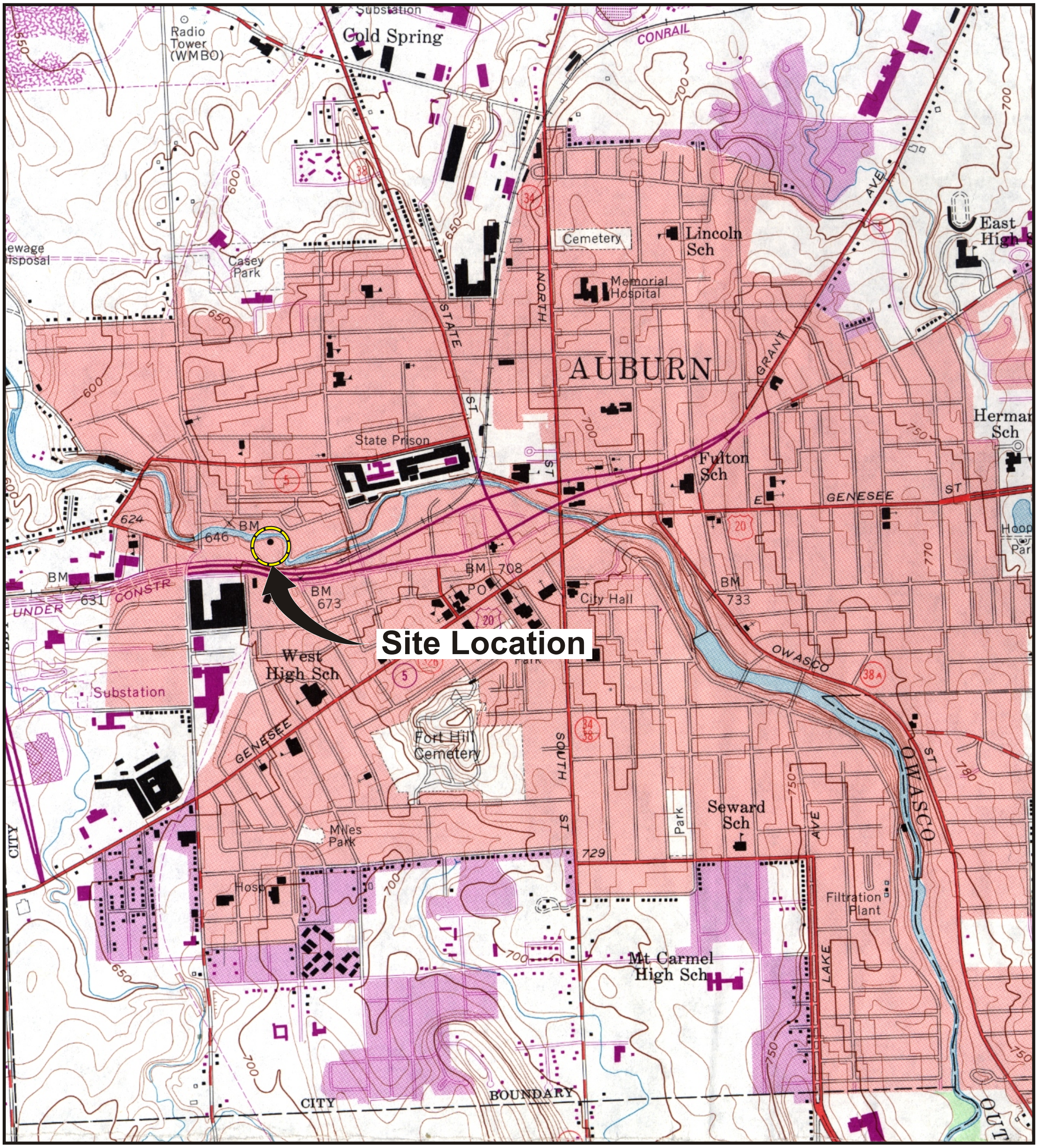
Figures



REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., AUBURN, NY, 1954, PHOTOREVISED 1980.

2000' 0 2000'

Approximate Scale: 1" = 2000'

Area Location

NYSEG
CLARK STREET FORMER MGP SITE
AUBURN, NEW YORK
REMEDIAL DESIGN WORK PLAN

SITE LOCATION MAP

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FIGURE
1

07/17/09 SYRACUSE-141ENV-DJHOWES
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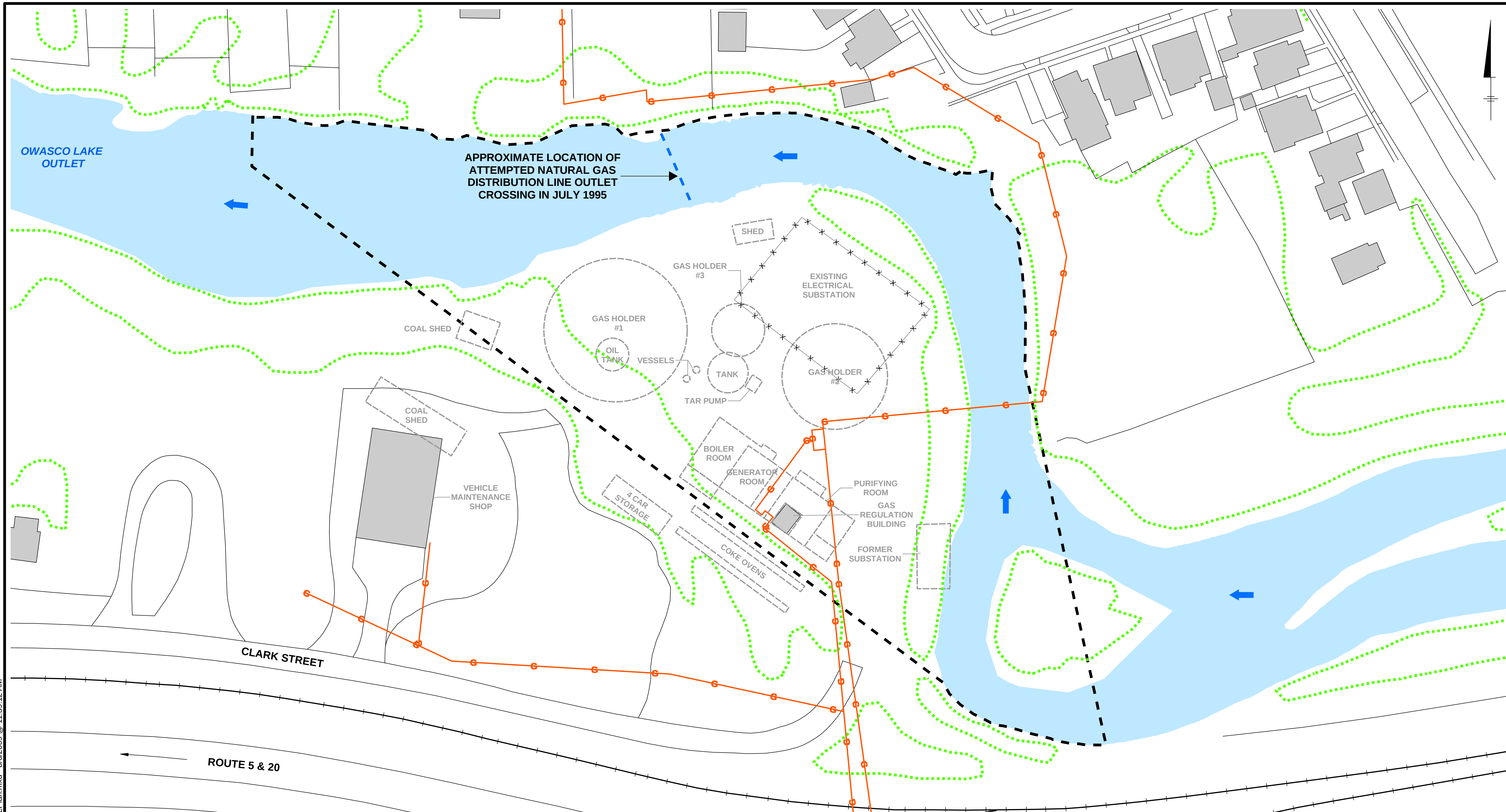

LEGEND:

- NATURAL GAS LINE
- CHAIN LINK FENCE
- RAILROAD
- TREE LINE
- FORMER MGP STRUCTURE/FORMER ELECTRICAL SUBSTATION
- EXISTING BUILDING
- SITE BOUNDARY (SEE NOTE 2)

0 70 140 Feet

GRAPHIC SCALE

NOTE:

1. BASEMAP GENERATED FROM SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT FIGURE 1-2 PREPARED BY URS (1117329.00000\DB\GIS\SITEPLAN.MXD) DATED 07/13/2006.
2. SITE BOUNDARY AS DEPICTED IN NYSDEC ROD.

NYSEG
CLARK STREET FORMER MGP SITE
AUBURN, NEW YORK

REMEDIAL DESIGN WORK PLAN

SITE PLAN

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FIGURE 2

CITY: SYR DIV/GROUP: 40 DB: KEW PM: JB
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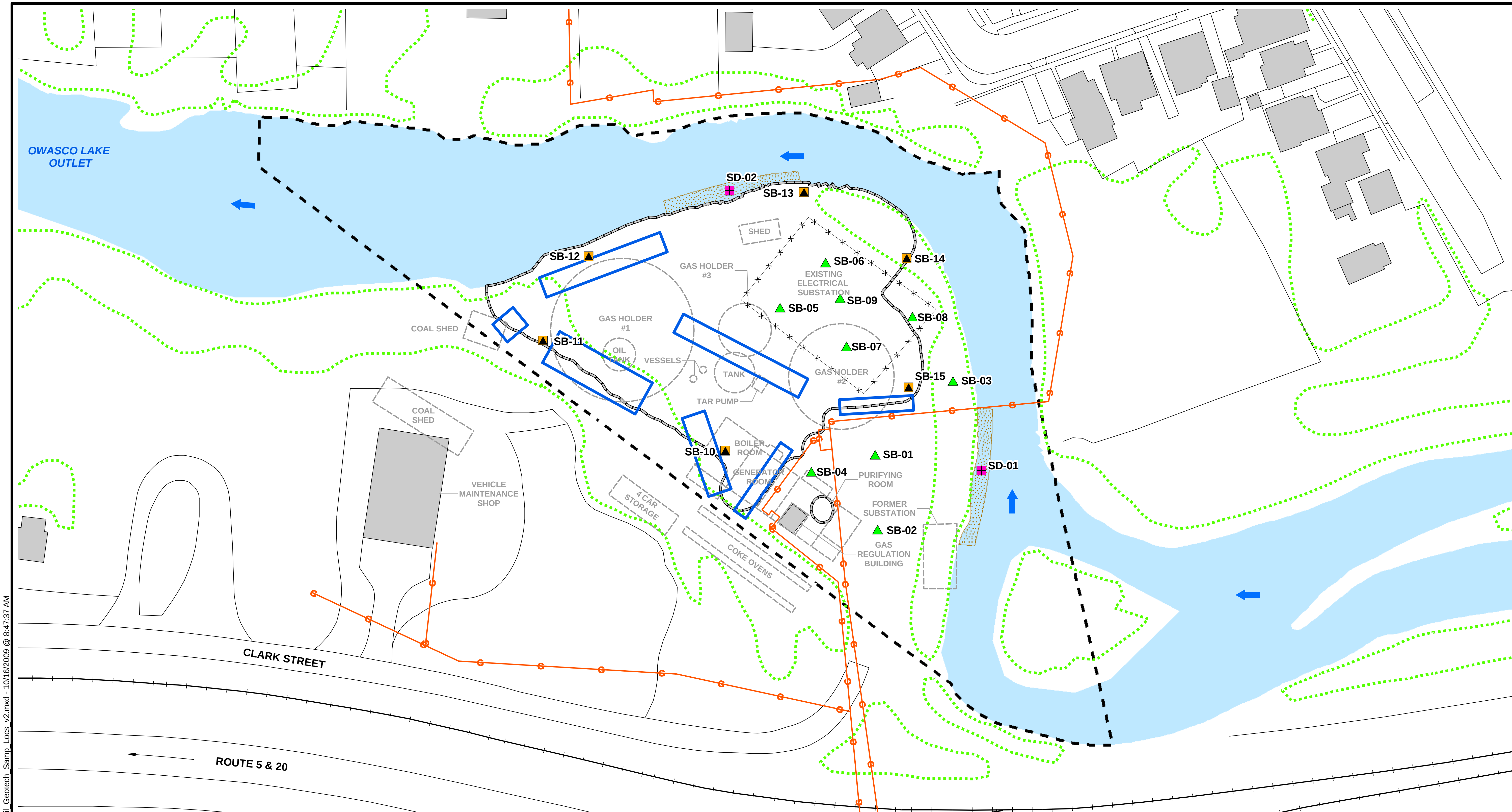

0 70 140
Feet
GRAPHIC SCALE

LEGEND:

- NATURAL GAS LINE
- PROPOSED SOIL DELINEATION BORING
- PROPOSED GEOTECHNICAL SOIL BORING
- PROPOSED GEOTECHNICAL SEDIMENT BORING
- CHAIN LINK FENCE
- RAILROAD
- TREE LINE
- FORMER MGP STRUCTURE/FORMER ELECTRICAL SUBSTATION
- PROPOSED TEST PIT AREAS (SEE NOTE 3)
- EXISTING BUILDING
- EXCAVATION LIMITS PER NYSDEC ROD
- SEDIMENT REMOVAL LIMITS PER NYSDEC ROD
- SITE BOUNDARY (SEE NOTE 2)

NOTE:

1. BASEMAP GENERATED FROM SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT FIGURE 1-2 PREPARED BY URS (1117329.00000\DB\GIS\SITEPLAN.MXD) DATED 07/13/2006.
2. SITE BOUNDARY AS DEPICTED IN NYSDEC ROD.
3. TEST PIT AREAS ARE APPROXIMATE AND MAY BE REFINED IN THE FIELD AT THE DISCRETION OF THE PROJECT GEOTECHNICAL ENGINEER BASED ON SUBSURFACE CONDITIONS ENCOUNTERED. MULTIPLE TEST PITS MAY BE COMPLETED WITHIN EACH AREA.

NYSEG
CLARK STREET FORMER MGP SITE
AUBURN, NEW YORK

REMEDIAL DESIGN WORK PLAN

SOIL AND GEOTECHNICAL SAMPLING LOCATION MAP

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FIGURE
3

CITY: SYR DIV/GROUP: 40 DB: KEW PM: JB
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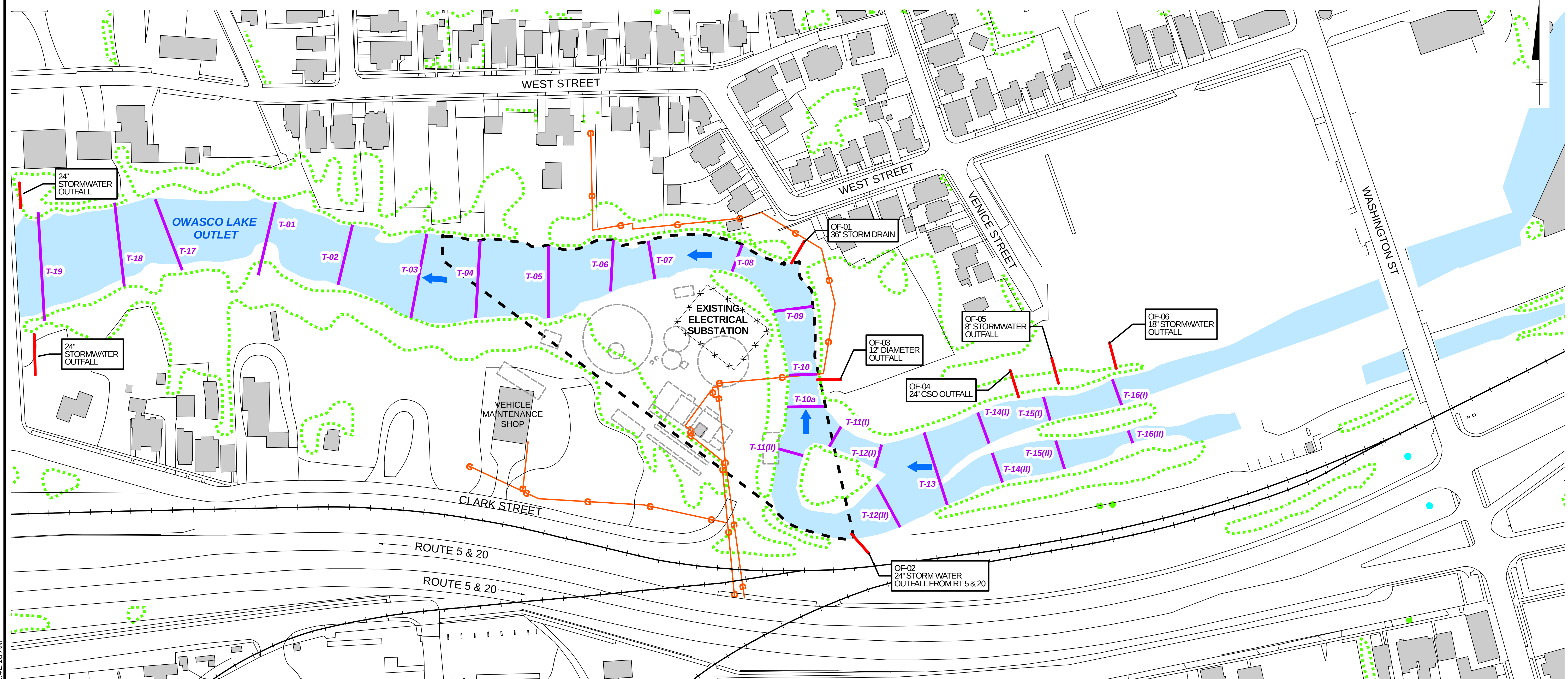

LEGEND:

- TRANSECT LOCATION
- NATURAL GAS LINE
- CHAIN LINK FENCE
- RAILROAD
- TREE LINE
- FORMER MGP STRUCTURE/FORMER ELECTRICAL SUBSTATION
- EXISTING BUILDING
- SITE BOUNDARY (SEE NOTE 3)

0 150 300 Feet

GRAPHIC SCALE

NOTES:

1. TRANSECT T-07 SHIFTED DOWNSTREAM TO CORRESPOND WITH LOCATION OF ATTEMPTED NATURAL GAS DISTRIBUTION LINE OUTLET CROSSING CONDUCTED IN JULY 1995.
2. BASEMAP GENERATED FROM SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT FIGURE 1-2 PREPARED BY URS (1117329.00000\DB\GIS\SITEPLAN.MXD) DATED 07/13/2006.
3. SITE BOUNDARY AS DEPICTED IN NYSDEC ROD.

NYSEG
CLARK STREET FORMER MGP SITE
AUBURN, NEW YORK

REMEDIAL DESIGN WORK PLAN

SEDIMENT SAMPLING TRANSECT LOCATION MAP

ARCADIS

FIGURE
4

CITY: SYR DIV/GROUP: 40 DB: KEW PM: JB
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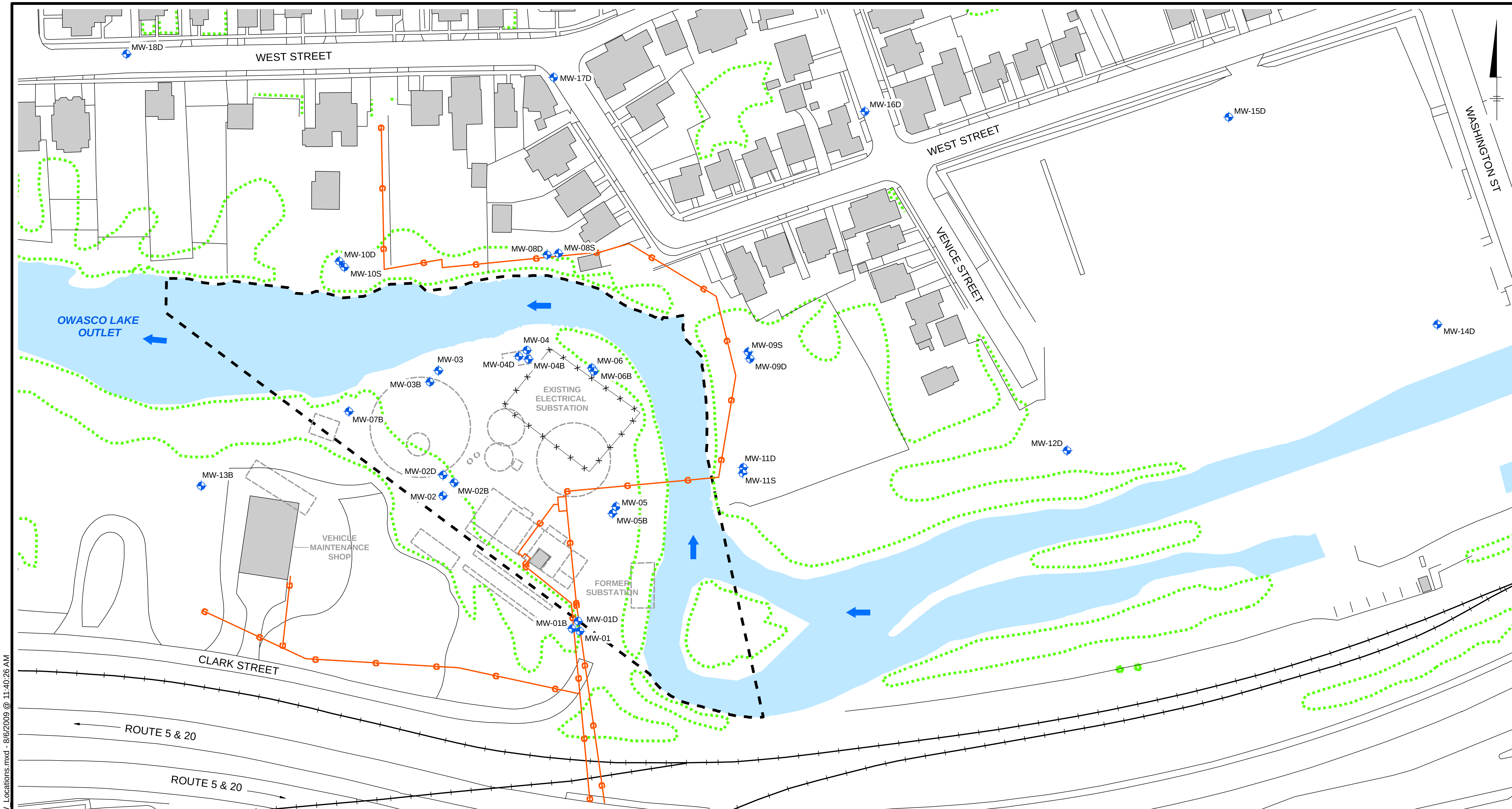

LEGEND:

- EXISTING MONITORING WELL
- NATURAL GAS LINE
- CHAIN LINK FENCE
- RAILROAD
- TREE LINE
- FORMER MGP STRUCTURE/FORMER ELECTRICAL SUBSTATION
- EXISTING BUILDING
- SITE BOUNDARY (SEE NOTE 2)

0 100 200 Feet

GRAPHIC SCALE

NOTE:

1. BASEMAP GENERATED FROM SUPPLEMENTAL REMEDIAL INVESTIGATION REPORT FIGURE 1-2 PREPARED BY URS (1117329.00000\DB\GIS\SITEPLAN.MXD) DATED 07/13/2006.
2. SITE BOUNDARY AS DEPICTED IN NYSDEC ROD.

NYSEG
CLARK STREET FORMER MGP SITE
AUBURN, NEW YORK

REMEDIAL DESIGN WORK PLAN

MONITORING WELL LOCATION MAP

ARCADIS

FIGURE
5

CITY: SYR DIV/GROUP: 40 DB: KEW PM: JB
NYSEG (B0013091.0000.00020)
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Appendix A

Select Tables and Figures prepared by URS

TABLE 1-1
POTENTIALLY APPLICABLE STANDARDS, CRITERIA AND GUIDANCE

Division/ Agency	Title	Standard or Guidance	Requirements
DAR/ NYSDEC	Air Guide 1 – Guidelines for the Control of Toxic Ambient Air Contaminants	G	▪ Control of toxic air contaminants ▪ Screening analysis for ambient air impacts ▪ Toxicity classifications ▪ Ambient standards – short-term/annual
DAR/ NYSDEC	6 NYCRR Part 200 (200.6) – General Provisions	S	▪ Ambient standards - Prohibits contravention of Ambient Air Quality Standards or causes of air pollution
DAR/ NYSDEC	6 NYCRR Part 201 - Permits & Certificates	S	▪ Ambient standards - Prohibits construction/operation without a permit/certificate
DAR/ NYSDEC	6 NYCRR Part 211 (211.1) – General Prohibitions	S	▪ Ambient standards -Prohibits emissions which are injurious to human, plant, or animal life, or causes a nuisance
DAR/ NYSDEC	6 NYCRR Part 212 – General Process Emission Sources	S	▪ Establishes control requirements
DAR/ NYSDEC	6 NYCRR Part 257 – Air Quality Standards	S	▪ Applicable air quality standards
DER/ NYSDEC	TAGM HWR-89-4031 Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites	G	▪ Dust suppression during Interim Remedial Measures/Remedial Actions
DER/ NYSDEC	TAGM HWR-92-4030 Selection of Remedial Actions at Inactive Hazardous Waste Sites	G	▪ Remedy selection criteria/evaluations
DER/ NYSDEC	TAGM HWR-92-4042 Interim Remedial Measures	G	▪ Define and track Interim Remedial Measures (IRMs)
DER/ NYSDEC	TAGM 4061 – Management of Coal Tar Waste and Coal Tar Contaminated Sediment From Former Manufactured Gas Plants (MGPs)	G	▪ Coal tar waste and coal tar contaminated soils and sediment that exhibit the toxicity characteristic for Benzene (D018) may be conditionally exempt from 6 NYCRR Parts 370 – 374 and 376 when they are destined for permanent thermal treatment

TABLE 1-1 (Continued)
POTENTIALLY APPLICABLE STANDARDS, CRITERIA AND GUIDANCE

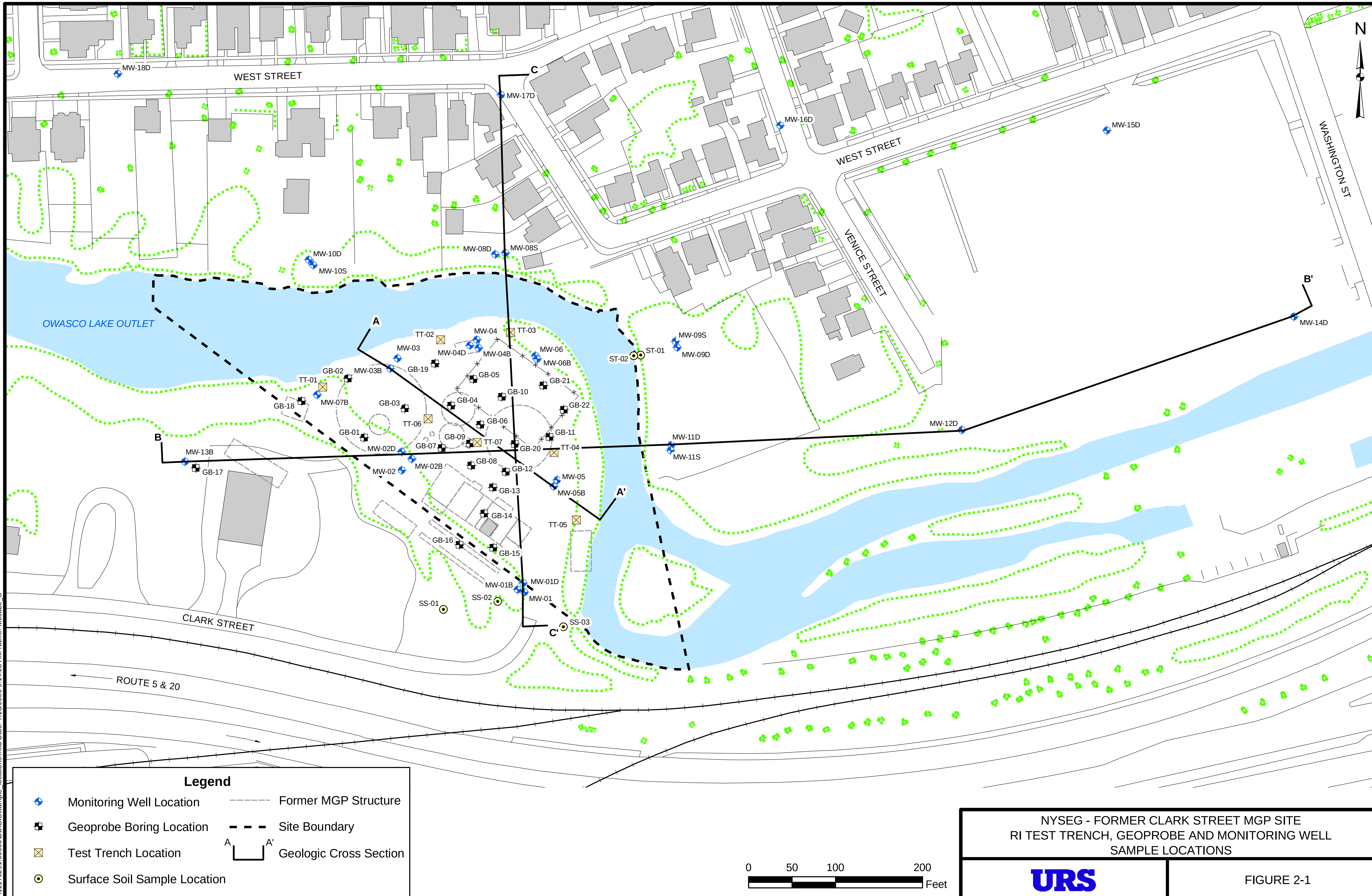
Division/ Agency	Title	Standard or Guidance	Requirements
DER/ NYSDEC	6 NYCRR Part 375 – Inactive Hazardous Waste Disposal Site Remediation Program	S	▪ Remedial program requirements ▪ Private party programs; state funded programs; state assistance to municipalities
DFWMR/ NYSDEC	Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites (FWIA)	G	▪ Habitat assessments ▪ Contaminant impact assessments ▪ Ecological effects of remedies ▪ Remedial requirements ▪ Monitoring ▪ Checklist
DOW/ NYSDEC	Analytical Services Protocols (ASP)	G	▪ Analytical procedures
DOW/ NYSDEC	TOGS 1.1.2 – Groundwater Effluent Limitations	G	▪ Guidance for developing effluent limitations
DOW/ NYSDEC	TOGS 1.1.1 – Ambient Water Quality Standards and Guidance Values	G	▪ Compilation of ambient water quality standards and guidance values
DOW/ NYSDEC	TOGS 1.2.1 – Industrial SPDES Permit Drafting Strategy for Surface Waters	G	▪ Guidance for developing effluent and monitoring limits for point source releases to surface water
DOW/ NYSDEC	TOGS 1.3.8 – New Discharges to Publicly Owned Treatment Works	G	▪ Limits on new or changed discharges to POTWs; strict requirements regarding bioaccumulative and persistent substances; plus other considerations
DOW/ NYSDEC	6 NYCRR Part 702-15(a), (b), (c), (d) & (e)	S	▪ Empowers NYSDEC to apply and enforce guidance where there is no promulgated standard
DOW/ NYSDEC	6 NYCRR Part 700-705 – NYSDEC Water Quality Regulations for Surface Waters and Groundwater	S	▪ 700 – Definitions, Samples and Tests; ▪ 701 – Classifications for Surface Waters and Groundwaters; ▪ 702 – Derivation and Use of Standards and Guidance Values; ▪ 703 – Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards

TABLE 1-1 (Continued)
POTENTIALLY APPLICABLE STANDARDS, CRITERIA AND GUIDANCE

Division/ Agency	Title	Standard or Guidance	Requirements
DOW/ NYSDEC	6 NYCRR Part 750-757 – Implementation of NPDES Program in NYS	S	▪ Regulations regarding the SPDES program
DSHM/ NYSDEC	6 NYCRR Part 364 – Waste Transporter Permits	S	▪ Regulates collection, transport, and delivery of regulated waste
DSHM/ NYSDEC	6 NYCRR Part 360 – Solid Waste Management Facilities	S	▪ Solid waste management facility requirements; landfill closures; construction & demolition (C&D) landfill requirements; used oil; medical waste; etc.
DSHM/ NYSDEC	6 NYCRR Part 370 – Hazardous Waste Management System: General	S	▪ Definitions and terms and general standards applicable to Parts 370-374 and 376
DSHM/ NYSDEC	6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes	S	▪ Hazardous waste determinations
DSHM/ NYSDEC	6 NYCRR Part 372 – Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities	S	▪ Manifest system and record keeping; certain management standards
DSHM/ NYSDEC	6 NYCRR Part 376 – Land Disposal Restrictions	S	▪ Identifies hazardous waste restricted from land disposal
DSHM/ NYSDEC	6 NYCRR Subpart 373-1 – Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements	S	▪ Hazardous waste permitting requirements; includes substantive requirements
DSHM/ NYSDEC	6 NYCRR Subpart 373-2 – Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	S	▪ Hazardous waste management standards such as contingency plans; releases from SWMUs; closure/post closure; container management; tank management; surface impoundments; waste piles; landfills; incinerators; etc.
DSHM/ NYSDEC	6 NYCRR subpart 373-3 – Interim Status Standards for Owners and Operators of Hazardous Waste Facilities	S	▪ Similar to 373-2

TABLE 1-1 (Continued)
POTENTIALLY APPLICABLE STANDARDS, CRITERIA AND GUIDANCE

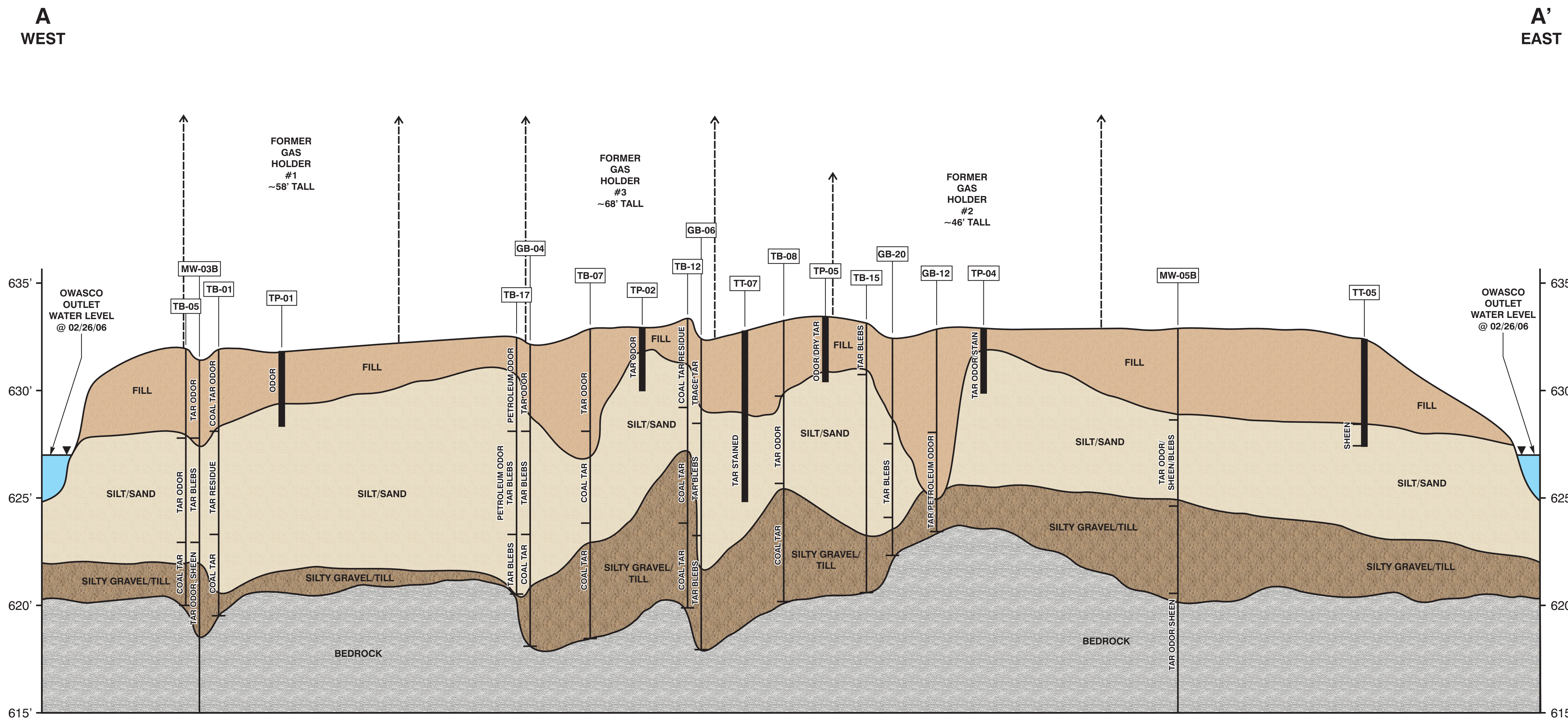
Division/ Agency	Title	Standard or Guidance	Requirements
OSHA/ PESH	29 CFR Part 1910.120; Hazardous Waste Operations and Emergency Response	S	▪ Health and safety
USEPA	40 CFR Part 261 – Hazardous Waste Management System; Definition of Solid Waste; Toxicity Characteristic; Final Rule; Response to Court Order Vacating Regulatory Provisions	S	▪ TCLP may not be used for determining whether MGP waste is hazardous under RCRA
NYSDOH	Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York	S	▪ Guidance for sampling, analysis, evaluation of soil vapor ▪ Soil vapor intrusion mitigation methods
USCOE	Nationwide Permit #38 Notification	G	▪ Notification to the U.S. Army Corps of Engineers for specific activities to effect the containment, stabilization or removal of hazardous or toxic waste materials of special aquatic sites
NYSDEC Resource Manage-ment Services	ECL Article 36 Part 502: Floodplain Management Criteria	G	▪ Floodplain management criteria for projects in flood hazard areas



NYSEG - FORMER CLARK STREET MGP SITE
RI TEST TRENCH, GEOPROBE AND MONITORING WELL SAMPLE LOCATIONS

FIGURE 2-1

N:\11173291.00000\DB\GIS\sample_locations.mxd Date: 7/13/2006 9:14:23 AM Name: Mccabe_S



NOTE: Cross section line is presented on Figure 2-1

20 FEET

VERTICAL EXAGGERATION ~5.0

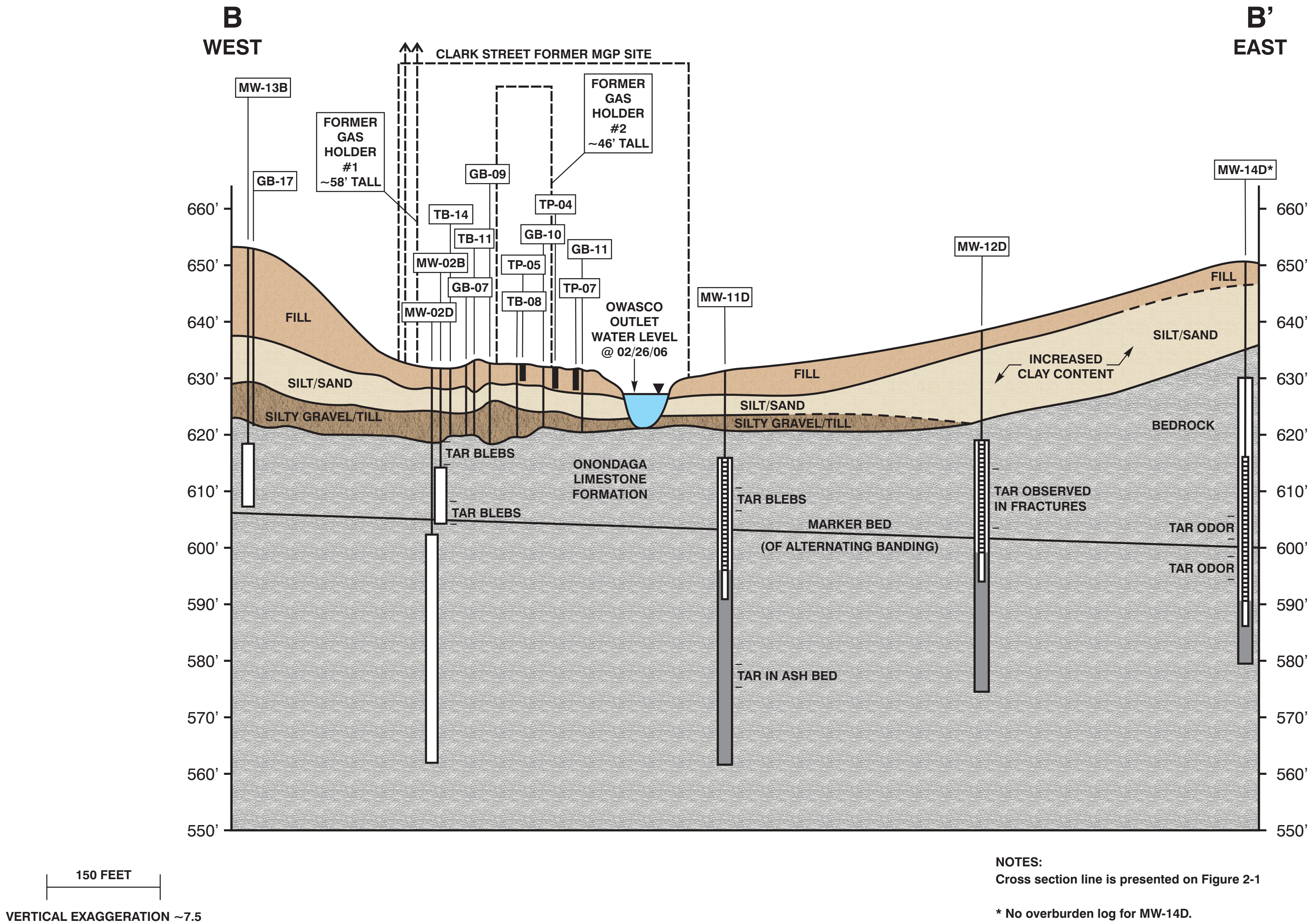
AG19436A-11173291-042508-GCM

OVERBURDEN CROSS-SECTION

URS

FIGURE 3-1

AG19437-11173291-060606-GCM



NOTES:
Cross section line is presented on Figure 2-1

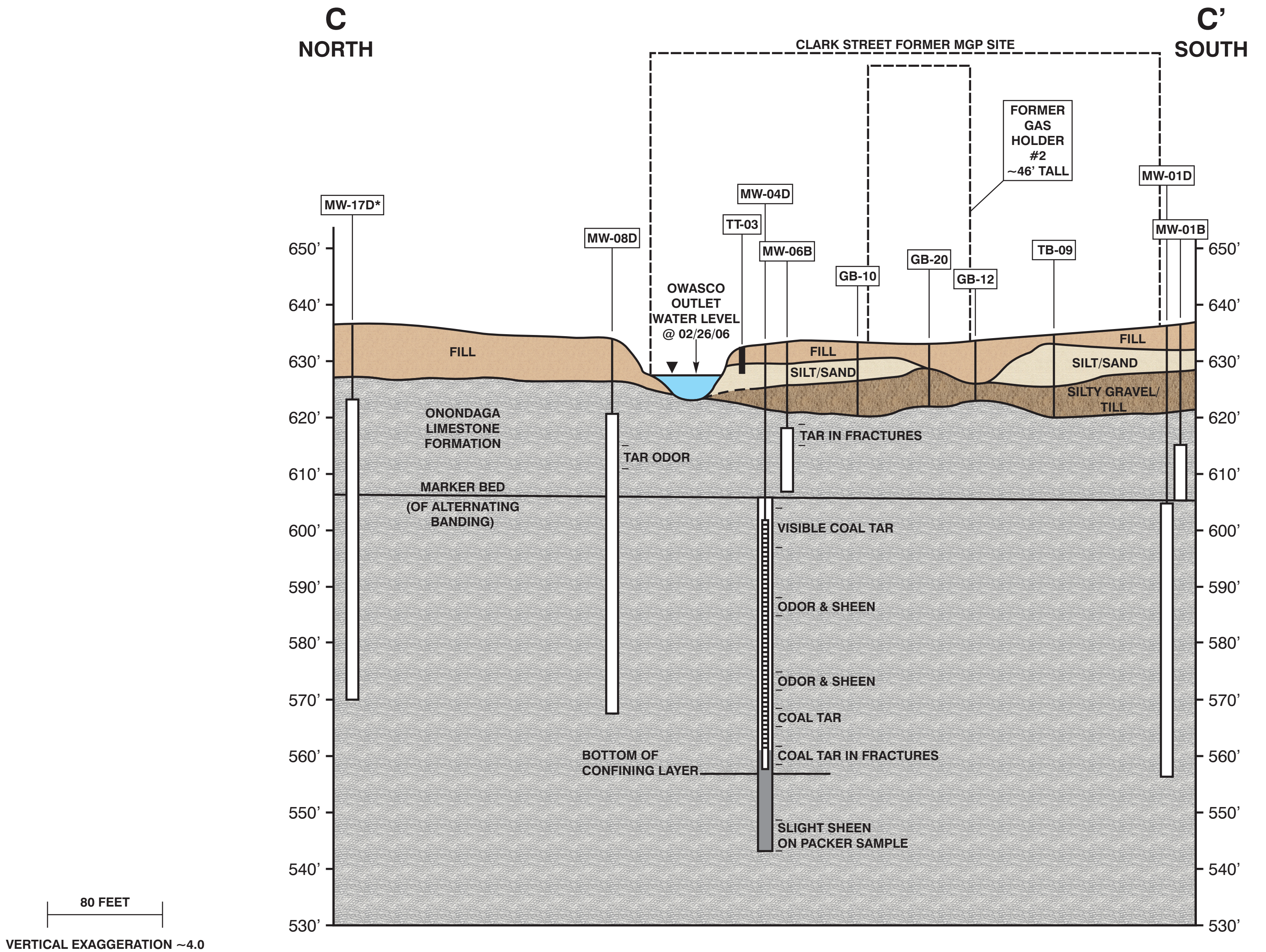
* No overburden log for MW-14D.

URS

BEDROCK CROSS-SECTION (WEST-EAST)

FIGURE 3-2

AG19438-11173291-060606-GCM



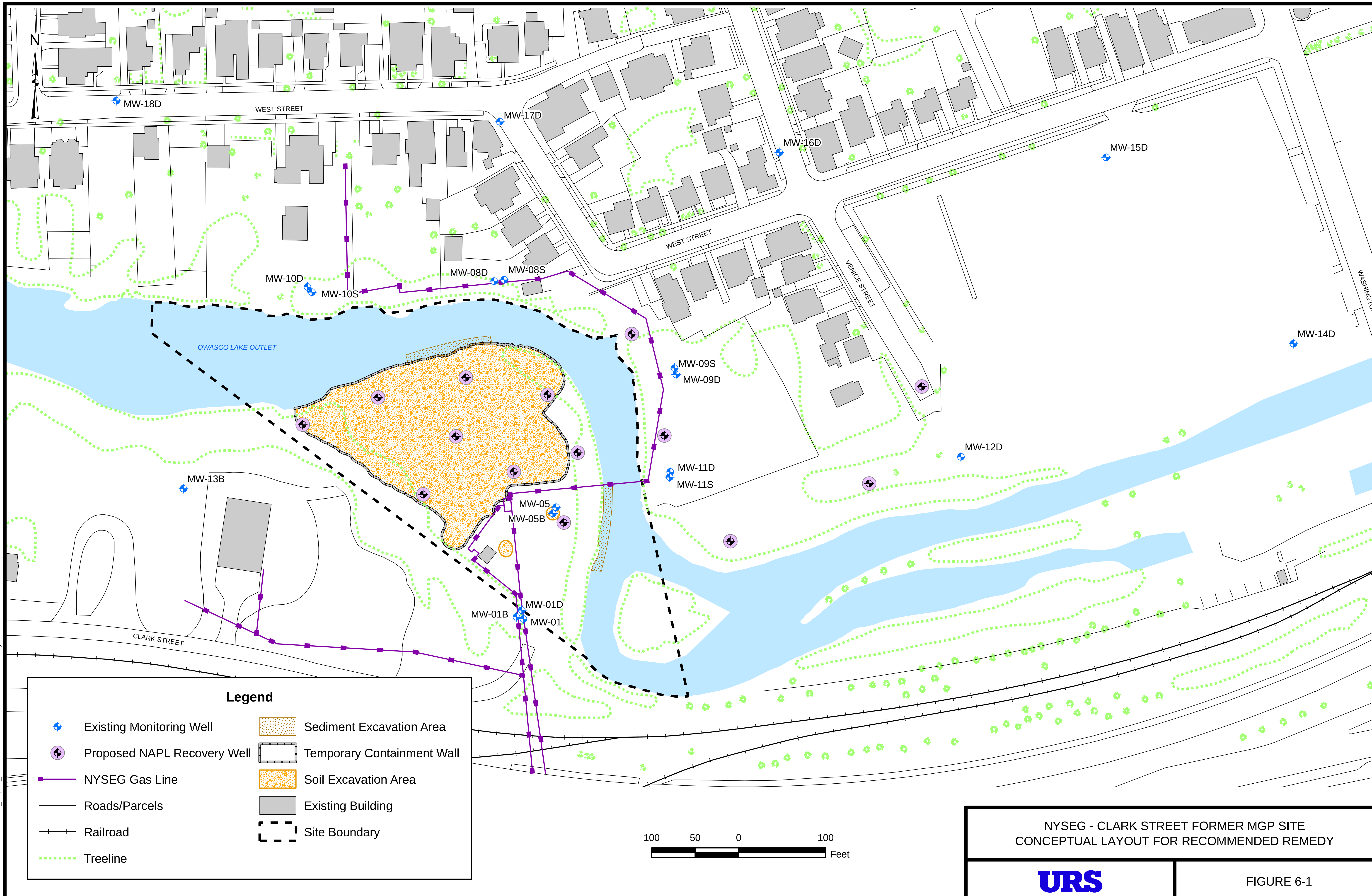
NOTES:
Cross section line is presented on Figure 2-1

* No overburden log for MW-17D.

URS

BEDROCK CROSS-SECTION (NORTH-SOUTH)

FIGURE 3-3



NYSEG - CLARK STREET FORMER MGP SITE
CONCEPTUAL LAYOUT FOR RECOMMENDED REMEDY

FIGURE 6-1

N:\11173291.00000\DB\GIS\FS_Report_10-01-08\FIG 6-1 Recommended Remedy.mxd 11/5/2008 B. Farster

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Appendix B

Field Sampling Plan

Infrastructure, environment, buildings

Imagine the result

NYSEG

Field Sampling Plan

Clark Street Former Manufactured Gas Plant Site
Auburn, New York

February 2010

ARCADIS

Field Sampling Plan

Clark Street Former
Manufactured Gas Plant Site

Prepared for:
NYSEG

Prepared by:
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6723 Towpath Road
P.O. Box 66
Syracuse
New York 13214-0066
Tel 315.446.9120
Fax 315.449.0017

Our Ref.:
B0013091

Date:
February 2010

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Appendix

A DNAPL Contingency Plan

1. Introduction

1.1 General

This *Field Sampling Plan* (FSP) supports of the *Remedial Design Work Plan* (RDWP) prepared by ARCADIS for the NYSEG Clark Street Former Manufactured Gas Plant (MGP) site (the site) located in Auburn, New York. The RDWP describes pre-design investigation (PDI) activities to be conducted at the site in support of completing the remedial design (RD) activities, as also described in the RDWP.

This FSP describes the field procedures and sample collection methods to be used during implementation of the PDI field activities. The FSP should be used in conjunction with the RDWP, the Quality Assurance Project Plan (QAPP), and the Health and Safety Plan (HASP) that have been prepared for the site. The RDWP presents the site background and defines the scope of the PDI field activities. The QAPP presents the quality assurance/quality control (QA/QC) procedures to be used during implementation of the RDWP, as well as a description of the general field and laboratory procedures. The QAPP and HASP are provided in Appendices C and D of the RDWP, respectively.

1.2 Project Objectives

The overall objective of the RDWP is to describe the activities necessary to complete the remedial design for the selected site remedy. The PDI field activities will be conducted to achieve the following objectives:

- Confirm the extent of soil and sediment to be removed as part of the site remedy.
- Obtain geotechnical data necessary to evaluate and design soil and sediment excavation support systems.
- Delineate shallow foundations and obstructions.
- Identify potential locations for new non-aqueous phase liquid (NAPL) collection wells.
- Characterize groundwater to support the design of a temporary water treatment system for groundwater removed from excavation areas.

1.3 Overview of Field Investigation Activities

The following PDI field activities will be conducted to achieve the objectives listed above in Section 1.2:

- Drilling soil borings and bedrock core holes
- Excavating test pits
- Collecting soil samples during the advancement of soil borings and excavation of test pits
- Collecting rock core samples during advancement of bedrock core holes
- Collecting sediment samples from sediment cores completed within the Owasco Outlet
- Measuring a comprehensive round of water levels at existing monitoring wells
- Gauging existing monitoring wells for the presence of NAPL and removing NAPL if present
- Collecting groundwater samples from existing monitoring wells

The sampling locations and number of samples to be collected for each field activity are described in the RDWP, and therefore, are not described further in this FSP. A site location map and sampling locations are depicted on the figures included with the RDWP.

2. PDI Field Activities

2.1 General

All underground utilities will be identified prior to any drilling or subsurface sampling. Public and privately owned utilities will be located by contacting responsible agencies by phone so that underground utilities can be marked at the site.

The following is a general list of equipment necessary for sample collection.

- stainless steel spoons and bowls for compositing soil samples
- appropriate sample containers provided by the laboratory (kept closed and in laboratory supplied coolers until the samples are collected)
- Reagent grade preservatives and pH paper (or pre-preserved sample containers) for aqueous samples
- chain of custody record forms
- log book, field sampling records, and indelible ink pens and markers
- laboratory grade soap (such as Alconox), reagent grade solvents, and distilled water to be used for decontaminating equipment between sampling stations
- buckets, plastic wash basins, and scrub brushes for decontaminating equipment
- digital camera
- stakes to identify sampling locations
- shipping labels and forms
- knife
- packing/shipping material for sample bottles
- strapping tape
- clear plastic tape
- duct tape
- aluminum foil
- re-closable plastic bags
- portable field instruments, including a photoionization detector (PID), water quality parameter meter, conductivity meter, and water-level indicator

Field log books will be maintained by the field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation.

Information pertinent to the field investigation and/or sampling activities will also be recorded in the log books. The books will be bound with consecutively numbered pages. Entries in the log book will include, at a minimum, the following information:

- name of author, date of entry, and physical/environmental conditions during field activity
- purpose of sampling activity
- location of sampling activity
- name of field crew members
- name of any site visitors
- 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 (where appropriate)
- preservatives used
- date and time of collection
- sample identification number(s)
- field observations
- any field measurements made, such as pH, temperature, conductivity, water-level, etc.

All original data recorded in field log books and Chain of Custody Records will be written with indelible ink. If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error and entering the correct information. The erroneous information will not be erased. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry. All subsequent corrections will be initialed and dated.

2.2 Sample Labeling, Packaging, and Shipping

Each sample will be given a unique identification. With this type of identification, no two samples will have the same label. Samples will be promptly labeled upon collection with the following information:

- project number and site
- unique sample identification
- analysis required

- date and time sampled
- sample type (composite or grab)
- preservative, if applicable.

Clear tape will be secured over the sample label and the chain-of-custody will be initiated. Appropriate sample containers, preservation methods, and laboratory holding times for each sample type will be applied as identified in the QAPP. If samples are to be shipped by commercial carrier (e.g., Federal Express), sample bottles/jars will be packed in coolers containing the following:

- a drain plug (if present) that has been sealed with duct tape
- one to two inches of vermiculite or bubble wrap on the bottom of the cooler
- water ice packaged in re-sealable plastic bags
- sufficient vermiculite or bubble wrap to fill in the remaining area
- the completed chain-of-custody in a re-sealable plastic bag, taped in place on the inside cover of the cooler

The cooler will then be sealed with tape. Appropriate shipping labels, such as "this-end-up" and "fragile" stickers will be affixed to the cooler. Samples will be hand delivered or delivered by an express carrier within 48 hours of sample collection. The express carrier will not be required to sign the chain-of-custody form; however, the shipping receipt should be retained by the sampler, and forwarded to the project files.

2.3 Equipment Decontamination

2.3.1 Drill Rig Decontamination

A decontamination pad will be lined with plastic sheeting on a surface sloped to a sump. The sump must also be lined and of sufficient volume to contain approximately 20 gallons of decontamination water. All drilling equipment including rear-end of drilling rig, augers, bits, rods, tools, split spoon samplers, and tremie pipe will be cleaned on the decontamination pad with a high pressure hot water "steam cleaner" unit and scrubbed with a wire brush, as needed, to remove dirt, grease, and oil before beginning work in the project area. If heavy accumulations of tars or oils are present on the downhole tools, a citrus-based cleaner (e.g., Citra-Solu®) may be used to aid in equipment cleaning. Tools, drill rods, and augers will be placed on sawhorses, decontaminated pallets, or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be avoided. All down-hole drilling tools will be decontaminated between each drilling location according to the above procedures.

Decontamination water will be contained in a dedicated plastic tank or 55-gallon open-top drums located on site. All open-top drums will remain closed when not in use.

Following decontamination of all heavy site equipment, the decontamination pad will be decommissioned. The decommissioning will be completed by:

- transferring the bulk of the remaining liquids and solids into the drums, tanks, and roll-offs to be provided by NYSEG or the drilling subcontractor for these materials.

- rolling the sheeting used in the decontamination pad onto itself to prevent discharge of the remaining materials to the ground surface. Once rolled up, the polyethylene sheeting will be placed in the roll-off or drums used for disposal of personal protective equipment (PPE) and disposable equipment.

2.3.2 Sampling Equipment Decontamination

Prior to every entry into each borehole, all non dedicated bowls, spoons, hand augers, bailers, and filtering equipment will be washed with potable water and a 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 10 percent “pesticide-grade” methanol rinse, and finally a distilled water rinse. When sampling for inorganic constituents in an aqueous phase, an additional rinse step will be added prior to the rinse with methanol. The rinse step will entail a rinse with a 10 percent “ultra pure-grade” nitric acid followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. At no time will washed equipment be placed directly on the ground. Equipment will be either be used immediately or wrapped in plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location.

2.4 Soil Boring and Sample Collection

The following materials will be available during soil boring and sampling activities, as required:

- Site Plan with proposed soil boring/well locations
- RDWP, FSP, and HASP
- PPE, as required by the HASP

- drilling equipment required by the American Society for Testing and Materials (ASTM) D 1586, when performing split-spoon sampling
- disposable plastic liners, when drilling with direct-push equipment
- appropriate soil sampling equipment (e.g., stainless steel spatulas, knife)
- equipment cleaning materials
- appropriate sample containers and labels
- chain-of-custody forms
- insulated coolers with ice, when collecting samples requiring preservation by chilling
- PID or flame ionization detector (FID)
- field notebook

2.4.1 Drilling Procedures

The drilling contractor will be responsible for obtaining accurate and representative samples; informing the supervising geologist of changes in drilling pressure; and keeping a separate general log of soils encountered, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments). Records will also be kept of occurrences of premature refusal due to boulders or construction materials that may have been used as fill. Where a boring cannot be advanced to the desired depth, the boring will be abandoned and an additional boring will be advanced at an adjacent location to obtain the required sample. Where it is desirable to avoid leaving vertical connections between depth intervals, the borehole will be sealed using cement and/or bentonite. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location.

If non-aqueous phase liquid (NAPL) is encountered during drilling, the supervising geologist should refer to the procedures detailed in the DNAPL Contingency Plan provided as Attachment A.

2.4.2 Soil Sampling Procedures

Samples of subsurface materials encountered while drilling soil borings will be collected using 2-inch or 3-inch split-barrel (split-spoon) sampler, if using the ASTM D 1586 – Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

Soil samples are typically field screened with an FID or PID at sites where volatile organic compounds are present in the subsurface. Field screening is performed using one of the following methods:

- Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a gloved hand. Such readings should be obtained at several locations along the length of the sample

- A portion of the collected sample is placed in a re-sealable plastic bag or jar, which is covered with aluminum foil, sealed, and allowed to warm to room temperature. After warming, the cover is removed, the foil is pieced with the FID or PID probe, and a reading is obtained.

Samples selected for laboratory analysis will be handled, packed, and shipped in accordance with the procedures outlined in the RDWP, FSP, or Chain-of-Custody, Handling, Packing, and Shipping SOP. A geologist will be on-site during drilling and sampling operations to describe each soil sample on the soil boring log, including:

- percent recovery
- soil type
- color
- moisture condition
- density
- grain-size
- consistency
- other observations, particularly relating to the presence of potential impacts

The supervising geologist or scientist will be responsible for documenting drilling events using a bound field notebook to record all relevant information in a clear and concise format. The record of drilling events will include:

- start and finish dates of drilling
- name and location of project
- project number, client, and site location
- sample number and depths
- blow counts and recovery
- depth to water
- type of drilling method
- drilling equipment specifications, including the diameter of drilling tools

- documentation of any elevated organic vapor readings
- names of drillers, inspectors, or other people onsite
- weather conditions

2.5 Rock Coring and Sample Collection

The following materials will be available during rock coring and sampling activities, as required:

- Core boxes
- Permanent marking pen for labeling boxes and cores
- Wood blocks to separate core runs in core boxes
- Field logbook
- Rock coring logs
- Hand lens
- Pen knife
- 10% solution of hydrochloric acid if drilling through carbonate rock
- Water-level probe
- Munsell rock color chart
- Tape measure
- Rock hammer
- Submersible pump
- Rubber hammer (for tapping rock core out of core barrel)

Prior to placing the core barrel into the hole, the driller will use air/water circulation to remove cuttings in the boring that may clog the barrel. Drilling rods will be carefully centered in initial borehole, if any, to reduce the potential for core breakage. The driller will maintain drilling bit pressure and water pressure at a consistent level throughout drilling, and runs will be completed without interruption, to the extent practical, so penetration rates (in feet per minute) can be determined.

Core samples will be placed in core boxes with increasing depths aligned left to right and core runs separated by wood blocks. Man-made breaks will be marked with a pen across the break. Wood blocks will be labeled and placed at the end of each core run to indicate run. A wooden space will be inserted if no sample is recovered and labeled “L.C.” (lost core) with corresponding depth.

The supervising geologist or geotechnical engineer will record the following parameters related to the core drilling process:

- penetration rates, drilling time, and core run length (i.e., minutes per foot)
- amount of water loss or gain
- drill type and size

The following rock core characteristics will be described in the field, as appropriate:

- lithology (rock type)
- friability/fissibility
- color
- strength of intact rock
- thickness
- weathered state
- particle angularity/shape
- voids
- particle sizes
- structure/bedding (bedding planes, joints, fractures) orientation
- Rock Quality Designation (RQD)
- rock core recovery length
- description of discontinuities and fillings (including interpretation of natural vs. artificial bedrock fractures)
- formation name (if known)
- water content
- texture
- odors/discoloration
- hardness
- fossil type
- depth to water
- Munsell color
- geologic contacts when observed

A key to abbreviations that may be used when describing rock core descriptions is presented below.

BkN	broken
CAL	calcareous or calcite
Cl	clay
F	foliation
Fe	iron staining on joint surface
GOG	gouge

HJ	horizontal joint
J	joint *
J//F	joint is parallel to foliation
JxF	joint crosses foliation
l	laminae
//	parallel
m	mud in opening
MB	mechanical break
N	angle of fracture surface from horizontal, where N is the angle in degrees
QTZ	quartz
s	solution enlargement
S	stratification
sa	sand
si	silt
SZ	sheer zone
U	unfoliated or unstratified
v	vuggy
VJ	vertical joint
w	weathered
WZ	weathered zone
x	crossing
Z	zone

* “Joint” indicates any natural fracture.

The geologist/geotechnical engineer will document drilling events in the field logbook. Documented drilling events will include:

- drilling start and finish dates
- project name and location
- project number and client
- corehole numbers
- sample number and depth
- sample type and size
- type of drilling equipment
- casing size
- names of contractor’s drillers
- weather conditions

It is advisable to photograph recovered core in the labeled core box. The core should be wet when photographed to improve contrast and visibility of rock features.

2.6 Test Pit Excavation

Test pits/trenches will be excavated using a backhoe equipped with a bucket or a small excavator. The following materials will be available, as required, during test pit excavation:

- backhoe with bucket
- shovel
- plastic sheeting
- stainless steel hand trowel
- stainless steel pan
- appropriate sample containers and packing materials, if required
- potable water
- steam cleaning equipment
- appropriate health and safety equipment, as required by the HASP
- PID
- camera/video camera
- test pit/trench log

The following procedures will be used to excavate test pits.

- Identify the test pit/trench number on an appropriate log or in the designated field notebook, as well as with the temperature, weather, date, time, and personnel at the site.

- Set up a decontamination station and decontaminate the backhoe, bucket, shovel, and other sampling apparatus with a high-pressure steam rinse using a tap water source.

- Put on appropriate health and safety equipment.

- Place the plastic sheeting on the ground next to the test pit/trench location.

- Position the backhoe and personnel at upwind (to the extent feasible) locations of the test pit/trench area.

- Turn on the PID. Measure and record on the test pit/trench log background PID readings on the log or in the field book.

- Excavate the soil with the backhoe in approximately 1 foot increments. At each interval, examine and classify the soils according to applicable standards. Record these observations in the test pit/trench log or field book. Also, screen the soil samples with a PID. These measurements will also be recorded in the test pit/trench log (or field book).

- If the contents of the test pit/trench visually appear to consist of site residues, the test pit/trench contents may be sampled. If sampling is required, the test pit/trench will be sampled with a shovel if the test pit/trench is less than 3 feet deep. If the test pit/trench is greater than 3 feet deep, then the test pit/trench will be sampled with the backhoe bucket. The contents of the bucket will then be sampled with a cleaned stainless steel hand trowel.

- If sampling is required, the samples will be collected in the appropriate containers and placed immediately in a cooler of wet ice to maintain a 4ºC temperature for preservation. Volatile organic samples will be collected immediately after sample retrieval. Next, a sufficient amount of the remaining soil will be removed from the sampling device and homogenized by mixing thoroughly in a clean stainless steel pan with a clean stainless steel trowel. Samples will be selected for analytical characterization only if visible residues are present and/or relatively high PID screening readings are measured.

- The test pit/trench will be terminated when significant residues are encountered, the top of the water table is reached, or to the maximum reach of the backhoe, whichever occurs first.

- Soils generated during drilling will be staged on plastic during excavation, monitored for PID readings and visual observations, and then placed back into the test pit/trench. Clean fill will be placed at the surface.

- A labeled stake will be placed at the test pit/trench location.

- A photograph of each location before, during, and after each test pit/trench is excavated will be taken.

- The backhoe, backhoe bucket, and all tools used at the test pit/trench area will be decontaminated using a high-pressure steam rinse using a tap water source. Decontamination water and residual materials associated with decontamination will be contained.

2.7 Sediment Sampling

The following materials will be available during sediment coring and sampling activities, as required:

- Site Plan with proposed sediment coring locations
- RDWP, FSP, and HASP
- PPE, as required by the HASP
- Lexan or Aluminum tubing with end caps
- duct tape
- hacksaw
- brass push road
- Long-handled steel shovel
- drilling equipment required for performing drive and wash sediment coring/sampling (if necessary)
- appropriate sediment sampling equipment (e.g., stainless steel spatulas, knife)
- equipment cleaning materials
- appropriate sample containers and labels
- chain-of-custody forms
- insulated coolers with ice, when collecting samples requiring preservation by chilling
- PID or flame ionization detector (FID)
- field notebook

2.7.1 Manual Sample Collection

The following procedures will be used to collect fine-grained sediment samples:

- Identify the proposed sample location in the field notebook.

- Don PPE, as required by the HASP.

- If necessary, attach Lexan tube to appropriate-sized check valve/ball assembly.

- At each sample location, lower a section of Lexan tube until it just reaches the top of sediment. Measure the depth of water. (Sections of Lexan tube may need to be spliced together in deep water locations.)

- Push the Lexan tube into the sediment by hand until refusal. Measure the depth of sediment.

- Drive the tube several more inches using a stainless steel core driver block and measure the distance. This procedure is performed to obtain a “plug” at the bottom of the core and prevent the loose sediment from escaping.

- Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

- Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged.

- Keeping the tube upright, wipe the bottom end dry and seal the cap with duct tape and label. Measure the length of sediment recovered and evaluate the integrity of the core. If the core is not suitably intact, repeat coring procedure within 5 to 10 feet of the first location attempted.

- While still keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately 1 inch above the sediment.

- Re-cap the cut end of the tube, seal the cap with duct tape, and mark this end as “top.”

- Wipe the tube dry.

- Label tube.

- Record the following information on the tube: 1) sample number; 2) sampling date; and 3) sampling time.

- Place the core sample upright in a container with ice or process the core.

- Repeat the above procedures until the appropriate number of core samples are collected (for the sampling event or the sampling day).

- Extrude the sediment cores from the Lexan tubing onto an aluminum or stainless steel tray. Describe and record sample description, including depths at which sediment characteristics change and visual characteristics.

- Section the sediment cores into the intervals determined for the project. Use a decontaminated hacksaw or knife to section the sediment cores. Characterize each sediment sample for color, texture, and visual staining/odors. Place each sediment sample into the appropriate laboratory-supplied sample containers.

- Label all sample containers according to the appropriate procedures.

- Handle, pack, and ship samples using the chain-of-custody procedures in accordance with the Section 2.2.

2.7.2 Coring Procedures

The drilling contractor will be responsible for obtaining accurate and representative samples; informing the supervising geologist of changes in drilling pressure; and keeping a separate general log of materials encountered, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments). Records will also be kept of occurrences of premature refusal due to boulders or construction materials. Where a boring cannot be advanced to the top of bedrock, the boring will be abandoned and an additional boring will be advanced at an adjacent location to obtain the required sample. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location.

If non-aqueous phase liquid (NAPL) is encountered during drilling, the supervising geologist should refer to the procedures detailed in the DNAPL Contingency Plan provided as Attachment A.

In general the coring procedures are as follows:

- Sediment cores will be advanced by driving and washing temporary steel casing or augering from a float-mounted drill rig

- Steel casing or augers will be lowered through the float and set on the outlet bottom.

- A sediment sample from the top of the outlet bottom to two feet below outlet bottom will be collected using a 2- or 3-inch diameter split spoon sampler. The sampler will be advanced using a 140-pound hammer falling 30-inches.

- If casing is used, the casing will then be advanced from top of creek bottom to 2 feet using the same hammer. Once the casing has reached 2 feet, the casing will then be washed out and the displaced fluid contained in a tub.

- A split spoon sample will then be collected from 2 to 4 feet below creek surface using the 140-pound hammer.

- The casing will then be advanced from 2 to 4 feet and once again the inside of the casing washed out.

These two steps (sampling and then advancing the casing) will be continued to the top of rock or to the point of casing refusal. At the point of casing refusal, a tri-cone roller bit may be used to drill ahead of the casing and a second attempt made to continue advancing the casing with a hammer. Should this second attempt fail, a smaller diameter casing could be used to “telescope” the boring to a smaller size. The drilling and sampling process would then resume using the steps outlined above.

2.7.3 Sediment Sampling Procedures

Samples of subsurface materials encountered while drilling soil borings will be collected using 2-inch or 3-inch diameter split-barrel (split-spoon) samplers.

Soil samples are typically field screened with an FID or PID at sites where volatile organic compounds are present in the subsurface. Field screening is performed using one of the following methods:

- Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a gloved hand. Such readings should be obtained at several locations along the length of the sample

- A portion of the collected sample is placed in a re-sealable plastic bag or jar, which is covered with aluminum foil, sealed, and allowed to warm to room temperature. After warming, the cover is removed, the foil is pieced with the FID or PID probe, and a reading is obtained.

Samples selected for laboratory analysis will be handled, packed, and shipped in accordance with the procedures outlined in the RDWP, FSP, or Chain-of-Custody, Handling, Packing, and Shipping SOP. A geologist will be on-site during drilling and sampling operations to describe each soil sample on the soil boring log, including:

- percent recovery
- sediment type
- color
- moisture condition
- density
- grain-size
- consistency
- Texture
- biological structures (e.g., shells, tubes, macrophytes)
- presence of debris (e.g., twigs, leaves)
- presence of an oily sheen
- odor (e.g., hydrogen sulfide, oil)other observations, particularly relating to the presence of potential impacts

The supervising geologist or scientist will be responsible for documenting sediment coring events using a bound field notebook to record all relevant information in a clear and concise format. The record of coring events will include:

- start and finish dates of coring
- name and location of project
- project number, client, and site location
- sample number and depths
- blow counts and recovery
- depth to rock
- type of drilling method
- drilling equipment specifications, including the diameter of drilling tools
- documentation of any elevated organic vapor readings
- names of drillers, inspectors, or other people onsite
- weather conditions

2.8 Water Level Gauging

The following materials, as required, shall be available during fluid level measurements at monitoring wells that do not contain NAPL:

- PID
- appropriate health and safety equipment, as specified in the HASP

- laboratory-type soap (Alconox or equivalent), methanol/hexane rinse, potable water, distilled water, and/or other equipment that may be needed for decontamination purposes
- electronic water-level meter
- 6-foot engineer's rule
- portable containers
- plastic sheeting
- field logbook
- indelible ink pen
- digital camera

If there is any uncertainty regarding the accuracy of the tape or cable associated with the electronic water-level probe, it should be checked versus a standard length prior to use to assess if the tape or cable above the meter has been correctly calibrated by the manufacturer, and to identify evidence of tape or cable stretching, etc.

- Measure the lengths between markers on the cable with a 6-foot engineer's rule or a fiberglass engineer's tape. The tape or cable associated with the electronic water-level probe should be checked for the length corresponding to the deepest total well depth to be monitored during the data collection event.

- If the length designations on the tape or cable associated with the electronic water-level probe are found to be incorrect, the probe will not be used until it is repaired by the manufacturer.

- Record verification of this calibration process in field logbook.

The detailed procedure for obtaining fluid level depth measurements is as follows. Field notes on logs will be treated as secured documentation and indelible ink will be used. As a general rule, the order of measuring should proceed from the least to most contaminated monitoring wells, based on available data.

- Identify site and well number in field logbook using indelible ink, along with date, time, personnel, and weather conditions.

- Field personnel will avoid activities that may introduce contamination into monitoring wells. Activities such as dispensing gasoline into vehicles or generators should be accomplished well in advance of obtaining field measurements.

- Don PPE as required by the HASP.

- Clean the water-level probe and cable in accordance with the appropriate cleaning procedures. Down-hole instrumentation should be cleaned prior to obtaining readings at the first monitoring well and upon completion of readings at each well.

- Clean the water-level probe and cable with a soapy (Alconox) water rinse followed by a solvent rinse (if appropriate based on site-specific constituents of concern) an analyte-free water rinse. Contain rinse water in a portable container that will be transferred to an on-site container.

- Put clean plastic sheeting on the ground next to the well.

- Unlock and open the well cover while standing upwind from the well. Place the well cap on the plastic sheeting.

- Locate a measuring reference point on the well casing. If one is not found, initiate a reference point at the highest discernable point on the inner casing (or outer if an inner casing is not present) by notching with a hacksaw, or using an indelible marker. All down-hole measurements will be taken from the reference point established at each well on the inner casing (on the outer only if an inner casing is not present).

- Measure to the nearest hundredth of a foot and record the height of the inner and outer casings (from reference point, as appropriate) to ground level.

- Record the inside diameter of the well casing in the field log.

- Lower the probe until it emits a signal (tone and or light) indicating the top of the water surface. Gently raise and lower the instrument through this interface to confirm its depth. Measure and record the depth of the water surface, and the total well depth, to the nearest hundredth of a foot from the reference point at the top of the well. Lower the probe to the bottom of the well to obtain a total depth measurement.

- Clean the water-level probe and cable in accordance with the appropriate cleaning procedures.

- Compare the depth of the well to previous records, and note any discrepancy.

- Lock the well when all activities are completed.

Fluid level measurement data will be recorded legibly on "write-in-the-rain" field notebook in indelible pen. Field situations such as apparent well damage or suspected tampering, or other observations of conditions that may result in compromised data collection will be photographically documented where practicable.

2.9 DNAPLGauging and Removal

This procedure describes the process to monitor for, and if observed, remove dense non-aqueous phase liquid (DNAPL) from a monitoring well expected to contain DNAPL. Implementing this procedure will help ensure that data are accurate, recovered DNAPL is properly managed and that the work is conducted safely.

The following materials, as required, shall be available during fluid-level measurements:

- Health and safety monitoring equipment and PPE as required by the site-specific HASP
- Keys for access to the site and wells
- Cleaning equipment
- Plastic sheeting
- Field log sheet and indelible ink pens
- Absorbent pads
- Peristaltic pump, appropriate tubing, and power supply
- Appropriate fittings for linking tubing connections
- New or dedicated, disposable bottom-loading, weighted transparent bailers with VOC-sampler attachments
- Bailer cord
- Graduated containers to measure recovered DNAPL
- Containers for transporting recovered DNAPL to site storage vessels (e.g., 5-gallon buckets)
- Appropriate equipment to open on-site DNAPL storage vessels
- Oil-water interface probe and/or weighted tape

Note that the field log sheet is a living document and will need to be updated if the construction of any existing monitoring well has changed (e.g., well has been damaged or repaired) or if additional wells are installed and added to the monitoring program.

The following procedures will be used to measure DNAPL thicknesses in wells, if present:

- At the monitoring well, the field personnel unlock and open the protective casing and well cap if present. Visually observe the physical conditions of the well. All observations, measurements, calculations, equipment used, times, and dates are to be recorded in the log sheet using an indelible ink pen.
- Place plastic sheeting and oil absorbent pads next to the well for staging equipment and minimizing the potential that DNAPL (if present) will contact the ground surface.
- Measure the depth to water using an oil-water interface probe from the pre-established mark at the top of the well casing.
- Carefully measure the depth to DNAPL using an oil-water interface probe from the pre-established mark at the top of the well casing. Take care to lower the interface probe slowly so as not to plunge the probe into DNAPL that may be present. Plunging the interface probe into DNAPL could result in an erroneous measurement (depending on DNAPL density, viscosity, etc.), and could require significant effort to clean the probe before another measurement attempt can be made. Use the well construction information provided on the log sheet to determine the well depths and sump length. If DNAPL is present, do not measure the total depth of the well is at this time.
- If DNAPL is not present, measure the total depth of the well using the oil-water interface probe from the pre-established mark at the top of the well casing. Compare the measured well depth to the installed total depth of well (as shown on field log sheet). Evaluate whether sediment is present in well, and if present, calculate sediment thickness. Compare sediment thickness to sump length provided on the field log sheet (if sump is installed). Sediment will need to be removed during the next monitoring event if the well sump is determined to have less than 6-inches of sump capacity (e.g., more than 18-inches of sediment exist in a 2-foot sump). Clean the oil-water interface probe according to the Equipment Decontamination SOP before moving to another well location or leaving the site.
- If DNAPL is observed in the well during gauging, a determination must be made on how best to remove it. Generally, if the DNAPL thickness is less than 0.5 feet, a new or dedicated, weighted disposable or dedicated polyethylene bailer will be

used. If the DNAPL thickness is greater than 0.5 feet thick, a peristaltic pump and new or dedicated, disposal tubing will be used. Regardless of the removal method, it is important to minimize, to the extent practicable, removal of water.

- Once the proper procedure is determined, don additional PPE if required by the HASP. Before removing DNAPL, estimate its volume using the depth to DNAPL measurement and the well construction information provided on the field log sheet. Convenient conversion factors for estimating DNAPL volume in common well diameters are included below.

Conversion Factors

Gallons per foot of Water Column	1” ID	2” ID	4” ID	6” ID
	0.041	0.163	0.653	1.469
1 gallon = 3.785 Liters = 3785 milliliters = 0.1337 cubic feet				

- Place an appropriately-sized graduated container and enough transfer containers (e.g., 5-gallon buckets) in the work area.

The following procedures will be used to remove DNAPL from wells, if present:

Bailer Method

Gently lower the new, disposable or dedicated bailer into the well using bailer cord. Once the bailer reaches the bottom of the well casing, gently raise and lower the bailer several times to load as much DNAPL as possible. Withdraw the bailer and insert the VOC-sampler device into the bailer to empty the DNAPL into the graduated container. Empty any water in the bailer into a transfer container. Repeat this process until DNAPL has been removed to the extent practicable. Once as much DNAPL as practicable is removed, carefully measure and record the volume of DNAPL in the graduated container. Gently pour the DNAPL into the transfer container and carefully transport the water and DNAPL to the on-site storage vessel. Use the oil-water interface probe to measure the total depth of the well and thickness of remaining DNAPL, if any. Compare the measured total depth of the well to the depth of well measured immediately after the well was installed and determine thickness of potential sediment accumulation (as described above). Finally, remove PPE, equipment, and supplies from the work area, and re-lock the cap and/or outer protective casing of the well.

Pump Method

When using a peristaltic pump, two types of disposable tubing are required. The tubing that goes into the well is typically 3/8" inner diameter (ID) low-density polyethylene (LDPE). The tubing used on the peristaltic pump head is typically 1/2" ID low-density silicone tubing. Gently lower the disposable LDPE tubing into the well. Once the tubing reaches the bottom of the well, raise the tubing off of the well bottom by approximately 0.3 feet to mitigate collecting sediment that may have accumulated at the well bottom. Connect all pump tubing and power supply cables to the peristaltic pump. Start the pump at a low flow rate. Direct the pump discharge into the graduated container until DNAPL can no longer be retrieved from the well, gently lower the tubing to remove the remaining 0.3' of DNAPL at the well bottom. Once as much DNAPL as possible is removed, measure and record the volume of DNAPL in the graduated container. Gently empty the contents of the graduated container into the transfer container and carefully transport the contents to the on-site storage vessel. Use the oil-water interface probe to measure the total depth of the well and thickness of remaining DNAPL, if any. Compare the measured total depth of the well to the depth of well measured immediately after the well was installed and determine thickness of potential sediment accumulation (as described above). Finally, remove PPE, equipment, and supplies from the work area, and re-lock the cap and/or outer protective casing of the well.

When collecting DNAPL with a peristaltic pump, cut the intake-end of the tubing at a slight angle to mitigate collection of sediment that could be at the well bottom.

Take care to minimize mixing of the groundwater and DNAPL, and/or creating an emulsion during removal. If mixing does occur, allow time for the groundwater and DNAPL to separate or "break" before measuring the DNAPL volume. Some MGP-related DNAPLs may be susceptible to forming emulsions and may even be present in the subsurface as an emulsion. If an emulsion does not break in an approximate one-half hour timeframe, record as an estimated volume, noting the presence of an emulsion. This can be expedited by lightly spraying the water surface with a water/alconox solution to break the surface tension of the water.

Regardless of the removal method, clean all equipment in accordance with the Equipment Decontamination SOP, and discard disposable investigation derived waste (IDW) and PPE in accordance with the site-specific protocols.

The DNAPL and water mixture recovered from the wells will be disposed of according to the site-specific protocols. IDW such as PPE, used bailers, used peristaltic tubing, absorbent pads, etc., will also be disposed of according to the site-specific protocols, or other project documentation.

2.10 Groundwater Sampling

This protocol describes the procedures to be used to collect groundwater samples. No wells will be sampled until well development has been performed. During precipitation events, groundwater sampling will be discontinued until precipitation ceases. When one round of water levels is taken to generate water-elevation data, the water levels will be taken consecutively at one time prior to sampling or other activities.

The following materials, as required, shall be available during groundwater sampling:

- sample pump
- sample tubing
- power source (i.e., generator, battery)
- PID
- appropriate health and safety equipment, as specified in the HASP
- plastic sheeting (for each sampling location)
- dedicated or disposable bailers
- new disposable polypropylene rope
- buckets to measure purge water
- water-level probe
- 6-foot rule with gradation in hundredths of a foot
- conductivity/temperature meter
- pH meter
- turbidity meter
- dissolved oxygen (DO) meter
- oxidation-reduction potential (ORP) meter
- appropriate water sample containers
- appropriate blanks (trip blank supplied by the laboratory)
- appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials

- groundwater sampling logs
- chain of custody forms
- indelible ink pens
- site map with well locations and groundwater contour maps
- keys to wells

The following steps detail the monitoring well sampling procedures:

- Review materials checklist (Part II) to ensure that the appropriate equipment has been acquired.

- Identify site and well sampled on sampling log sheets, along with date, arrival time, and weather conditions. Identify the personnel and equipment used and other pertinent data requested on the logs (Attachment A-2).

- Label all sample containers using an appropriate label.

- Use safety equipment, as required in the HASP.

- Place plastic sheeting adjacent to the well to use as a clean work area.

- Establish the background reading with the PID and record the reading on the field log.

- Remove lock from the well and if rusted or broken replace with a new brass keyed-alike lock.

- Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe in the breathing zone above the well casing following instructions in the HASP.

- Set out on plastic sheeting the dedicated or disposable sampling device and meters.

- Prior to sampling, groundwater elevations will be measured at each monitoring well and the presence of light non-aqueous phase liquid (LNAPL) or DNAPL (if any) within the well will be evaluated. Obtain a water-level depth and bottom of well depth using an electric well probe and record on the sampling log sheet. Clean the well probe after each use with a soapy (Alconox) water wash and a tap water rinse. [Note: water levels will be measured at all wells prior to initiating a sampling event].

- After groundwater elevations are measured and NAPLs are determined not to be present, groundwater will be purged from the wells. If NAPLs are determined present, then a groundwater sample will not be collected, rather a representative NAPL sample may be collected (if required) using a peristaltic pump or other method determined by the Field Manager/Site Supervisor.

- Pump, safety cable, electrical lines, and/or tubing (for peristaltic pumps) will be lowered slowly into the well to a depth corresponding to the center of the saturated screen section of the well.

- Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 200 to 500 milliliters per minute. Ideally, the pump rate should cause little water-level drawdown in the well (less than 0.3 feet and the water level should stabilize). The water level should be monitored every three to five minutes (or as appropriate) during pumping. Care should be taken not to cause the pump suction to be broken or entrainment of air in the sample. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If the recharge rate of the well is very low, purging should be interrupted so as not to cause the drawdown within the well to advance below the pump. However, a steady flow rate should be maintained to the extent practicable. Sampling should commence as soon as the volume in the well has recovered sufficiently to permit sample collection.

- During well purging, monitor the field indicator parameters (turbidity, temperature, specific conductance, pH, dissolved oxygen [DO], and oxidation-reduction potential [ORP]) every three to five minutes (or as appropriate). The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

  - $\pm$0.1 for pH
  - $\pm$3% for specific conductance (conductivity)
  - $\pm$10 mV for ORP
  - $\pm$10% for turbidity and DO

- Note that turbidity and DO usually require the longest time to achieve stabilization. As such, sampling may be allowed prior to stabilization of turbidity and/or DO if all other parameters have stabilized. The decision to sample under this scenario must be agreed to by the Project Manager.

- The pump must not be removed from the well between purging and sampling. If the parameters have stabilized, but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to no more than 100 millimeters per minute. Measurement of the indicator parameters should continue every three to five minutes. Measurements for parameters may be taken using a flow-thru cell or in a clean container such as a glass beaker. Measurements of DO should be taken from a sample collected using an in-line tee fitting installed before the tubing outlet, prior to connection to the flow-through cell (if one is being used). DO measurements should be measured using a field test kit (e.g., colorimetric).

- Fill in the sample label and cover the label with clear packing tape to secure the label onto the container.

- After the groundwater quality parameters have stabilized as discussed above, obtain the groundwater sample needed for analysis directly from the sampling device in the appropriate container and tightly screw on the caps. Note that groundwater samples collected for analysis of VOCs cannot be collected using a peristaltic pump. If purging the well using a peristaltic pump, collect all other types of samples (e.g., SVOCs, inorganics, etc.) prior to collecting the sample for VOC analysis. Once other samples are collected, remove the peristaltic pump tubing and collect the VOC samples using a new disposable polyethylene bailer. The bailer should be gently lowered to the approximate depth that the pump intake was set, and then retrieved.

- Secure with packing material and store at 4 degrees Celsius on wet ice in an insulated transport container provided by the laboratory.

- After all sampling containers have been filled, remove one additional volume of groundwater. Check the calibration of the meters and then measure and record on the field log the physical appearance, pH, temperature, turbidity, and conductivity.

- Record the time sampling procedures were completed on the field logs.

- Place all disposable sampling materials (plastic sheeting, disposable bailers, and health and safety equipment) in appropriately labeled containers. Go to the next well and repeat Step 1 through Step 21 until all wells are sampled.

- Complete the procedures for packaging, shipping, and handling with associated COC forms.

2.11 Air Monitoring

Air monitoring will be conducted with a PID and dust monitor during all land based intrusive activities. The PID will be used to monitor organic vapors in the breathing zone and borehole and to screen samples for analysis. The dust monitoring will be used to monitor particulate concentration in the breathing zone for particulates less than 10 microns in diameter. In addition, air monitoring during the PDI activities will be consistent with the New York State Department of Health's (NYSDOH's) community air monitoring plan, as described in the HASP.

The PID and dust monitor readings will be recorded in the field book during land based trenching and drilling activities. The instruments will be calibrated at least once each day and more frequently, if needed.

3. Field Instrumentation

All field-screening equipment will be calibrated immediately prior to each day's use and more frequently, if required. The calibration procedures will conform to the manufacturer's standard instructions. Records of all instrument calibration will be maintained by the field personnel. Copies of all of the instrument manuals will be maintained on site by the field personnel.

3.1 Portable Photoionization Detector

The PID will be a MiniRae (or equivalent), equipped with a 10.6 electron volt (eV) lamp. The MiniRae is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73 percent of the VOCs on the Target Compound List.

3.2 Dust Monitor

The dust monitor will be an MIE DataRAM (or equivalent) and will be calibrated at the start of each day of use. Calibration and maintenance of the dust monitor will be conducted in accordance with the manufacturer’s specifications. The calibration data will be recorded in field notebooks.

3.3 pH Meter

The pH meter will be calibrated at the start of each day of use and after very high or low readings, as required by this FSP. National Institute of Standards and Technology traceable standard buffer solutions that bracket the expected pH range will be used. The standards will most likely be a pH of 7.0 and 10.0 standard units. The pH calibration and slope knobs will be used to set the meter to display the value of the standard being checked. The calibration data will be recorded in field notebooks.

3.4 Specific Conductivity Meter

Calibration checks using the appropriate conductivity standard for the meter will be performed at the start of each day of use and after very high or low readings, as required by this FSP. Readings must be within 5 percent to be acceptable. The thermometer of the meter will be calibrated against the field laboratory thermometer on a weekly basis.

3.5 Dissolved Oxygen Meter

The DO meter will be calibrated and the condition of the DO sensor will checked at the start of each day of use. Calibration and maintenance of the DO meter will be conducted in accordance with the manufacturer's specifications. The calibration data will be recorded in field notebooks.

3.6 Water-Level Meter

The water-level cable will be checked once to a standard to assess if the meter has been correctly calibrated by the manufacturer or vendor. If the markers are incorrect, the meter will be sent back to the manufacturer or vendor.

3.7 Turbidity Meter

The turbidity meter will be calibrated daily prior to use. Calibration and maintenance will be conducted in accordance with the manufacturer's specifications. Calibration and maintenance information will be recorded in the field notebook.

3.8 Oxidation-Reduction Potential Meter

The ORP meter will be calibrated at the start of each day of use. Calibration and maintenance of the ORP meter will be conducted in accordance with the manufacturer's specifications. The calibration data will be recorded in the field notebook.

4. References

ARCADIS, 2010a. *Remedial Design Work Plan,* NYSEG Clark Street Former MGP Site, Auburn, New York. January 2009.

ARCADIS, 2010b. *Quality Assurance Project Plan,* NYSEG Clark Street Former MGP Site, Auburn, New York. January 2009.

ARCADIS, 2010c. *Health and Safety Plan*, NYSEG Clark Street Former MGP Site, Auburn, New York. January 2009.

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Appendix A

DNAPL Contingency Plan

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Appendix A
DNAPL Contingency Plan

Clark Street Former Manufactured Gas Plant Site

Auburn, New York

February 2010

I. Scope and Application

This document has been prepared to guide drilling activities at sites where there is a reasonable expectation that dense, non-aqueous phase liquid (DNAPL) may be present, and provide procedures to be implemented in the event that DNAPL is encountered during subsurface investigations. These procedures are proposed to limit the potential of remobilizing DNAPL, if any, in response to drilling and sampling activities. In addition, the procedures are designed to optimize the recovery of encountered DNAPL (if any) in a safe and efficient manner. This DNAPL Contingency Plan was developed based on a similar document prepared by DNAPL expert Bernard H. Kueper, Ph.D., P.Eng., of Queens University, for an EPA Region 1 Superfund Site (Kueper, May 1995).

Downward DNAPL mobilization from overburden into the bedrock may occur in response to drilling activities (short-circuiting along drill stem and/or completed well screen) and groundwater extraction (creation of downward hydraulic gradient in excess of previously measured downward gradients). This DNAPL Contingency Plan addresses drilling-related issues.

II. Personnel Qualifications

DNAPL contingency field activities will be performed by persons who have been trained in proper drilling and well installation procedures under the guidance of an experienced field geologist, engineer, or technician.

III. Equipment List

The following materials will be available during soil boring and monitoring well installation activities, as required:

- Work Plan, Field Sampling Plan (FSP), and site Health and Safety Plan (HASP)
- personal protective equipment (PPE), as required by the HASP
- equipment specified under drilling and well installation SOPs
- hydrophobic dye (Oil Red O or Sudan IV), pertinent at chlorinated solvent sites

- disposable polyethylene pans for performing soil-water pan tests
- clean, empty jars for performing soil-water shake tests

IV. Cautions

The presence or absence of DNAPL at a site can have significant implications in terms of site management, health and safety, and the feasibility of potential remedial alternatives. Therefore, field personnel must be attentive to the potential for DNAPL, recognize when DNAPL is encountered during drilling, and accurately document field observations indicating the presence of DNAPL and interpreted DNAPL depth. In addition, opportunities to characterize DNAPL, when present, may be rare. When practicable, DNAPL samples should be collected and analyzed for physical and chemical characteristics.

V. Health and Safety Considerations

Field activities associated with this DNAPL Contingency Plan will be performed in accordance with the site HASP, a copy of which will be present on site during such activities.

VI. Procedure

DNAPL Screening During Overburden Drilling

To screen for the potential presence of DNAPL in soil, drilling procedures must allow for high-quality porous media samples to be taken. Split-spoon samples or direct-push samplers should be taken continuously in 2-foot intervals ahead of the auger or drill casing. Upon opening each split-spoon sampler or direct-push plastic liner sleeve, the soil will immediately be screened for the presence of organic vapors using a portable photoionization detector (PID) or organic vapor analyzer (OVA). During screening, the soil will be split open using a clean spatula or knife and the PID or OVA probe will be placed in the opening and covered with a gloved hand. Such readings will be obtained along the entire length of the sample.

If the PID or OVA examination reveals the presence of organic vapors above 100 parts per million (ppm), the sample will undergo further detailed evaluation for visible non-aqueous phase liquid (NAPL). The assessment for NAPL will include a combination of the following tests/observations:

- Evaluation for Visible NAPL Sheen or Free-Phase NAPL in Soil Sampler – The NAPL sheen will be a colorful iridescent appearance on the soil sample. NAPL may also appear as droplets or continuous accumulations of liquid with a color typically ranging from yellow to brown to black, depending on the type of NAPL. Creosote DNAPL (associated with wood-treating sites) and coal-tar DNAPL (associated with manufactured gas plant [MGP] sites) are typically black and have a characteristic, pungent odor. Pure chlorinated solvents may be colorless in the absence of hydrophobic dye. Solvents mixed with oils may appear brown.

- Soil-Water Pan Test – A portion of the selected soil interval with the highest PID or OVA reading > 100 ppm will be placed in a disposable polyethylene dish along with a small volume of potable or distilled water. The dish will be gently tilted back and forth to mix the soil and water, and the surface of the water will be viewed in natural light to observe the development of a sheen, if any. A small quantity of Oil Red O or Sudan IV hydrophobic dye powder will be added and the soil and dye will be manually mixed for approximately 30 to 60 seconds and smeared in the dish to create a paste-like consistency using a new nitrile glove-covered hand. A positive test result will be indicated by a sheen on the surface of the water and/or a bright red color imparted to the soil following mixing with dye.

- Soil-Water Shake Test – A small quantity of soil (up to 15 cc) will be placed in a clear, colorless, 40-mL vial containing an equal volume of potable or distilled water. After the soil settles into the water, the surface of the water will be evaluated for a visible sheen. The jar will be closed and gently shaken for approximately 10 to 20 seconds. Again, the surface of the water will be evaluated for a visible sheen or a temporary layer of foam. A small quantity (approximately 0.5 to 1 cc) of Oil Red O or Sudan IV powder will be placed in the jar. The sheen layer will be evaluated for a reaction to the dye (change to bright red color). The jar will be closed and gently shaken for approximately 10 to 20 seconds. The contents in the closed jar will be examined for visible bright red dyed liquid inside the jar. A positive test result will be indicated by the presence of a visible sheen and foam on the surface of water, a reaction between the dye and the sheen layer upon first addition of the dye powder, a bright red coating the inside of the vial (particularly above the water line), or red-dyed droplets within the soil.

- Estimation of Relative Degree of NAPL Saturation – When NAPL is interpreted as present in a particular portion of soil, the field geologist will attempt to estimate the relative degree of NAPL saturation in the soil. Specifically, based on the apparent, visible continuity of NAPL within the soil, an interpretation will be made as to whether the observed NAPL is pooled (continuous section of soil across entire diameter of soil sample in which the pore spaces are filled with a mixture of NAPL and water) or residual (isolated droplets or blebs of NAPL, surrounded by pore spaces containing only water).

If NAPL is obviously present upon opening the soil sampler or evaluating the soil sample within the split-spoon sampler or direct-push liner sleeve, it is not necessary to perform a soil-water pan test or soil-water shake test. In addition, it is not necessary to perform both a soil-water pan test and a soil-water shake test. Either test method is acceptable. The pan test may be preferred in some circumstances because the presence of a sheen may be easier to see on a wider surface.

The results of each test or observation will be recorded in the field notebook.

DNAPL Screening During Bedrock Drilling

To screen for the potential presence of DNAPL in bedrock, drilling fluids, rock cuttings, and/or core samples are monitored for the presence of sheens. During drilling using rotary methods (coring or roller bit drilling with water or drilling mud), the return fluid will be screened with a PID or OVA and evaluated continuously for the presence of a sheen in the recirculation tub. Where core samples are obtained, they will be carefully evaluated for the presence of a sheen on fracture surfaces. During drilling using air-rotary methods, rock cuttings will be continuously screened using a PID or OVA and evaluated for the presence of a sheen. During drilling with rotary methods, the positive head level at the borehole will reduce the potential for DNAPL short-circuiting via the borehole.

If a sheen is observed with any of these methods, drilling will be temporarily discontinued and an evaluation will be undertaken to determine whether pooled DNAPL is present. The drill stem will be retracted to a few feet above the apparent depth where the sheen was first encountered. Groundwater will be extracted from the borehole to produce a drawdown of 5 to 10 feet below the approximate static, non-pumping water level for a period of 20 minutes to test for the presence of pooled, mobilizable DNAPL in the fractures surrounding the open borehole. The bottom of the borehole will then be evaluated for the presence of DNAPL using an interface probe or bottom-loading bailer. If no DNAPL is observed, the interpretation will be made that the sheen was not produced by pooled DNAPL. In this case, if drilling by the rotary method, the recirculation water will be replaced by clean water and drilling will continue. Replacing the recirculation water reduces the potential for cross-contamination and facilitates observation of a newly created sheen, if any, at a deeper interval. Accumulation of DNAPL in the bottom of the borehole, however, indicates that the boring has encountered pooled DNAPL. If DNAPL has accumulated, it will be removed using a bottom-loading bailer or pump.

Data Collection Below Zone Containing Pooled DNAPL

If pooled DNAPL is encountered in a borehole and deeper drilling is required to collect data below a zone containing pooled DNAPL, one of the following actions will be taken.

1. Adjustment of Drilling Location - The boring where pooled DNAPL was encountered will be abandoned by tremie grouting using neat cement grout and a replacement boring will be re-attempted at a nearby location.

2. DNAPL Sump Installation - A DNAPL collection well will be installed with a blank sump properly grouted in place below the screen and the boring will be re-attempted at a nearby location. In this case, after removing the DNAPL in the borehole, the boring may be advanced an additional 2 to 3 feet to accommodate a blank sump below the interval with apparent pooled DNAPL.

3. Casing Off DNAPL Layers - If pooled DNAPL is found to be present throughout an area where deeper drilling is essential, a permanent, grouted casing should be installed. The bottom of the pooled DNAPL likely coincides with the top of a relatively fine-grained, low permeability, stratum (capillary barrier). Permanent casing will be installed to the bottom of the borehole and grouted in place using the displacement method prior to advancing the borehole any further. In this case, after removing any DNAPL that may have accumulated in the borehole, the boring may be advanced a few feet into the top of the underlying confining layer or up to 5 feet in bedrock prior to grouting the casing to assist in isolating the zone containing apparently pooled DNAPL. When the casing is grouted in place and the grout has set, the drilling recirculation water will be replaced with clean water to prevent cross-contamination and facilitate observation of a newly created sheen (if any) at a deeper interval, and drilling will continue.

DNAPL Monitoring

New wells installed in borings where DNAPL was encountered during drilling will be monitored for DNAPL accumulation in the DNAPL sump using an oil-water interface probe or bottom-loading bailer within approximately one day following initial installation. If DNAPL is encountered, a bottom-loading bailer or pump will be used to remove the DNAPL, the final DNAPL thickness will be recorded, and the DNAPL thickness will be reassessed after another day of accumulation (if any). This process will be repeated until DNAPL no longer accumulates overnight, at which point the accumulation monitoring and removal period will extend to one-week intervals. If no DNAPL accumulation is observed over a period of one week, further DNAPL monitoring may be continued with a longer period between monitoring events.

Any DNAPL recovered during drilling and monitoring activities should be analyzed for chemical composition, DNAPL-water interfacial tension, density, and viscosity. The physical tests should be performed at the approximate groundwater temperature at the site where the DNAPL sample was obtained, typically between 10ºC and 20ºC. These parameters will allow for correlation of groundwater chemistry with suspected DNAPL locations and will allow an estimate to be made of the volume and potential mobility of DNAPL, if any, in the formation.

VII. Waste Management

DNAPL removed from wells will be temporarily stored on-site in metal drums for subsequent appropriate off-site disposal. The locations and volumes of recovered DNAPL will be noted.

VIII. Data Recording and Management

Any occurrence of DNAPL encountered during subsurface investigations will be documented in an appropriate field notebook in terms of the drilling location (boring or well identification), depth below surface, type of geologic material DNAPL was observed within, field screening and testing results, and apparent degree of DNAPL saturation (pooled or residual). DNAPL locations and depths will be recorded on subsurface log forms, as appropriate.

IX. Quality Assurance

DNAPL can be mobilized downward as a result of drilling operations. It is very difficult to drill through DNAPL without bringing about vertical DNAPL mobilization. This opinion is stated by USEPA (1992): "In DNAPL zones, drilling should generally be minimized and should be suspended when a potential trapping layer is first encountered. Drilling through DNAPL zones into deeper stratigraphic units should be avoided." The DNAPL screening procedure outlined in this plan should, therefore, be implemented while drilling at all locations and depths within overburden or bedrock where potential DNAPL presence is suspected. If data collection is required below a zone containing DNAPL, the interval containing DNAPL will be cased off prior to drilling deeper.

X. References

Kueper, B.H., May 11, 1995. DNAPL Contingency Plan. [Prepared at the request of *de maximis, inc*.].

United States Environmental Protection Agency (USEPA), 1992. Memorandum from D. Clay: Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities – Update. OSWER Directive No. 9283.1-06.

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Appendix C

Quality Assurance Project Plan

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Quality Assurance Project Plan

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Auburn, New York

February 2010

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Quality Assurance Project Plan

Clark Street Former MGP Site

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Preface

This *Quality Assurance Project Plan* (QAPP) presents the analytical methods and procedures that will be used during implementation of the select actions at the site.

This QAPP was prepared in a manner consistent with the following reference and guidance documents:

- United States Environmental Protection Agency's (USEPA's) *Test Methods for Evaluating Solid Waste, SW-846* (USEPA, 1996)

- The USEPA's guidance document entitled *EPA Requirements for Quality Assurance Project Plans for Environmental Operations, EPA-QA/R-5* (USEPA, 2001), which replaces QAMS-005/80 *Interim Guidance and Specifications for Preparing Quality Assurance Project Plans* (USEPA, 1980)

- the National Enforcement Investigations Center *Policies and Procedures Manual* (USEPA, 1991)

Information contained in this QAPP has been organized into the following sections:

Section	Content
Project Management	
1	Project Organization and Responsibilities
2	Project Background
3	Project Description
4	Quality Objectives and Criteria for Measurement Data
5	Special Training Requirements/Certification
6	Documentation and Records
Measurement/Data Acquisition	
7	Sampling Process Design
8	Sampling Method Requirements
9	Sample Handling and Custody Requirements
10	Analytical Procedures
11	Quality Control Requirements
12	Instrument/Equipment Testing, Inspection, and Maintenance Requirements
13	Instrument Calibration and Frequency

Section	Content
14	Inspection/Acceptance Requirements for Supplies and Consumables
15	Data Acquisition Requirements for Nondirect Measurements
16	Data Management
Assessment/Oversight	
17	Assessment and Response Actions
18	Reports to Management
Data Validation and Usability	
19	Data Review, Validation, and Verification
20	Validation and Verification Methods
21	Reconciliation with User Requirements
22	References

Details are provided in the subsequent sections. This document also contains pertinent information from the *Remedial Design Work Plan* (RDWP) related to the measurements and evaluation of the analytical data.

Acronyms

ASP	Analytical Services Protocol
CLP	Contract Laboratory Program
DQO	data quality objective
EDD	electronic data deliverable
FS	feasibility study
FSP	*Field Sampling Plan*
HASP	*Health and Safety Plan*
MGP	manufactured gas plant
MS/MSD	matrix spike/matrix spike duplicate
NAPL	nonaqueous phase liquid
NYSDEC	New York State Department of Environmental Conservation
NYSEG	New York State Electric & Gas Corporation
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
QA/QC	quality assurance/quality control
QAM	Quality Assurance Manager
QAPP	*Quality Assurance Project Plan*
RD Work Plan	*Remedial Design Work Plan*

RPD	relative percent difference
SDG	sample delivery ground
SVOC	semivolatile organic compound
3-D	three-dimensional
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1. Project Organization and Responsibilities

1.1 Project Organization

The site will require integration of personnel from the organizations identified below, collectively referred to as the project team. A detailed description of the responsibilities of each member of the project team is presented in Section 1.2.

1.1.1 Overall Project Management

ARCADIS, on behalf of NYSEG (New York State Electric & Gas Corporation), has overall technical responsibility for site investigation activities. ARCADIS personnel will perform the tasks and subtasks presented in Section 3 and will be responsible for evaluating resultant investigation data and preparing the deliverables specified in the RD Work Plan. Project direction and oversight will be provided by NYSEG personnel. A listing of project management personnel and their responsibilities is provided below.

Company/ Organization	Title	Name	Phone Number
NYSDEC	Project Manager	John Spellman	518.402.9662
NYSEG	Project Manager	John J. Ruspantini, CHMM	607.762.8787
ARCADIS	Project Manager in Charge	Keith White	315.671.9530
	Project Manager	John Brien	315.671.9114
	Field Activities Manager	David Cornell	315.671.9379
	Quality Assurance Coordinator	Dennis Capria	315.671.9299
Lab – TestAmerica Edison	Project Manager	Janae McCloud	732.549.3900
	Quality Assurance Officer	Carl Armbruster	732.549.3900
Lab – PW Labs	Project Manager	Donald Blasland	315.437.1420

1.2 Team Member Responsibilities

This section of the *Quality Assurance Project Plan* (QAPP) discusses the responsibilities and duties of the project team members.

1.2.1 NYSEG

Project Manager In Charge

1. oversight of the ARCADIS work products

2. provide ARCADIS approval for major project deliverables

Project Manager

1. overall direction of the investigation

2. review of ARCADIS work products

1.2.2 ARCADIS

Project Manager

1. Management and coordination of all aspects of the project as defined in the RD Work Plan with an emphasis on adhering to the project objectives.

2. Reviews investigation results reports and all documents prepared by ARCADIS.

3. Confirms that corrective actions are taken for deficiencies cited during audits of the field activities.

Field Activities Manager

1. Oversight of field hydrogeologic efforts.

2. Oversight of field screening and collection of soil samples.

3. Review of field hydrogeologic records and boring logs.

4. Oversight of groundwater sampling.

5. Oversight of field analysis and collection of QA samples.

6. Reduction of field data calibration and maintenance.

7. Review of the field instrumentation, maintenance, and calibration to maintain quality data.

8. Preparation of draft reports and other key documents.

9. Maintenance of field files of notebooks and logs and calculations.

10. Instruction of field staff.

11. Coordination of field and laboratory schedules.

Field Personnel

1. Perform field procedures associated with the tasks and subtasks presented in Section 3.

2. Perform field analyses and collect QA samples.

3. Calibrate, operate, and maintain field equipment.

4. Reduce field data.

5. Maintain sample custody.

6. Prepare field records and logs.

Quality Assurance Manager

1. Review laboratory data packages.

2. Oversee and interface with the analytical laboratories.

3. Coordinate field quality assurance/quality control (QA/QC) activities with task managers, including audits of field activities, concentrating on field analytical measurements and practices to meet data quality objectives (DQOs).

4. Review field reports.

5. Review audit reports.

6. Prepare a QA/QC report that includes an evaluation of field and laboratory data and data validation reports.

1.2.3 Laboratory Subcontractor

General responsibilities and duties include:

1. Perform sample analyses.

2. Supply sample containers and shipping cartons.

3. Maintain laboratory custody of samples.

4. Strictly adhere to laboratory protocols.

Laboratory Project Manager

1. Serve as primary communication link between ARCADIS and laboratory staff.

2. Monitor workloads and confirm availability of resources.

3. Oversee preparation of analytical reports.

4. Supervise in-house chain of custody.

Quality Assurance Officer

1. Supervise technical staff in QA/QC procedures.

2. Conduct audits of all laboratory activities.

2. Project Background

The following summarizes background information for the facility and the off-site areas. Additional information can be found in the RD Work Plan.

2.1 Site Location and Description

The Clark Street Former MGP site is located at the east end of Clark Street near US Route 20 in Auburn, New York. The property, currently owned and operated by NYSEG, consists of a triangular-shaped, approximately 3-arce parcel that is occupied by a NYSEG electrical substation and natural gas regulator building (see Figure 1). Access to the property is restricted by a locked gate at the Clark Street entrance and a cable fence along the southern property line. A majority of the property is covered with gravel and surrounding areas are vegetated with trees and grass. Surrounding land use includes a vehicle maintenance shop to the southwest and a CSX railroad right-of-way and US Route 20 to the south of the site. The Owasco Outlet borders the site to the east and north, with the site forming a peninsula into the outlet. Ground surface elevations at the site generally slope downward toward the outlet (URS, 2009).

2.2 Site History

MGP operations reportedly began in 1901 when operations included a gashouse (consisting of an engine room, purifier room, meter room, generator room, and boiler room), an oil tank, a shed, a 204,000 cubic-foot (cf) holder (gas holder #2), and a 75,000 cf holder (gas holder #3). A 491,000 cf holder (gas holder #1) was constructed at some point later in the early 1900s at the location of the oil tank. In 1943 gas holders #2 and #3 and a tar tank were removed and a coal storage area and tar shed were added. Gas operations ceased in 1946 when portions of the gas house were converted to a carpenter shop, storage area, regulator room, fireproof regulator room, and a booster room. Gas holder #1 was removed in 1958 when the substation transformer area was constructed. The gashouse was demolished in 1961 with exception of the existing gas regulator building (URS, 2009).

During operation of the MGP, coal was transported to the site via the railroad located south of the site. The plant manufactured gas utilizing the carbureted water gas (CWG) process. Gas holders #2 and #3 were water seal holders constructed around subsurface pit foundations. These type of structures utilized water in the bottom of the holders to create a seal at the bottom to prevent manufactured gas from escaping. Gas holder #1 is believed to be an at-grade waterless holder.

2.3 Project Objectives

The purpose of the field investigation activities is to gather additional data to complete the remedial design of the NYSDEC-selected soil remedy. The data collected during the investigation will be used with existing data from previous investigations. NYSEG has developed the following specific objectives:

- Conducting soil investigation activities in support of developing and completing soil excavation plans and activities. Additional soil investigation activities are necessary prior to remedial design to 1) confirm the extent of soil meeting the removal criteria presented in the NYSDEC ROD, 2) obtain geotechnical data necessary to evaluate and design potential soil excavation support systems, and 3) delineate shallow foundations and obstructions.

- Conduct subsurface sediment investigation within the Owasco Outlet. The investigation will consist of 1) establishing background concentrations for Owasco Outlet sediment, 2) further characterizing surface and subsurface sediment in the outlet upstream, adjacent to, and downstream from the site, and 3) obtaining geotechnical information to support the design of sediment removal support systems, if required, to implement remedial construction activities.

- Conducting a NAPL monitoring program prior to remedial construction to aid in the evaluation of potential locations for new NAPL collection wells that will be installed following upland excavation and site restoration activities.

- Collecting and submitting groundwater samples for laboratory analysis in support of designing a temporary water treatment system

3. Quality Objectives and Criteria for Measurement Data

The DQO process, as described in the USEPA EPA QA/G-4 QAPP instructions document, is intended to provide a “logical framework” for planning field investigations. The following addresses, in turn, each of the seven sequential steps in the EPA QA/G-4 QAPP DQO process.

Step 1: State the Problem

Soil, sediment and groundwater sampling will be completed in support of preparing a remedial design for the project site.

Step 2: Identify the Goal of the Study

The goal of the study is to obtain necessary data to finalize the limits of the proposed remedy and to obtain data necessary to design remedial components (e.g., excavation support, temporary groundwater treatment systems).

Step 3: Identify Information Inputs

Information inputs will consist of geotechnical testing results, visual and chemical characterization of sediment and soil samples and analytical results for groundwater samples.

Step 4: Define the Boundaries of the Study

The Clark Street Former MGP site is located at the east end of Clark Street near US Route 20 in Auburn, New York. The property, currently owned and operated by NYSEG, consists of a triangular-shaped, approximately 3-arce parcel that is occupied by a NYSEG electrical substation and natural gas regulator building (see Figure 1 of RDWP). Surrounding land use includes a vehicle maintenance shop to the southwest and a CSX railroad right-of-way and US Route 20 to the south of the site. The Owasco Outlet borders the site to the east and north, with the site forming a peninsula into the outlet.

Step 5: Developing the Analytical Approach

The decision on whether data can be used will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions noted. The sampling plan has been devised so that the loss of any single data point will not hinder description of the distribution of constituents of concern. Given this, a reasonable decision rule would be that 90% of the data points not be rejected and deemed unusable.

Step 6: Specify Performance or Acceptance Criteria

Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability; and 2) understanding the representative nature of the sampling design. This QAPP has been designed to meet both specifications for this step. The sampling and analysis program has been developed based on a review of previous site data and knowledge of present Site conditions. Corrective actions are described elsewhere in the document and in the appended documents. The representative nature of the sampling design has been assured by discussions among professionals familiar with the Site and the appropriate government agencies.

Step 7: Develop the Plan for Obtaining Data

Field sampling procedures are detailed in the *Field Sampling Plan* included as Appendix B to the RDWP. Laboratory analysis of samples collected per the RDWP will be conducted in accordance with this QAPP.

3.1 Data Categories

Three data categories have been defined to address various analytical data uses and the associated QA/QC effort and methods required to achieve the desired levels of quality. These categories are:

Screening Data: Screening data affords a quick assessment of site characteristics or conditions. This objective for data quality is applicable to data collection activities that involve rapid, non-rigorous methods of analysis and QA. This objective is generally applied to physical and/or chemical properties of samples, degree of contamination relative to concentration differences, and preliminary health and safety assessment.

Screening Data with Definitive Confirmation: Screening data allows rapid identification and quantitation, although the quantitation can be relatively imprecise. This objective for data quality is available for data collection activities that require qualitative and/or quantitative verification of a select portion of sample findings (10 percent or more). This objective can also be used to verify less rigorous laboratory-based methods.

Definitive Data: Definitive data are generated using analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files.

It is anticipated that both the screening and definitive data categories will be used during the investigation. Field parameters (i.e., turbidity, conductivity, temperature, and pH) that will be obtained during surface-water sampling for use in qualitatively interpreting other site data will be determined using screening techniques. All remaining parameters will be determined using definitive techniques.

For this project, three levels of data reporting have been defined. They are as follows:

Level 1 – Minimal Reporting: Minimal or “results only” reporting is used for analyses that, either due to their nature (i.e., field monitoring) or the intended data use (i.e., preliminary screening), do not generate or require extensive supporting documentation.

Level 2 – Modified Reporting: Modified reporting is used for analyses that are performed following standard USEPA-approved methods and QA/QC protocols and that, based on the intended data use, require some supporting documentation but not, however, full “Contract Laboratory Program-type” (CLP-type) reporting.

Level 3 – Full Reporting: Full “CLP-type” reporting is used for those analyses that, based on intended data use, require full documentation. This reporting level would include Analytical Services Protocol (ASP) Superfund and Category B reporting.

The analytical methods to be used during the investigation activities will be USEPA SW-846, USEPA Methods for Chemical Analysis of Water and Waste and Standard Methods for Water and Wastewater methods with New York State Department of Environmental Conservation (NYSDEC) ASP Revision 2005, QA/QC requirements, and Category B reporting deliverables. A summary of the testing methods is provided in Table 1.

3.2 Field Activities

To obtain information necessary to meet the objectives stated above in Section 2.3, the following tasks will be performed: (Note: only tasks that require collection and analysis of environmental samples or collecting field measurements are listed below. Refer to the RD Work Plan for a description of the tasks and subtasks.)

- Task 1 – Soil Investigation
- Task 2 – Sediment Investigation
- Task 3 – Groundwater Investigation

A description of the DQOs is presented below.

3.2.1 Data Quality Objectives for Task 1 – Soil Investigation

As described in the RDWP, soil borings will be completed to confirm the extent of MGP-impacted soil in the upland portion of the site. Additional soil borings will be completed at the approximate locations shown on Figure 3 of RDWP. Each soil sample will be visually characterized for soil type and the presence of visible staining, sheen, NAPL, and obvious odors.

In the event that additional laboratory analyses are required, soil samples may be collected from the borings and submitted for analysis. In this instance, it is anticipated that samples may be collected for:

- Method 8260 for BTEX
- Method 8270 for 17 priority pollutant PAHs

The number of soil samples that will be collected (if additional laboratory analyses are required), including QA/QC samples, is summarized in Table 2. Table 1 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

3.2.2 Data Quality Objectives for Task 2 – Sediment Investigation

As described in the RD Work Plan, a subsurface sediment investigation within the Owasco Outlet will be conducted. The background PAH concentrations will be established by collecting sediment samples upstream of the site. The investigation will consist of identifying the potential presence/extent of MGP-impacted sediment and obtaining geotechnical information to support the design of sediment removal support systems, if required, to implement remedial construction activities.

Subsurface sediment samples will be visually characterized for color, composition, and presence/absence of MGP-related impacts (i.e., NAPL/tar, sheens, staining, or odors). In the event that additional laboratory analyses are required, the sediment samples that are collected will be submitted in duplicate for PAHs and submitted for analysis. In this instance, it is anticipated that samples may be collected for:

- Method 8270 for 17 priority pollutant PAHs

The duplicate samples must be frozen upon receipt by the laboratory. The laboratory will be notified of the samples that will be selected for analysis for:

- Method 8270C for approximately 50 parent and alkyl group PAHs (forensic PAHs)

- Method 8015 (modified) for total petroleum hydrocarbons (TPH/DRO & GRO)

The number of sediment samples that will be collected (if additional laboratory analyses are required), including QA/QC samples, is summarized in Table 2. Table 1 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

3.2.3 Data Quality Objectives for Task 3 – Groundwater Investigation

The PDI involves the collection and submitting groundwater samples for laboratory analysis in support of designing a temporary water treatment system. Up to 10 groundwater samples (plus quality assurance/quality control and blind duplicate samples) will be collected from overburden and shallow bedrock monitoring wells within the proposed excavation limits to characterize groundwater quality within the excavation area. Groundwater samples will be submitted for the following treatability parameters:

- Total Toxic Organics (TTO) Methods 8260, 8270, 8081 and 8082
- Target Analyte List (TAL) inorganics (Methods 6010/7470) and cyanide (Method 9012) (filtered and unfiltered samples)
- Oil and grease (Method 1664)
- Total suspended solids (TSS) (Method SM2540D)
- Total dissolved solids (TDS) (Method SM2540C)

- 5-Day biological oxygen demand (BOD5) (Method SM5210B)
- Chemical oxygen demand (COD) (Method 410.4)
- Bioactivity (iron-reducing, sulfate-reducing, and slime-forming bacteria)(Biological Activity Reaction Test BART)
- Total kjeldahl nitrogen (TKN) (Method 351.3)
- Hardness (SM2340C)
- pH (Method 150.1)

The number of groundwater samples that will be collected (if additional laboratory analyses are required), including QA/QC samples, is summarized in Table 2. Table 1 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

The groundwater level measurement procedures, the field parameter measurement procedures, and the groundwater sampling methods are provided in the FSP and RD Work Plan.

4. Special Training Requirements/Certification

Compliant with the Occupational Safety and Health Administration's (OSHA's) final rule, *Hazardous Waste Operations and Emergency Response*, 29 Code of Federal Regulations Part 1910.120(e), all personnel performing remedial activities at the site will have completed the requirements for OSHA 40-hour Hazardous Waste Operations and Emergency Response training. Persons in field supervisory positions will have also completed the additional OSHA 8-hour Supervisory Training.

5. Documentation and Records

5.1 General

Samples of the various media will be collected, as described in the RD Work Plan. Detailed descriptions of the documentation and reporting requirements are presented below.

5.2 Sample Designation System

Samples will be identified with a unique designation system that will facilitate sample tracking. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events and conditions. An alpha-numeric system is considered appropriate and will be used by field personnel to assign each sample with a unique sample identification number. The sample identification number will begin with a two-letter prefix indicating the sample type and two digits indicating the sequential sample number collected from the location.

The samples types (if applicable) will be designated using the following codes:

- Subsurface (Soil boring) Soil Sample – “SB”
- Surface Soil Sample – “SS”
- Surface Water Sample – “SW”
- Sediment Sample – “SD”
- Groundwater Sample – “MW”
- Test Pit Soil Sample – “TP”
- Trip Blank Sample – “TB”
- Field Duplicate Sample – “DUP”
- Equipment Blank Sample – “EB”

- Matrix Spike and Matrix Spike Duplicate – "MS" and MSD"

- Ambient Air Sample – "AA"

The location code, consisting of a two to five digit designation, will follow the sample type code. For subsurface soil samples, the designation will also consist of the sample depth in feet. For example, a subsurface soil sample collected form a depth of 2 to 4 feet from SB-02 would be designated SB-02 (2-4). For groundwater and surface water samples, the sample code will also be eight-digit number indicating the month, day, and year the sample was obtained. For example a groundwater sample collected from MW-2 on July 30, 2008 will be designated MW-2-20080730.

QA/QC samples will be designated by a three-letter code followed by the eight –digit sample collection date. For field and equipment blanks, a two letter sample type code will precede the blank designation to indicate which medium the blank was intended to represent. For example, a field blank collected on July 30, 2008 during surface soil samples collection would be designated SS-FB1-20080730. The sampling point associations for field duplicates must be recorded in the field log.

5.3 Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain of custody. This documentation constitutes a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records, and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include:

- *Daily Production Documentation* – A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- *Sampling Information* – Detailed notes will be made as to the exact site of sampling, physical observations, and weather conditions (as appropriate).

- *Sample Chain of Custody* – Chain of custody forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. Chain of custody forms will be filled out at each sampling site, at a group of sampling sites, or at the end of each day of sampling by ARCADIS field personnel designated to be responsible for sample custody. In the event that the samples are relinquished by the designated sampling person to other sampling or field personnel, the chain of custody form will be signed and dated by the appropriate personnel to document the sample transfer. The original chain of custody form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample chain of custody form is included in Attachment B-1.

Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- *Field Equipment, Calibration, and Maintenance Logs* – To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory calibrated.

5.4 Laboratory Documentation

5.4.1 Laboratory Project Files

The laboratory will establish a file for all pertinent data. The file will include all correspondence, faxed information, phone logs, and chain of custody forms. The laboratory will retain all project files and data packages for a period of 5 years.

5.4.2 Laboratory Logbooks

Workbooks, bench sheets, instrument logbooks, and instrument printouts will be used to trace the history of samples through the analytical process and document and relate important aspects of the work, including the associated QCs. As such, all logbooks, bench sheets, instrument logs, and instrument printouts will be part of the permanent record of the laboratory.

Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with a single stroke, corrected without the use of whiteout or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions.

Information regarding the sample, analytical procedures performed, and the results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, the instrument used, and the instrument conditions.

Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness, and compliance to this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, then the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

5.4.3 Computer Tape and Hard Copy Storage

All electronic files will be maintained on CD-ROM for 5 years; hard copy data packages will be maintained in files for 5 years.

5.5 Data Reporting Requirements

5.5.1 Field Data Reporting

Information collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the appropriate Task Manager for adherence to the RD Work Plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

Where appropriate, field data forms and calculations will be processed and included in appendices to a Site Action Report (when generated). The original field logs, documents, and data reductions will be kept in the project file at the ARCADIS office in Syracuse, New York.

5.5.2 Laboratory Data Reporting

Analytical results will be provided by the laboratory in a digital format. The data packages will be examined to insure that the correct analyses were performed for each sample submitted and that all of the analyses requested on the chain of custody form were performed. If discrepancies are noted, the Quality Assurance Coordinator will be notified and will promptly follow up with the laboratory to resolve any issues.

If validation is required, each data package will be validated in accordance with the procedures presented in this QAPP. Data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation, the data review will be used to populate the appropriate database tables. This format specifies one data record for each constituent and each sample analyzed. Specific fields include:

- Sample identification number
- Date sampled
- Date analyzed
- Parameter name
- Analytical result
- Units
- Detection limit
- Qualifier(s)

The individual electronic data deliverables (EDDs) supplied by the laboratory in either an ASCII comma-separated value (CSV) format or in a Microsoft Excel worksheet, will be loaded into the appropriate database table via a custom-designed user interface Visual Basic program. The EDD format can be found in Table 5. Analytical data that cannot be provided by the laboratory in electronic format will be entered manually. Hand-keyed data will be reviewed for accuracy. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data were received.

The laboratory is responsible for preparing ASP Category B data packages for all soil and sediment samples (SVOC, Parent/Alkyl PAHs, and TPH). The groundwater sample results will be Level 2 data packages as described in 3.2.

All data reports for all parameters will include, at a minimum, the following items:

Narrative – Summary of activities that took place during the course of sample analysis, including the following information:

- laboratory name and address
- date of sample receipt
- cross reference of laboratory identification number to contractor sample identification
- analytical methods used
- deviations from specified protocol
- corrective actions taken

Included with the narrative will be any sample handling documents, including field and internal chain of custody forms, air bills, and shipping tags.

Analytical Results – Reported according to analysis type, including the following information, as acceptable:

- sample ID
- laboratory ID
- date of collection
- date of receipt
- date of extraction
- date of analysis

- detection limits

Sample results on the report forms will be corrected for dilutions. Soil samples will be reported on a dry weight basis. Unless otherwise specified, results will be reported uncorrected for blank contamination.

The data for volatile and semi-volatile analyses will be expanded to include all supporting documentation necessary to provide a Category B package. This additional documentation will include, but is not limited to, all raw data required to recalculate any result, including printouts, chromatograms, and quantitation reports. The report also will include standards used in calibration and calculation of analytical results; sample extraction, digestion, and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

5.6 Project File

Project documentation will be placed in project files according to ARCADIS' protocol for document management at the ARCADIS office in Syracuse, New York. Project files typically consist of the following components:

1. Agreements/Proposals (filed chronologically)

2. Change Orders/Purchase Orders (filed chronologically)

3. Invoices (filed chronologically)

4. Project Management (filed by topic)

5. Correspondence (filed chronologically)

6. Notes and Data (filed by topic)

7. Public Relations Information (filed by topic)

8. Regulatory Documents (filed chronologically)

9. Marketing Documents (filed chronologically)

10. Final Reports/Presentations (filed chronologically)

11. Draft Reports/Presentations (filed chronologically)

12. Documents Prepared by Others (filed chronologically)

Final reports (including QA Reports) are filed in a designated folder within the project file. Analytical laboratory documentation (when received) and field data will also be filed in a designated folder within the project file. Filed materials may be removed and signed out by authorized personnel on a temporary basis only.

6. Sampling Process Design

Information regarding the sampling design and rationale and associated sampling locations can be found in the RDWP and Field Sampling Plan (FSP).

7. Sampling Method Requirements

Groundwater, sediment and soil samples will be collected, as described in the RDWP. The approximate sample quantities and field quality control samples are shown in Table 2. The FSP also contains the procedures that will be followed to install monitoring wells; measure water levels; perform field measurements; and handle, package, and ship collected samples.

8. Sample Handling and Custody Requirements

8.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in Table 3.

The analytical laboratory will supply appropriate sample containers and preservatives, as necessary. The bottles will be purchased pre-cleaned to USEPA Office of Solid Waste and Emergency Response Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate).

8.2 Packing, Handling, and Shipping Requirements

Sample packaging and shipment procedures are designed to confirm that the samples will arrive at the laboratory, with the chain of custody intact.

Samples will be packaged for shipment as outlined below:

- Confirm that all sample containers have the sample labels securely affixed to the container with clear packing tape.
- Check the caps on the sample containers to confirm that they are properly sealed.
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- Complete the chain of custody form with the required sampling information and confirm that the recorded information matches the sample labels. (Note: If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain of custody prior to this transfer. The appropriate personnel will sign and date the chain of custody form to document the sample custody transfer.)
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.

- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Ice layer.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain of custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock, and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.
- Mark the cooler on the outside with the following information: shipping address, return address, “Fragile” labels, and arrows indicating “this side up.” Cover the labels with clear plastic tape. Place a signed custody seal over the cooler lid.

All samples will be packaged by field personnel and transported as low-concentration environmental samples. The samples will be hand-delivered or delivered by an express carrier within 48 hours of the time of collection. All shipments will be accompanied by the chain of custody form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the samples are sent by common carrier, a bill of lading should be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the chain of custody form, as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled, and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage. Trip blank(s) of analyte-free water will be provided by the laboratory and included in each cooler containing aqueous samples to be analyzed for VOCs.

Procedures for packing, handling, and shipping environmental samples are included in the FSP.

8.3 Field Custody Procedures

The objective of field sample custody is to confirm that samples are not tampered with from the time of sample collection through the time of transport to the analytical laboratory. Persons will have "custody of samples" when the samples are in their physical possession, in their view after being in their possession, or in physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field chain of custody forms.

8.3.1 Field Logbooks

Field logbooks will provide the means of recording data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned
- logbook number
- project name
- project start date
- end date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station shall be recorded. The number of the photographs taken of the station, if any, will also be noted. All equipment used to make measurements will be identified, as well as with the date of calibration.

Samples will be collected following the sampling procedures documented in the FSP. The equipment used to collect samples will be noted, as well as with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

8.3.2 Sample Labeling

Preprinted sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required in each sample label.

- project
- date collected
- time collected
- location
- sampler
- analysis to be performed
- preservative
- sample number

8.3.3 Field Chain of Custody Forms

Completed chain of custody forms will be required for all samples to be analyzed. Chain of custody forms will be initiated by the sampling crew in the field. The chain of custody forms will contain the sample's unique identification number, sample date and time, sample description, sample type, preservation (if any), and analyses required. The original chain of custody form will accompany the samples to the laboratory. Copies of the chain of custody will be made prior to shipment (or multiple copy forms used) for field documentation. The chain of custody forms will remain with the samples at all times. The samples and signed chain of custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., FedEx) or hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink, unless prohibited by weather conditions. The labels will include sample information, such as sample number and location, type of sample, date and time of sampling, sampler's name or initials, preservation, and analyses to be performed. The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are collocated with a source or government agency, a separate Sample Receipt will be prepared for those samples and marked to indicate with whom the samples are being collocated. The person relinquishing the samples to the facility or agency should request the representative's signature, acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

8.4 Management of Investigation-Derived Materials and Wastes

Disposable equipment, debris, and decontamination rinsate (e.g., tap and distilled water containing small amounts of solvent) will be containerized during the sampling events and labeled for appropriate disposal.

8.5 Laboratory Custody Procedures

8.5.1 General

Upon sample receipt, laboratory personnel will be responsible for sample custody. A field chain of custody form will accompany all samples requiring laboratory analysis.

Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for maintaining sample integrity.

8.5.2 Sample Receipt and Storage

Upon sample receipt, the laboratory sample custodian will verify the package seal, open the package, verify the sample integrity, and compare the contents against the field chain of custody. If a sample container is broken, the sample is in an inappropriate container, has not been preserved by appropriate means, or if there is a discrepancy between the chain of custody and the sample shipment, ARCADIS will be notified. The laboratory sample custodian will then log the samples in, assign a unique laboratory identification number to each, and label the sample bottle with the laboratory identification number. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory information management system. If the sample container is broken, the sample is in an inappropriate container, or has not been preserved by appropriate means, ARCADIS will be notified.

8.5.3 Sample Chain of Custody and Documentation

Laboratory chain of custody and documentation will follow procedures consistent with Exhibit F of the NYSDEC ASP 2005.

8.5.4 Sample Analysis

Analysis of an acceptable sample will be initiated by worksheets that contain all pertinent information for analysis. The analyst will sign and date the laboratory chain of custody form when removing the samples from storage.

Samples will be organized into sample delivery groups (SDGs) by the laboratory. An SDG may contain up to 20 field samples (field duplicates, trip blanks, and rinse blanks are considered field samples for the purposes of SDG assignment). All field samples assigned to a single SDG shall be received by the laboratory over a maximum of 7 calendar days, and must be processed through the laboratory (preparation, analysis, and reporting) as a group. Every SDG must include a minimum of one site-specific matrix/matrix spike duplicate (MS/MSD) pair, which shall be received by the laboratory at the start of the SDG assignment.

Each SDG will be self-contained for all of the required QC samples. All parameters within an SDG will be extracted and analyzed together in the laboratory. At no time will the laboratory be allowed to run any sample (including QC samples) at an earlier or later time than the rest of the SDG. These rules for analysis will confirm that the QC samples for an SDG are applicable to the field samples of the same SDG and that the best possible comparisons can be made.

8.5.5 Sample Storage Following Analysis

The remaining samples will be maintained by the laboratory for 1 month after the final report is delivered to ARCADIS. After this period, the samples will be disposed of in accordance with applicable rules and regulations.

9. Analytical Procedures

9.1 Field Analytical Procedures

Field analytical procedures may include the measurement of pH, ORP, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Specific field measurement protocols are provided in the FSP.

9.2 Laboratory Analytical Procedures

Laboratory analytical requirements presented in the subsections below include a general summary of requirements, specifics related to each sample medium that may be analyzed, and details of the methods to be used for this project. SW-846 methods, USEPA Methods for the Chemical Analysis of Water and Wastes and Standard Methods for Water and Wastewater with NYSDEC, ASP, 2005 Revision, QA/QC and reporting deliverables requirements will be used for all analytes except for geotechnical analyses.

9.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table 1	Parameters, Methods, and Target Reporting Limits
Table 2	Sample Quantities and Quality Control Frequencies
Table 3	Sample Containers, Preservation Methods, and Holding Times
Table 4	Analytical Quality Control Limits

9.2.2 Sample Metrics

9.2.2.1 Soil and Sediment

Analyses in this category will relate to soil and sediment samples. Analyses will be performed following the methods listed in Table 1 and quality control frequencies listed in Table 2. Results will be reported as dry weight. Moisture content will be reported separately.

9.2.3 Analytical Requirements

The primary sources to describe the analytical methods to be used during the investigation are provided in USEPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition and USEPA Methods for Chemical Analysis of Water and Waste with NYSDEC ASP 2005 Revision, QA/QC and reporting deliverables requirements. Detailed information regarding QC procedures, including MS/MSDs, MS blanks, and surrogate recoveries is provided in NYSDEC, ASP 2005 Revision, Exhibit E.

9.2.3.1 Groundwater

Analyses in this category will relate to groundwater samples. Analyses will be performed following the methods listed in Table 1 and quality control frequencies listed in Table 2. Results will be reported in units presented in Table 1.

9.2.4 Analytical Requirements

The primary sources to describe the analytical methods to be used during the investigation are provided in USEPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition, and USEPA Methods for Chemical Analysis of Water and Waste, QA/QC, and reporting deliverables requirements.

10. Quality Control Requirements

10.1 Quality Assurance Indicators

The overall QA objective for this QAPP is to develop and implement procedures for sampling, chain of custody, laboratory analysis, instrument calibration, data reduction and reporting, internal QC, audits, preventive maintenance, and corrective action such that valid data will be generated. These procedures are presented or referenced in the following sections of the QAPP. Specific QC checks are discussed in Sections 10.3 and 10.4.

QA indicators are generally defined in terms of five parameters:

1. representativeness
2. comparability
3. completeness
4. precision
5. accuracy

Each parameter is defined below. Specific objectives for the site actions are set forth in other sections of this QAPP, as referenced below.

10.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability. The investigation activities have been designed to assess the presence of the constituents at the time of sampling. The RDWP presents the rationale for sample quantities and location. The FSP and this QAPP present field sampling methodologies and laboratory analytical methodologies. The use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

10.1.2 Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between this investigation, and to the extent possible, with existing data will be maintained through consistent sampling and analytical methodology set forth in the FSP and this QAPP, SW-846 analytical methods with NYSDEC ASP Revision 2005 QA/QC requirements and Category B reporting deliverables, and through use of QA/QC procedures and appropriately trained personnel.

10.1.3 Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the amount that was expected to be obtained under normal conditions. This will be determined upon assessment of the analytical results, as discussed in Section 17.

10.1.4 Precision

Precision is the measure of reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the project objectives. To maximize precision, sampling and analytical procedures will be followed. All work for this investigation will adhere to established protocols presented in the RDWP. Checks for analytical precision will include the analysis of MSDs, laboratory duplicates, and field duplicates. Checks for field measurement precision will include obtaining duplicate field measurements. Further discussion of precision QC checks is provided in Sections 10.4.

10.1.5 Accuracy

Accuracy is the deviation of a measurement from the true value of a known standard. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, internal standards, MS, blank spikes, and surrogates (system monitoring compounds) will be used to assess the accuracy of the laboratory analytical data. Further discussion of these QC samples is provided in Section 10.4.

10.2 Decision Rule

The decision on whether data can be used will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions noted. The sampling plan has been devised so that the loss of any single data point will not hinder description of the distribution of potential COCs. Given this, a reasonable decision rule would be that 90% of the data points not be rejected and deemed unusable.

10.3 Field Quality Control Checks

10.3.1 Field Measurements

To verify the quality of data using field instrumentation, duplicate measurements will be obtained and reported for all field analytical measurements.

10.3.2 Sample Containers

Certified, clean sample containers in accordance with Exhibit I of the NYSDEC ASP Revision 2005 (Eagle Picher pre-cleaned containers or equivalent) will be supplied by the laboratory.

10.3.3 Field Duplicates

Field duplicates will be collected from the different site materials to verify the reproducibility of the sampling methods. For soils, field duplicates will be prepared by placing well homogenized aliquots from the same sample location into individual sample containers, which are submitted blind to the laboratory. In general, field duplicates will be analyzed at a 5% frequency (every 20 samples) for the chemical constituents. Field duplicates collected for VOC analysis will be collected as discrete samples from the same location. For groundwater, one well will have a field duplicate collected per sampling event. Table 2 provides an estimated number of field duplicates to be prepared for each applicable parameter and matrix.

10.3.4 Rinse Blanks

Rinse blanks are used to monitor the cleanliness of the sampling equipment and the effectiveness of the cleaning procedures. Rinse blanks will be prepared and submitted for analysis at a frequency of 1 per day (when sample equipment cleaning occurs) or once for every 20 samples collected, whichever is less. Rinse blanks will be prepared by filling sample containers with analyte-free water (supplied by the laboratory), which has been routed through a cleaned sampling device. When dedicated sampling devices are used or sample containers are used to collect the samples, rinse blanks will not be necessary. Table 2 provides an estimated number of rinse blanks collected during the investigation activities.

10.3.5 Trip Blanks

Trip blanks will be used to assess whether site samples have been exposed to non-site-related volatile constituents during storage and transport. Trip blanks will be analyzed at a frequency of once per day, per cooler containing groundwater samples to be analyzed for VOCs. A trip blank will consist of a container filled with analyte-free water (supplied by the laboratory), which remains unopened with field samples throughout the sampling event. Trip blanks will only be analyzed for aqueous VOCs. Table 2 provides an estimated number of trip blanks collected for each matrix and parameter during the investigation activities.

10.4 Analytical Laboratory Quality Control Checks

Internal QC procedures are specified in the analytical methods. These specifications include the types of QC checks required (method blanks, reagent/preparation blanks, MS/MSDs, calibration standards, internal standards, surrogate standards, the specific calibration check standards, laboratory duplicate/replicate analysis), compounds and concentrations to be used, and the QC acceptance criteria.

10.4.1 Method Blanks

Sources of contamination in the analytical process, whether specific analyses or interferences, need to be identified, isolated, and corrected. The method blank is useful in identifying possible sources of contamination within the analytical process. For this reason, it is necessary that the method blank is initiated at the beginning of the analytical process and encompasses all aspects of the analytical work. As such, the method blank would assist in accounting for any potential contamination attributable to glassware, reagents, instrumentation, or other sources which could affect sample analysis. One method blank will be analyzed with each analytical series associated with no more than 20 samples.

10.4.2 Matrix Spike/Matrix Spike Duplicates

MS/MSDs will be used to measure the accuracy of analyte recovery from the sample matrices and will be site-specific. MS/MSD pairs will be analyzed at a 5% frequency (every 20 samples or once every week, whichever comes first).

When MS recoveries are outside quality control limits, associated control sample and surrogate spike recoveries will be evaluated, as applicable, to attempt to verify the reason for the deviation and determine the effect on the reported sample results. Table 2 presents an estimated number of MS and MSD analyses for each applicable parameter.

10.4.3 Surrogate Spikes

Surrogates are compounds which are unlikely to occur under natural conditions that have properties similar to the analytes of interest. This type of control is primarily used for organic samples analyzed by gas chromatography/mass spectrometry (GC/MS) and gas chromatography (GC) methods and is added to the samples prior to purging or extraction. The surrogate spike is utilized to provide broader insight into the proficiency and efficiency of an analytical method on a sample-specific basis. This control reflects analytical conditions that may not be attributable to sample matrix.

If surrogate spike recoveries exceed specified quality control limits, the analytical results need to be evaluated thoroughly in conjunction with other control measures. In the absence of other control measures, the integrity of the data may not be verifiable and reanalysis of the samples with additional control may be necessary.

Surrogate spike compounds will be selected utilizing the guidance provided in the analytical methods.

10.4.4 Laboratory Duplicates

For inorganics, laboratory duplicates will be analyzed to assess laboratory precision. Laboratory duplicates are defined as a separate aliquot of an individual sample that is analyzed as a separate sample. Table 2 presents an estimated number of laboratory duplicates for each applicable parameter.

10.4.5 Calibration Standards

Calibration check standards analyzed within a particular analytical series provide insight regarding the instruments' stability. A calibration check standard will be analyzed at the beginning and end of an analytical series, or periodically throughout a series containing a large number of samples.

In general, calibration check standards will be analyzed after every 12 hours or more frequently, as specified in the applicable analytical method. In analyses where internal standards are used, a calibration check standard will only be analyzed in the beginning of an analytical series. If results of the calibration check standard exceed specified tolerances, then all samples analyzed since the last acceptable calibration check standard will be reanalyzed.

Laboratory instrument calibration standards will be selected utilizing the guidance provided in the analytical methods, as summarized in Section 12.

10.4.6 Internal Standards

Internal standard areas and retention times will be monitored for organic analyses performed by GC/MS methods. Method-specified internal standard compounds will be spiked into all field samples, calibration standards, and quality control samples after preparation and prior to analysis. If internal standard areas in one or more samples exceed the specified tolerances, the cause will be investigated, the instrument will be recalibrated if necessary, and all affected samples may be reanalyzed.

The acceptability of internal standard performance will be determined using the guidance provided within the analytical methods.

10.4.7 Reference Standards/Control Samples

Reference standards are standards of known concentration and independent in origin from the calibration standards. The intent of reference standard analysis is to provide insight into the analytical proficiency within an analytical series. This includes the preparation of calibration standards, the validity of calibration, sample preparation, instrument set up, and the premises inherent in quantitation. Reference standards will be analyzed at the frequencies specified within the analytical methods.

10.5 Data Precision Assessment Procedures

Field precision is difficult to measure because of temporal variations in field parameters. However, precision will be controlled through the use of experienced field personnel, properly calibrated meters, and duplicate field measurements. Field duplicates will be used to assess precision for the entire measurement system, including sampling, handling, shipping, storage, preparation, and analysis.

Laboratory data precision for organic analyses will be monitored through the use of MSDs, laboratory duplicate, and field duplicates as identified in Table 2.

The precision of data will be measured by calculation of the relative percent differences (RPDs) of duplicate sample sets.

The RPD can be calculated by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = analytical result from one of two duplicate measurements

B = analytical result from the second measurement

Precision objectives for MSD and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2005.

10.6 Data Accuracy Assessment Procedures

The accuracy of field measurements will be controlled by experienced field personnel, properly calibrated field meters, and adherence to established protocols. The accuracy of field meters will be assessed by review of calibration and maintenance logs.

Laboratory accuracy will be assessed via the use of MSs, surrogate spikes, internal standards, and reference standards. Where available and appropriate, quality assurance Performance Standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A - X}{B} \times 100$$

Where:

A = value measured in spiked sample or standard

X = value measured in original sample

B = true value of amount added to sample or true value of standard

This formula is derived under the assumption of constant accuracy over the original and spiked measurements. If any accuracy calculated by this formula is outside of the acceptable levels, data will be evaluated to determine whether the deviation represents unacceptable accuracy, or variable, but acceptable accuracy. Accuracy objectives for MS recoveries and surrogate recovery objectives are identified in the NYSDEC ASP, 2005 Revision.

10.7 Data Completeness Assessment Procedures

Completeness of a field or laboratory data set will be calculated by comparing the number of samples collected or analyzed to the proposed number.

$$\text{Completeness} = \frac{\text{No. Valid Samples Collected or Analyzed}}{\text{No. Proposed Samples Collected or Analyzed}} \times 100$$

As general guidelines, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

11. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Preventive maintenance schedules have been developed for both field and laboratory instruments. A summary of the maintenance activities to be performed is presented below.

11.1 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to confirm that it is operational. If the equipment is not operational, it must be serviced prior to use. All meters that require charging or batteries will be fully charged or have fresh batteries. If instrument servicing is required, it is the responsibility of the Field Activities Task Manager to follow the maintenance schedule and arrange for prompt service.

Field instrumentation to be used in this study includes meters to measure pH, ORP, turbidity, temperature, conductivity, dissolved oxygen, and groundwater levels. Field equipment also includes sampling devices for groundwater. A logbook will be kept for each field instrument. Each logbook contains records of operation, maintenance, calibration, and any problems and repairs. The Field Activities Task Manager will review calibration and maintenance logs.

Field equipment returned from a site will be inspected to confirm it is in working order. This inspection will be recorded in the logbook or field notebooks as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook.

Non-operational field equipment will be either repaired or replaced. Appropriate spare parts will be made available for field meters. A summary of preventive maintenance requirements for field instruments, and details regarding field equipment maintenance, operation, and calibration, are provided in the FSP.

11.1.1 Equipment Maintenance

All measuring and test equipment to be used in support of the PDI activities that directly affect the quality of the analytical data shall be subject to preventative maintenance measures that minimize equipment downtime. Equipment will be examined to certify that it is in operating condition. This includes checking the manufacturer’s operating manual to ensure that all maintenance requirements are being observed. Field notes from previous sampling events will be reviewed to ensure that any prior equipment problems are not overlooked and that any necessary repairs to equipment have been carried out.

Field equipment returned from a site will be inspected to confirm that it is in working order. The inspection will be recorded in the field logbook, as appropriate. It will also be the obligation of the last user to record any equipment problems in the logbook. Non-operational field equipment will either be repaired or replaced. Appropriate spare parts will be made available for field meters.

Consultant-/subcontractor-owned or leased equipment maintenance shall be in accordance with the manufacturer's instructions.

11.2 Laboratory Instruments and Equipment

Laboratory instrument and equipment documentation procedures include details of any observed problems, corrective measure(s), routine maintenance, and instrument repair (which will include information regarding the repair and the individual who performed the repair).

Preventive maintenance of laboratory equipment generally will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer.

11.2.1 Instrument Maintenance

Maintenance schedules for laboratory equipment adhere to the manufacturer's recommendations. Records reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures are performed through service contracts with manufacturer or qualified contractors. Paperwork associated with service calls and preventative maintenance calls will be kept on file by the laboratory.

Laboratory Systems Managers are responsible for the routine maintenance of instruments used in the particular laboratory. Any routine preventative maintenance carried out is logged into the appropriate logbooks. The frequency of routine maintenance is dictated by the nature of samples being analyzed, the requirements of the method used, and/or the judgment of the Laboratory Systems Manager.

All major instruments are backed up by comparable (if not equivalent) instrument systems in the event of unscheduled downtime. An inventory of spare parts is also available to minimize equipment/instrument downtime.

11.2.2 Equipment Monitoring

On a daily basis, the operation of balances, incubators, ovens, refrigerators, and water purification systems will be checked and documented. Any discrepancies will be immediately reported to the appropriate laboratory personnel for resolution.

12. Instrument Calibration and Frequency

12.1 Field Equipment Calibration Procedures and Frequency

Specific procedures for performing and documenting calibration and maintenance for the equipment measuring conductivity, temperature, pH, groundwater levels, and surface-water levels are provided in the FSP. Calibration checks will be performed daily when measuring pH, ORP, turbidity, temperature, conductivity, and dissolved oxygen. Field equipment operation, calibration, and maintenance procedures are provided in the FSP.

12.2 Laboratory Equipment Calibration Procedures and Frequency

Instrument calibration will follow the specifications provided by the instrument manufacturer or specific analytical method used. The analytical methods for target constituents are identified separately below.

Volatile Organics

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit E, Part III.

Semivolatile Organics

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit E, Part IV.

Metals and Cyanide

Equipment calibration procedures will follow guidelines presented in NYSDEC ASP 2005 Revision, Exhibit E, Part VII.

Supplemental Parameters

Additional parameters (biological oxygen demand, chemical oxygen demand, total suspended solids, total dissolved solids, oil and grease, total kjeldahl nitrogen, hardness and pH) will be calibrated according to their respective methods, following the guidance presented in NYSDEC ASP 2005, Exhibit E, Part VIII.

13. Inspection/Acceptance Requirements for Supplies and Consumables

All supplies to be used in the field and laboratory will be available when needed. They will be free of target chemicals and interferences. All reagents will be tested prior to use with site samples. All standards will be verified against a second source standard. The laboratory will follow a “first in first out” procedure for the storage and use of all consumables to minimize the risk of contamination and degradation.

14. Data Management

The purpose of the data management is to confirm that all of the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigations will encompass a large number of samples and a variety of sample matrices and analytes from a large geographic area. From the large amount of resulting data, the need arises for a structured, comprehensive, and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/QC procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements:

1. Sample Designation System

2. Field Activities

3. Sample Tracking and Management

4. Data Management System

5. Document Control and Inventory

14.1 Sample Designation System

A concise and easily understandable sample designation system is an important part of the project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected.

14.2 Field Activities

Field activities designed to gather the information necessary to make decisions regarding the off-site areas require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security, and QA. These procedures are described in further detail in the following subsections.

14.2.1 Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To confirm that all aspects of the field investigation are thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- field logs
- instrument calibration records
- chain of custody forms

A description of each of these types of field documentation is provided below.

<u>Field Logs</u>

The personnel performing the field activities will keep field logs that detail all observations and measurements made during the remedial investigation. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To confirm at any future date that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it, and then documenting the proper information. In addition, certain media sampling locations will be surveyed to accurately record their locations. The survey crew will use their own field logs and will supply the sampling location coordinates to the File Custodian.

Instrument Calibration Records

As part of data quality assurance procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration confirms that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Section 13.1. In order to demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- calibration date and time
- type and identification number of equipment
- calibration frequency and acceptable tolerances
- identification of individual(s) performing calibration
- reference standards used
- calibration data
- information on calibration success or failure

The calibration record will serve as a written account of monitoring or detection equipment QA. All erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Chain of Custody Forms

Chain of custody forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A chain of custody form will accompany each field sample collected, and one copy of the form will be filed in the field office. All field personnel will be briefed on the proper use of the chain of custody procedure. A more thorough description of the chain of custody forms is located in the Standard Operating Procedures.

14.2.2 Data Security

Measures will be taken during the field investigation to confirm that samples and records are not lost, damaged, or altered. When not in use, all field notebooks will be stored at the field office in a locked, fireproof cabinet. Access to these files will be limited to the field personnel who utilize them.

14.3 Sample Management and Training

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to confirm the validity of data used in the site analysis. To effectively execute such documentation, carefully constructed sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of chain of custody forms, as described in Section 8.3.3. On a daily basis, the completed chain of custody forms associated with samples collected that day will be faxed from the project office to the QA Manager (QAM). Copies of all completed chain of custody forms will be maintained in the field office. On the following day, the QAM will telephone the laboratory to verify receipt of samples.

When analytical data are received from the laboratory, the QAM will review the incoming analytical data packages against the information on the chains of custody to confirm that the correct analyses were performed for each sample and that results for all samples submitted for analysis were received. Any discrepancies noted will be promptly followed-up by the QAM.

14.4 Data Management System

In addition to the sample tracking system, a data management system may be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database, to be maintained by the Database Administrator, will combine pertinent geographical, field, and analytical data. Information that will be used to populate the database will be derived from three primary sources: surveying of sampling locations, field observations, and analytical results. Each of these sources is discussed in the following sections.

14.4.1 Computer Hardware

If required, the database will be constructed on Pentium®-based personal computer work stations connected through a network server. The network will provide access to various hardware peripherals, such as, but not limited to, laser printers, backup storage devices, image scanners, and modems. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

14.4.2 Computer Software

If required, the database will be written in Microsoft Access, running in a Windows operating system.

14.4.3 Surveying Information

In general, each location sampled will be surveyed to confirm that accurate documentation of sample locations for mapping and geographic information system purposes (if appropriate) to facilitate the resampling of select sample locations during future monitoring programs, if needed, and for any potential remediation activities. The surveying activities that will occur in the field will consist of the collection of information that will be used to compute a northing and easting in state plane coordinates for each sample location and the collection of information to compute elevations relative to the National Geodetic Vertical Datum of 1988 for select sample locations, as appropriate. All field books associated with the surveying activities will be stored as a record of the project activities.

Conventional surveying techniques will be used to gather information, such as the angle and distance between the sample location and the control monument, as well as point attributes. Control monuments will be established using global positioning system techniques. The surveying software allows the rapid computation of a location’s state plane coordinates.

Differential leveling techniques will be used to gather information to be used to compute a sample location's (or top-of-casing for groundwater monitoring wells) elevation. During the differential leveling process, which includes at least one benchmark of known elevation, detailed field notes will be kept in a field book

14.4.4 Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field.

Following each sampling event, a status memorandum may be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to present a summary and a record of the sampling event. Topics to be discussed include the locations sampled, the sampling methodologies used, QA/QC procedures, blind duplicate and MS/MSD sample identification numbers, equipment decontamination procedures, personnel involved in the activity, and any other noteworthy events that occurred.

Tables are typically attached to the memorandum and are used to summarize measurements that were recorded in the field books. It is anticipated that these tables will be developed using a personal computer spreadsheet program to reduce possible transcription error and to facilitate the transfer of information to the data management system. For example, for soil samples, the table would present the sampling date and time, soil depth, depth of soil recovered in a given core, the depth increment submitted for analysis, and a description of the lithology.

Status memos are valuable tools to keep project personnel informed on the details of the field activities and are also invaluable during the development of the final report. Each status memo will be reviewed for accuracy and completeness by the respective sampling activity manager. Following the approval and finalization of each memo, the status memo will be used to transfer field observations into the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the chain of custody forms and field notebooks.

14.4.5 Analytical Results

Analytical results provided by the laboratory will generally be available in both a digital and a hard copy format. Upon receipt of each analytical package, the original chain of custody form will be placed in the project files. The data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the chain of custody form were performed. If discrepancies are noted, the QAM will be notified and will promptly follow up with the laboratory to resolve any issues.

Where appropriate, the data packages will be validated in accordance with the procedures presented in Section 20. Any data that does not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of that data may not necessarily be restricted.

Following completion of the data validation (if necessary), the digital files of analytical data will be processed to populate the appropriate database tables. Specific fields include:

- sample identification number
- date sampled
- date analyzed
- parameter name
- analytical result
- units
- detection limit
- qualifier(s)

The individual electronic data deliverables (EDDs) supplied by the laboratory in either an ASCII comma separated value format or in a Microsoft Excel worksheet, will be loaded into the appropriate database table. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually.

After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

14.4.6 Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of the data. Data entry screens will be developed to assist in the keypunching of field observations. Routines will also be developed to permit the user to scan analytical data from a given site for a given media. Several output functions that have been developed by ARCADIS will be appropriately modified for use in the data management system.

A valuable function of the data management system will be the generation of tables of analytical results from the project databases. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function creates a digital comma-delimited ASCII file of analytical results and qualifiers for a given media. The ASCII file is then processed through a spreadsheet, which transforms the comma-delimited file into a table of rows and columns. Tables of analytical data will be produced as part of data interpretation tasks, the reporting of data, and the generation of the Pre-Design Investigation (PDI) Summary Report.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/presentation software. A function has been created by ARCADIS that creates a digital file consisting of sample location number, state plane coordinates, sampling date, and detected constituents and associated concentrations and analytical qualifiers. The file is then transferred to an AutoCAD work station, where another program has been developed to plot a location's analytical data in a "box" format at the sample location (represented by the state plane coordinates). This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

The data management system also has the capability of producing a digital file of select parameters that exists in one or more of the databases. This type of custom function is accomplished on an interactive basis and is best used for transferring select information into a number of analysis tools, such as statistical or graphing programs.

14.5 Document Control and Inventory

ARCADIS maintains project files at its Syracuse, New York office as discussed in Section 5.6.

15. Assessment and Response Actions

Performance and systems audits will be completed in the field and the laboratory during the investigation activities, as described below.

15.1 Field Audits

The following field performance and systems audits will be completed during this project.

15.1.1 Performance Audits

The appropriate Task Manager will monitor field performance. Field performance audit summaries will contain an evaluation of field measurements and field meter calibrations to verify that measurements are taken according to established protocols. The ARCADIS QAM will review all field reports and communicate concerns to the ARCADIS Project Manager and/or Task Managers, as appropriate. In addition, the ARCADIS QAM will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures.

15.1.2 Internal Systems Audits

A field internal systems audit is a qualitative evaluation of all components of field QA/QC. The systems audit compares scheduled QA/QC activities from this document with actual QA/QC activities completed. The appropriate Task Manager will periodically confirm that work is being performed consistent with the RD Work Plan, the FSP, and the HASP.

15.2 Laboratory Audits

The laboratory will perform internal audits consistent with NYSDEC ASP, 2005 Revision, Exhibit E.

In addition to the laboratory's internal audits and participation in state and federal certification programs, the laboratory sections at the laboratory are audited by representatives of the regulatory agency issuing certification. Audits are usually conducted on an annual basis and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation, and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

ARCADIS reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the course of the project, as deemed necessary.

15.3 Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP, the FSP, or the Work Plan. Corrective actions include procedures to promptly investigate, document, evaluate, and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures are described below.

15.3.1 Field Procedures

When conducting the field work, if a condition is noted that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action implemented will be documented on a Corrective Action Report Form and reported to the appropriate ARCADIS Project Manager and Task Manager.

Examples of situations that would require corrective actions are provided below:

1. Protocols, as defined by this QAPP, the FSP, or the Work Plan, have not been followed.

2. Equipment is not in proper working order or properly calibrated.

3. QC requirements have not been met.

4. Issues resulting from performance or systems audits.

Project personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

15.3.2 Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause, and corrective action to be taken will be documented and reported to the appropriate Project Manager and Task Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

1. Specific laboratory analytical protocols have not been followed.

2. Predetermined data acceptance standards are not obtained.

3. Equipment is not in proper working order or calibrated.

4. Sample and test results are not completely traceable.

5. QC requirements have not been met.

6. Issues resulting from performance or systems audits.

Laboratory personnel will continuously monitor ongoing work performance in the normal course of daily responsibilities.

16. Reports to Management

16.1 Internal Reporting

The analytical laboratory will submit analytical reports to ARCADIS for review. If required, ARCADIS will, in turn, submit the reports to the data validator for review. Supporting data (i.e., historic data, related field or laboratory data) will also be reviewed to evaluate data quality, as appropriate. The ARCADIS QAM will incorporate results of the data validation reports (if required) and assessments of data usability into a summary report (if required) that will be submitted to the ARCADIS Project Manager and appropriate Task Managers. If required, this QAPP will be filed in the project file at ARCADIS' office and will include the following:

1. Assessment of data accuracy, precision, and completeness for both field and laboratory data.
2. Results of the performance and systems audits.
3. Significant QA/QC problems, solutions, corrections, and potential consequences.
4. Analytical data validation report.

16.2 Reporting

Upon sample transport to the laboratory, a copy of the chain of custody will be forwarded to NYSEG. Upon receipt of the ASP – Category B Data Package from the laboratory, the ARCADIS QAM will determine if the data package has met the required DQOs. The analytical data package will be submitted to NYSEG's Project Manager and will also be incorporated into the reports.

17. Data Review, Validation, and Verification

After field and laboratory data are obtained, the data will be subject to the following:

1. Reduction, or manipulation mathematically, or otherwise into meaningful and useful forms

2. Review

3. Organization, interpretation, and reporting

4. Data validation

17.1 Field Data Reduction, Validation, and Reporting

17.1.1 Field Data Reduction

Information that is collected in the field through visual observation, manual measurement, and/or field instrumentation will be recorded in field notebooks, log sheets, and/or other appropriate forms. Such data will be reviewed by the appropriate Task Manager for adherence to the RD Work Plan and consistency of data. Any concerns identified as a result of this review will be discussed with the field personnel, corrected if possible, and, as necessary, incorporated into the data evaluation process.

17.1.2 Field Data Review

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the appropriate Task Manager and the QAM. Task Managers will recalculate at least 5 percent of all data reductions. Field documentation and data reduction prepared by field personnel will be reviewed by the appropriate Task Manager and QAM. All logs and documents will be checked for:

1. General completeness

2. Readability

3. Usage of appropriate procedures

4. Appropriate instrument calibration and maintenance

5. Reasonableness in comparison to present and past data collected

6. Correct sample locations

7. Correct calculations and interpretations

17.1.3 Field Data Reporting

Where appropriate, field data forms and calculations will be processed and included in appendices to the reports. The original field logs, documents, and data reductions will be kept in the project file at the ARCADIS office in Syracuse, New York.

17.2 Laboratory Data Reduction, Review, and Reporting

17.2.1 Laboratory Data Reduction

The calculations used for data reduction will be specified in each of the analytical methods referenced previously. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be entered into permanently bound laboratory notebooks. The data entered are sufficient to document all factors used to arrive at the reported value.

Concentration calculations for chromatographic analyses will be based on response factors. Quantitation will be performed using either internal or external standards.

Total cyanide analyses will be based on regression analysis. Regression analysis is used to fit a curve through the calibration standard data. The sample concentrations will be calculated using the resulting regression equations. Non-aqueous values will be reported on a dry-weight basis. Unless otherwise specified, all values will be reported uncorrected for blank contamination.

17.2.2 Laboratory Data Review

All data will be subject to multi-level review by the laboratory. The group leader will review all data reports prior to release for final data report generation, and the laboratory director will review a cross section of the final data reports. All final data reports are reviewed by the laboratory QAM prior to shipment to ARCADIS.

If discrepancies or deficiencies exist in the analytical results, then corrective action will be taken, as discussed in Section 15. Deficiencies discovered as a result of internal data review, as well as the corrective actions to be used to rectify the situation, will be documented on a Corrective Action Form. This form will be submitted to the ARCADIS Project Manager.

18. Validation and Verification Methods

Data validation entails a review of the QC data and the raw data to verify that the laboratory was operating within required limits, the analytical results are correctly transcribed from the instrument, and which, if any, environmental samples are related to any out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

No validation of the analytical data collected during the PDI is proposed at this time. If required, data validation will consist of data screening, checking, reviewing, editing, and interpreting to document analytical data quality and determine if the quality is sufficient to meet the DQOs.

The data validator will use the most recent versions of the USEPA functional guidelines for data validation with NYSDEC ASP 2005 Revision, QA/QC and reporting deliverables requirements available at the time of project initiation and for the entire duration of the project, as guidance, where appropriate.

The data validator will verify reduction of laboratory measurements and laboratory reporting of analytical parameters are in accordance with the procedures specified for each analytical method (i.e., perform laboratory calculations in accordance with the method-specific procedure).

If required, upon receipt of the laboratory data, the following reduction, validation, and reporting scheme will be executed by the data validator:

1. Laboratory data will be screened to confirm that the necessary QC procedures (e.g., detection limit verification, initial calibration, continuing calibration, duplicates, spikes, blanks) have been performed. QC information not included or of insufficient frequency will be identified in the validation report, including a discussion of the implications.

2. QC supporting information will subsequently be screened to identify QC data outside established control limits. If out-of-control data are discovered, documentation of appropriate corrective action will be reviewed. Out-of-control data without appropriate corrective action shall result in designation of the affected data as qualified or rejected, as appropriate.

It should be noted that the existence of qualified results does not automatically invalidate data. This point is repeatedly emphasized in the USEPA functional guidelines for data validation and is inherently acknowledged by the very existence of the data validation/flagging guidelines. The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the data validator, laboratory Project Manager, and the ARCADIS Project Manager.

Upon completion of the data validation (if required), a data usability summary report addressing the following topics will be prepared.

1. assessment of the data package

2. description of any protocol deviations

3. failures to reconcile reported and/or raw data

4. assessment of any compromised data

5. laboratory case narrative

6. overall appraisal of the analytical data

7. table of site name, sample quantities, data submitted to the laboratory, year of protocol used, matrix, and fractions analyzed

19. Reconciliation with User Requirements

The data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives. Of particular note will be samples at or near action levels. All deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Action options may include any or all of the following:

- retrieval of missing information
- request for additional explanation or clarification
- reanalysis of sample from extract (when appropriate)
- recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty, and may eliminate the need to qualify or reject data.

If these actions do not improve the data quality to an acceptable level, the following actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, then the following action must be taken:

- additional sample collection and analysis

20. References

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Tables

TABLE 1

PARAMETERS, METHODS, AND TARGET REPORTING LIMITS

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

Analyte	Soil/Sediment[2] (ug/kg)		
	Criteria	Laboratory MDL	Laboratory RL
Polycyclic Aromatic Hydrocarbon (PAH) Compounds 8270 [1]			
Acenaphthene	**	47.1	330
Acenaphthylene	**	47.3	330
Anthracene	**	58.4	330
Benzo(a)anthracene	**	6.12	33
Benzo(a)pyrene	**	4.07	33
Benzo(b)fluoranthene	**	4.92	33
Benzo(g,h,i)perylene	**	34.9	330
Benzo(k)fluoranthene	**	4.63	33
Chrysene	**	48.1	330
Dibenz(a,h)anthracene	**	3.98	33
Fluoranthene	**	55	330
Fluorene	**	56	330
Indeno(1,2,3-cd)pyrene	**	5.29	33
Naphthalene	**	48.4	330
Phenanthrene	**	57.7	330
Pyrene	**	57.2	330
Alkylated Polycyclic Aromatic Hydrocarbon (PAH) Compounds 8270C [1]			
TBD See Notes		TBD	TBD
Total Petroleum Hydrocarbons (TPH) 8015 [1]			
Diesel Range Organics (DRO)		2.4	6.7
Gasoline Range Organics (GRO)		260	1250
Analyte	**Groundwater (ug/L)**		
	Criteria	**Laboratory MDL**	**Laboratory RL**
Volatile Organic Compounds 8260 [1]			
Benzene	NA	0.13	1
Bromodichloromethane	NA	0.09	1
Bromoform	NA	0.10	1
Bromomethane	NA	0.31	1
Carbon tetrachloride	NA	0.19	1
Chlorobenzene	NA	0.16	1
Chloroethane	NA	0.45	1
2-Chloroethylvinyl ether	NA	0.19	1
Chloroform	NA	0.15	1
Chloromethane	NA	0.21	1
Dibromochloromethane	NA	0.11	1
1,1-Dichloroethane	NA	0.10	1
1,2-Dichloroethane	NA	0.24	1
1,1-Dichloroethene	NA	0.14	1
trans-1,2-Dichloroethene	NA	0.14	1

TABLE 1

PARAMETERS, METHODS, AND TARGET REPORTING LIMITS

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

Analyte	Groundwater (ug/L)		
	Criteria	Laboratory MDL	Laboratory RL
1,2-Dichloropropane	NA	0.09	1
cis-1,3-Dichloropropene	NA	0.11	1
trans-1,3-Dichloropropene	NA	0.12	1
Ethyl benzene	NA	0.25	1
Methylene chloride	NA	0.19	1
1,1,2,2-Tetrachloroethane	NA	0.09	1
Tetrachloroethene	NA	0.20	1
Toluene	NA	0.09	1
1,1,1-Trichloroethane	NA	0.25	1
1,1,2-Trichloroethane	NA	0.10	1
Trichloroethene	NA	0.18	1
Vinyl chloride	NA	0.13	1
Semivolatile Organic Compounds 8270 [1]			
Acenaphthene	NA	3.76	10
Acenaphthylene	NA	4.03	10
Anthracene	NA	3.55	10
Benzidine	NA	3.76	10
Benzo(a)anthracene	NA	0.27	1
Benzo(a)pyrene	NA	0.18	1
Benzo(b)fluoranthene	NA	0.21	1
Benzo(g,h,i)perylene	NA	2.72	10
Benzo(k)fluoranthene	NA	0.30	1
Butylbenzylphthalate	NA	2.78	10
bis(2-Chloroethyl) ether	NA	0.41	1
bis(2-Chloroethoxy)methane	NA	3.47	10
Bis(2-ethylhexyl)phthalate	NA	2.40	10
2,2'-oxybis(1-Chloropropane)	NA	3.21	10
4-Bromophenyl-phenylether	NA	3.92	10
2-Chloronaphthalene	NA	3.75	10
4-Chloro-3-methylphenol	NA	2.00	10
2-Chlorophenol	NA	2.62	10
4-Chlorophenyl-phenylether	NA	3.92	10
Chrysene	NA	3.77	10
Dibenz(a,h)anthracene	NA	0.16	1
Di-n-butyl phthalate	NA	2.77	10
1,3-Dichlorobenznene	NA	3.77	10
1,4-Dichlorobenznene	NA	3.61	10
1,2-Dichlorobenznene	NA	3.73	10
3,3'-Dichlorobenzidine	NA	6.97	20
2,4-Dichlorophenol	NA	2.75	10
Diethylphthalate	NA	3.82	10
2,4-Dimethylphenol	NA	2.51	10
Dimethylphthalate	NA	3.26	10
2,4-Dinitrophenol	NA	4.81	30
Di-n-octyl phthalate	NA	1.91	10
1,2-Diphenylhydrazine	NA	4.22	10
4,6-Dinitro-2-methylphenol	NA	5.22	30
2,4-Dinitrotoluene	NA	0.43	2
2,6-Dinitrotoluene	NA	0.59	2
Fluoranthene	NA	2.64	10

TABLE 1

PARAMETERS, METHODS, AND TARGET REPORTING LIMITS

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

Analyte	Groundwater (ug/L)		
	Criteria	Laboratory MDL	Laboratory RL
Fluorene	NA	3.26	10
Hexachlorobenzene	NA	0.27	1
Hexachlorobutadiene	NA	0.94	2
Hexachlorocyclopentadiene	NA	4.57	10
Hexachloroethane	NA	0.50	1
Indeno(1,2,3-cd)pyrene	NA	0.12	1
Isophorone	NA	3.58	10
2-Nitrophenol	NA	3.39	10
4-Nitrophenol	NA	2.32	30
Naphthalene	NA	3.66	10
Nitrobenzene	NA	0.41	1
N-Nitrosodimethylamine	NA	1.60	10
N-Nitroso-di-n-propylamine	NA	0.32	1
N-Nitrosodiphenylamine	NA	3.87	10
Pentachlorophenol	NA	5.1	30
Phenanthrene	NA	3.56	10
Phenol	NA	0.89	10
Pyrene	NA	4.27	10
2,3,7,8-TCDD	NA	1.00	1
1,2,4-Trichlorobenzene	NA	0.52	1
2,4,6-Trichlorophenol	NA	3.16	10
Pesticides 8081 [1]			
alpha-BHC	NA	0.05	0.2
beta-BHC	NA	0.04	0.2
delta-BHC	NA	0.04	0.2
gamma-BHC	NA	0.04	0.2
Heptachlor	NA	0.05	0.2
Aldrin	NA	0.04	0.2
Heptachlor epoxide	NA	0.05	0.2
Endosulfan I	NA	0.04	0.2
Dieldrin	NA	0.04	0.2
4,4'-DDE	NA	0.06	0.2
Endrin	NA	0.05	0.2
Endosulfan II	NA	0.04	0.2
4,4'-DDD	NA	0.05	0.2
Endrin aldehyde	NA	0.04	0.2
Endosulfan sulfate	NA	0.04	0.2
4,4'-DDT	NA	0.05	0.2
Chlordane	NA	0.46	2
Toxaphene	NA	0.51	2
PCBs 8082 [1]			
Aroclor-1016	NA	0.15	1
Aroclor-1221	NA	0.12	1
Aroclor-1232	NA	0.12	1
Aroclor-1242	NA	0.16	1
Aroclor-1248	NA	0.21	1
Aroclor-1254	NA	0.13	1
Aroclor-1260	NA	0.12	1

TABLE 1

PARAMETERS, METHODS, AND TARGET REPORTING LIMITS

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

Analyte	Groundwater (mg/L)		
	Criteria	Laboratory MDL	Laboratory RL
Inorganics 6010 [1]			
Aluminum	NA	0.0870	0.200
Antimony	NA	0.0046	0.010
Arsenic	NA	0.0040	0.005
Beryllium	NA	0.0009	0.002
Cadmium	NA	0.0009	0.005
Calcium	NA	0.0722	5.000
Chromium	NA	0.0032	0.010
Cobalt	NA	0.0028	0.050
Copper	NA	0.0036	0.025
Iron	NA	0.0402	0.150
Lead	NA	0.0028	0.005
Magnesium	NA	0.0569	5.000
Manganese	NA	0.00251	0.015
Nickel_	NA	0.0035	0.040
Potassium	NA	0.2087	5.000
Selenium	NA	0.0048	0.010
Silver	NA	0.0010	0.010
Thallium	NA	0.00464	0.010
Zinc	NA	0.00579	0.030
Inorganics 7470 [1]			
Mercury	NA	0.00018	0.0002
Inorganics 9012 [1]			
Cyanide	NA	0.5	0.5
Conventional Chemistry			
Oil and Grease (EPA 1664)	NA	--	5
Total Suspended Solids (SM 2540D)	NA	--	10
Total Dissolved Solids (SM 2540C)	NA	--	10
5-Day Biological Oxygen Demand (SM 5210B)	NA	--	2
Chemical Oxygen Demand (EPA 410.4)	NA	--	10
Total Kjeldahl Nitrogen (EPA 351.3)	NA	--	3
Hardness (SM2340C)	NA	--	5
pH (EPA 150.1)	NA	--	0.1
Bioactivity-iron-reducing bacteria [3]	NA	--	1
Bioactivity-sulfate reducing bacteria [3]	NA	--	1
Bioactivity-slime-forming bacteria [3]	NA	--	1

Notes:

1 USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste* SW-846 3rd ed. *Washington, D.C. 1996.*

2 The target reporting limits are based on wet weight. The actual reporting limits will vary based on sample weight and moisture content.

3 Biological Activity Reaction Test (BART) units are CFU/ml.

4 NA - not applicable. These analyses are being conducted for treatability testing and will not be compared to regulatory criteria.

5 * Comparison criteria for BTEX is 10 ppm for the sum of the concentrations for the 4 BTEX compounds.

6 ** Comparison criteria for PAHs is 500 ppm for the sum of the concentrations for the 17 PAH compounds.

7 The analyte list, MDL/RL and analytical laboratory for Parent & alkylated PAHs is to be determined.

TABLE 2
SAMPLE QUANTITIES AND QUALITY CONTROL FREQUENCIES

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

	Estimated Environ. Sample Quantity [1]	Field QC Analyses						Laboratory QC Sample						Total
		Trip Blank		Rinse Blank		Field Duplicate		Matrix Spike		Matrix Spike Duplicate		Lab Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Sediment														
SVOCs (SW-846 8270)	36	NA	--	TBD	--	1/20	2	1/20	2	1/20	2	NA	--	42
Parent & Alkylated PAHs (SW-846 8270C)	TBD [2]	NA	--	TBD	--	1/20	TBD	1/20	TBD	1/20	TBD	NA	--	TBD
TPH (DRO/GRO) (SW-846 8015)	TBD [2]	NA	--	TBD	--	1/20	TBD	1/20	TBD	1/20	TBD	NA	--	TBD
Background Sediment														
PAHs (SW-846 8270)	20	NA	--	TBD	--	1/20	1	1/20	1	1/20	1	NA	--	23
Soil														
SVOCs (SW-846 8270)	10	NA	--	TBD	--	1/20	1	1/20	1	1/20	1	NA	--	13
Water (Groundwater)														
VOCs (SW846 8260)	10	1/day	1	NA	--	1/20	1	1/20	1	1/20	1	NA	--	14
SVOCs (SW846 8270)	10	NA	--	NA	--	1/20	1	1/20	1	1/20	1	NA	--	13
Pesticides/PCBs (SW846 8081/8082)	10	NA	--	NA	--	1/20	1	1/20	1	1/20	1	NA	--	13
TAL Metals and Mercury (SW846 6010/7470)	10	NA	--	NA	--	1/20	1	1/20	1	NA	--	1/20	1	13
Cyanide (SW846 9012)	10	NA	--	NA	--	1/20	1	1/20	1	1/20	1	NA	--	13
BOD (SM5210B)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	1/20	1	12
COD (EPA 410.4)	10	NA	--	NA	--	1/20	1	1/20	1	NA	--	1/20	1	13
TDS (SM2540C)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	1/20	1	12
TSS (SM2540D)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	1/20	1	12
pH (EPA 150.1)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	1/20	1	12
TKN (EPA 351.3)	10	NA	--	NA	--	1/20	1	1/20	1	1/20	1	1/20	1	14
Oil & Grease (EPA 1664)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	1/20	1	12
Bioactivity (Iron, sulfate and reducing bacteria) (BART)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Soil														
Moisture Content (ASTM D2216)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Atterberg limits (ASTM D4318)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Grain size analysis with hydrometer (ASTM D422)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Grain size analysis with #200 wash (ASTM D422, D1140)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Specific gravity (ASTM D4767)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Flex-wall permeability (ASTM D5084)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
CU tri-axial shear test (ASTM D4767)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11
Direct-shear test (ASTM D3080)	10	NA	--	NA	--	1/20	1	NA	--	NA	--	NA	--	11

Notes:

1. All sample quantities are an approximation.

2. The sediment samples collected for PAHs will be collected in duplicate. The duplicate container will be designated for Parent & Alkylated PAH analysis, which will be frozen upon receipt by the laboratory.

1/day = One rinse blank per day or one per 20 samples, whichever is more frequent. Rinse blanks not required when dedicated sampling equipment is used.
Freq = Frequency.
No. = Number.

TABLE 3
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

Parameter	Method	Bottle Type	Preservation	Holding Time
Soil and Sediment				
SVOCs	8270 [2]	One8-oz glass jar with Teflon®-lined lid	Cool to 4°C±2°C	14 days to extraction 40 days to analysis
Parent & Alkylated PAHs	8270 [2]	One8-oz glass jar with Teflon®-lined lid	Freeze to -6°C	1 year to extraction analysis 40 days from extraction
TPH (DRO/GRO)	8015 [2]	One8-oz glass jar with Teflon®-lined lid	Freeze to -6°C	1 year to extraction analysis 14 days from extraction
Background Sediment				
SVOCs (PAHs)	8270 [2]	One8-oz glass jar with Teflon®-lined lid	Cool to 4°C±2°C	14 days to extraction 40 days to analysis
Water (Groundwater)				
VOCs	8260 [2]	Three 40-ml glass vial	Cool to 4°C±2°C	14 days to analysis
SVOCs	8270 [2]	Two 1-L amber glass bottle with Teflon®-lined lid	Cool to 4°C±2°C	7 days to extraction 40 days to analysis
Pesticides	8081 [2]	Two 1-L amber glass bottle with Teflon®-lined lid	Cool to 4°C±2°C	7 days to extraction 40 days to analysis
PCBs	8082 [2]	Two 1-L amber glass bottle with Teflon®-lined lid	Cool to 4°C±2°C	7 days to extraction 40 days to analysis
TAL Metals	6010 [2] 7470 [2]	One 500ml plastic bottle	HNO_3 to pH<2, Cool to 4°C±2°C	180 days to analysis 28 days to analysis
Cyanide	9012 [2]	One 250ml plastic bottle	NaOH to pH>12, Cool to 4°C±2°C	14 days to analysis
BOD	5210B	One 1-L plastic bottle	Cool to 4°C±2°C	48 hours from collection to analysis
COD	410.4 [1]	One 100-ml plastic bottle	H2SO4 to pH<2, Cool to 4°C±2°C	28 days to analysis
TDS	2540C	One 1-L plastic bottle	Cool to 4°C±2°C	7 days to analysis
TSS	2540D			7 days to analysis
pH	150.1 [1]			As soon as possible
TKN	351.3 [1]	One 500-ml plastic bottle	H2SO4 to pH<2, Cool to 4°C±2°C	28 days to analysis
Oil & Grease	1664	One 1-L glass bottle	H2SO4 to pH<2, Cool to 4°C±2°C	14 days to analysis
Bioactivity (Iron, sulfate and slime reducing bacteria)	BART	Two 1-L glass bottle	Cool to 4°C±2°C	24-48 hours from collection to analysis

Notes:

1. USEPA. *Methods for Chemical Analysis of Water and Wastes*. EPA/600/4-79/020. EMSL-Cincinnati. 1983.
2. USEPA. Office of Solid Waste and Emergency Response. *Test Methods for Evaluating Solid Waste SW-846.* 3rd ed. Washington, DC. 1996.
3. USEPA. *Appendix A to Part 136 Methods For Organic Chemical Analysis of Municipal and Industrial Wastewater Method 608—Organocholrine Pesticides and PCBs*. July 1995.
4. All holding times are measured from date of collection except where noted.

°C = Degrees Celsius.
PCB = Polychlorinated biphenyl.
TDS = Total dissolved solid.
TSS = Total suspended solid.
BOD = Biological oxygen demand
COD = Chemical oxygen demand

TABLE 4
LABORATORY QUALITY CONTROL LIMITS [1]

QUALITY ASSURANCE PROJECT PLAN
NYSEG
CLARK STREET FORMER MGP SITE

Parameter	Accuracy - % Recovery			Precision - RPD		
	Surrogate	MS/MSD	LCS	MS/MSD	Lab Duplicate	Field Duplicate
Soil and Sediment						
Semivolatile Organics	20-140	20-140	40-120	40	--	100
TPH (DRO/GRO)	47-131	70-130	70-130	30	--	100
Groundwater						
Volatile Organics	75-115	60-145	70-140	20	--	50
Semivolatile Organics	20-140	20-130	40-120	40	--	50
PCBs	30-150	40-130	50-140	20	--	50
Pesticides	30-150	50-140	50-140	20	--	50
Metals	--	75-125	80-120	--	30	50
Cyanide	--	75-125	80-120	30	--	50
BOD	--	70-130	70-130	--	30	50
COD	--	70-130	70-130	--	30	50
Hardness	--	70-130	70-130	--	30	50
Oil and Grease	--	70-130	70-130	--	30	50
TKN	--	70-130	70-130	--	30	50
TDS	--	70-130	70-130	--	30	50
TSS	--	70-130	70-130	--	30	50

Notes:
1 The listed QC limits are based on SW-846 guidance and are advisory. The actual limits are determined based on laboratory performance. Frequent failure to meet the QC limits; however, warrant investigation of the laboratory.

TABLE 5

ELECTRONIC DATA DELIVERABLE (EDD) FORMAT

QUALITY ASSURANCE PROJECT PLAN

NYSEG

CLARK STREET FORMER MGP SITE

Field Name [1]	Data Type [2]	Notes
Sample Name	Text-50	Sample ID as it appears on Laboratory Form 1 for analysis (e.g., MW-1 reported as MW-1RE for re-analysis).
COC Sample Name	Text-50	Sample ID as it appears on the chain of custody.
SDG	Text-50	Sample Delivery Group
Lab Sample ID	Text-50	
Matrix	Text-25	e.g., Soil, Water, Sediment
Sample Type	Text-10	e.g., FB, RB, FD , FS, TB, MS, MSD -- for Field Blank, Rinse Blank, Field Duplicate, Field Sample, Trip Blank, Matrix spike, Matrix Spike Duplicate respectively. MS and MSD sample results are optional.
Date Collected	Date/Time	
Time Collected	Date/Time	
Depth Start	Number	
Depth End	Number	
Depth Units	Text-25	
Method	Text-50	Analytical method used by laboratory. Include "-TCLP" or "-Filtered" as appropriate (e.g., Soil-1 reported as Soil-1-TCLP for TCLP samples).
CAS Number	Text-25	Chemical Abstracts Service Registry Number
Analyte	Text-100	
Result Value	Number	For non-detected results a "U" must be present in Lab Qualifiers field.
Lab Qualifiers	Text-10	"U" for not detected, others as defined by the lab.
Reporting Limit	Number	PQL
Result Units	Text-25	
Dilution Factor	Number	
Reportable Result	Yes/No	If the field is not included, default on import will be "Yes". If the field is included it must be populated. Used where re-analyses or dilutions are present to determine proper result to report.
Filtered	Yes/No	
MDL	Number	Method Detection Limit
Date Analyzed	Date/Time	
Time Analyzed	Date/Time	
Date Received	Date/Time	Date Received by Lab
Laboratory	Text-50	
Lab Certification Number	Text-50	
Result Type	Text-10	e.g., IS, SC, SUR, TIC or TRG -- for Internal Standard, Spiked Compound, Surrogate, Tentatively Identified Compound, Target (regular) result, respectively. IS, SC and SUR results are optional.
Basis	Text-10	e.g., Wet, Dry or NA -- for wet weight, dry weight, not applicable, respectively.
Test Type	Text-10	e.g., Initial, DL, DL1…DLn, RE, RE1…Ren, REX, REX1…REXn; where Initial = Initial Analysis, DL = Dilution, RE = Re-analysis, REX = Re-extraction, n = the nth analysis of the test type.
Time Received	Date/Time	Time Received by Lab

Notes:
1. Fields highlighted in pink are not required. They may be left empty or the field can be eliminated from the EDD if the lab is not providing that data.
2. Number after "Text-" indicates the maximum number of characters allowed.
3. If lab is providing Matrix or Sample Types, they can use codes different from the examples above but will need to provide definitions for them.
4. Depth related fields can be left blank for samples where they are not applicable.

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Attachment B-1

Sample Chain-of-Custody Form

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Infrastructure, environment, facilities

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name:	Telephone:
Address:	Fax:
City State Zip	E-mail Address:
Project Name/Location (City, State):	Project #:
Sampler's Printed Name:	Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: ________
G. Other: ________
H. Other: ________

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ________
10. Other: ________

Matrix Key:
SO - Soil
SE - Sediment
NL - NAPL/Oil
W - Water
SL - Sludge
SW - Sample Wipe
T - Tissue
A - Air
Other: _______

Sample ID	Collection		Type (✓)		Matrix								REMARKS
	Date	Time	Comp	Grab									

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt	
Lab Name:	Cooler Custody Seal (✓)
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact
Specify Turnaround Requirements:	Sample Receipt:
Shipping Tracking #:	Condition/Cooler Temp: _________

Relinquished By	Received By	Relinquished By	Laboratory Received By
Printed Name:	Printed Name:	Printed Name:	Printed Name:
Signature:	Signature:	Signature:	Signature:
Firm:	Firm/Courier:	Firm/Courier:	Firm:
Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by BBL**

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Appendix D

Health and Safety Plan

ARCADIS
Infrastructure, environment, buildings

Imagine the result

NYSEG

Environmental Health and Safety Plan (E-HASP)

Clark Street Former Manufactured Gas Plant Site
Auburn, New York

February 2010

ARCADIS

Environmental Health and Safety Plan (E-HASP)

Clark Street Former Manufactured Gas Plant Site
Auburn, New York

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Date:
February 2010

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F Emergency Action Plan and Route to Hospital

G HASP Forms and Checklists

H NYSDOH G-CAMP

1. Introduction

All work on this project will be carried out in compliance with ARCADIS' Health and Safety policies and procedures, and the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response regulation 29 CFR 1910.120. The design of this health and safety plan (HASP) conforms to the requirements of the ARC HSFS010 (HASP H&S Procedure). Specific health and safety information for the project is contained in this HASP. All personnel working on hazardous operations or in the area of hazardous operations shall read and be familiar with this HASP before doing any work. All project personnel shall sign the certification page acknowledging that they have read and understand this HASP.

Changes in the scope of the project or introduction of new hazards to the project shall require revision of the HASP by the HASP writer and reviewer, and approval by the Project Manager. The HASP Addendum Form and log table are included as Appendix A.

2. Project Site History and Requirements

2.1 Site Background

MGP operations reportedly began at the site in 1901 when operations included a gashouse (consisting of an engine room, purifier room, meter room, generator room, and boiler room), an oil tank, a shed, a 204,000 cubic-foot (cf) holder (gas holder #2), and a 75,000 cf holder (gas holder #3). A 491,000 cf holder (gas holder #1) was constructed at some point later in the early 1900s at the location of the oil tank. In 1943 gas holders #2 and #3 and a tar tank were removed and a coal storage area and tar shed were added. Gas operations ceased in 1946 when portions of the gas house were converted to a carpenter shop, storage area, regulator room, fireproof regulator room, and a booster room. Gas holder #1 was removed in 1958 when the substation transformer area was constructed. The gashouse was demolished in 1961 with exception of the existing gas regulator building.

During operation of the MGP, coal was transported to the site via the railroad located south of the site. The plant manufactured gas utilizing the carbureted water gas (CWG) process. Gas holders #2 and #3 were water seal holders constructed around subsurface pit foundations. These type of structures utilized water in the bottom of the holders to create a seal at the bottom to prevent manufactured gas from escaping. Gas holder #1 is believed to be an at-grade waterless holder.

2.2 Site Description

The Clark Street Former MGP site is located at the east end of Clark Street near US Route 20 in Auburn, New York. The property, currently owned and operated by NYSEG, consists of a triangular-shaped, approximately 3-arce parcel that is occupied by a NYSEG electrical substation and natural gas regulator building. Access to the property is restricted by a locked gate at the Clark Street entrance and a cable fence along the southern property line. A majority of the property is covered with gravel and surrounding areas are vegetated with trees and grass. Surrounding land use includes a vehicle maintenance shop to the southwest and a CSX railroad right-of-way and US Route 20 to the south of the site. The Owasco Outlet borders the site to the east and north, with the site forming a peninsula into the outlet. Ground surface elevations at the site generally slope downward toward the outlet.

The Owasco Outlet is a Class C water body that conveys water from Owasco Lake to the Seneca River. The outlet has a peak flow rate of approximately 1,200 cubic-feet per second (cfs) and the outlet width varies from 30 to 80 feet adjacent to the site. Flow within the outlet can be regulated by the City of Auburn Department of Municipal Utilities through a series of dams within the outlet both upstream and downstream from the site. Land use on the north side of the outlet (i.e., across from the site) is primarily residential.

Site Type: (Check as many as applicable}

X	Active		Secure	X	Industrial		Landfill		Service station
	Inactive	X	Unsecured		Commercial		Well field		Water work
			Uncontrolled		Residential		Railroad		Undeveloped
Other specify: Electrical Substation and Natural Gas Regulator Building On-Site									

2.3 List of Project Tasks and Scope of Work

- *Task 1 – Tree and Brush Removal*. ARCADIS' subcontractor will remove trees and/or brush to facilitate completion of soil boring.

- *Task 2 – Soil Boring Completion*. ARCADIS' subcontractor will complete soil borings in support of developing and completing soil excavation plans and activities.

- *Task 3 – Test Pit Excavation*. ARCADIS' subcontractor will excavate test pits to identify shallow foundations and obstructions.

- *Task 4 – Sediment Coring/Sampling*. ARCADIS will conduct sediment sampling within the Owasco Outlet. Sediment cores will be collected via a float-mounted drill rig.

- *Task 5 – NAPL Monitoring and Passive Removal*. ARCADIS will conduct NAPL monitoring of the existing site monitoring wells to evaluate potential locations for new NAPL monitoring wells.

- *Task 6 – Groundwater Sampling*. ARCADIS will collect groundwater samples from existing monitoring wells using low-flow sampling procedures.

- *Task 7 – Surveying*. ARCADIS' survey subcontractor will obtain the horizontal location and ground surface elevation of the soil borings and sediment sampling locations.

3. ARCADIS Organization and Responsibilities

3.1 Project Manager/Task Manager

In planning and preparation of this project, the project manager and/or task manager has completed the project-specific H&S Stewardship Checklist & Project Hazard Analysis Worksheet. The project Hazard Analysis Worksheet was completed using the Hazard Analysis Risk Control (HARC) ranking process (ARCADIS H&S Procedure ARC HSMS002). Additional responsibilities of the project manager and task manager are as follows:

- Review all applicable H&S Procedures, and ensure that project activities conform to all requirements.
- Obtain client-specific health and safety information and communicate with the client on health and safety issues.
- Communicate with the Site Safety Officer (SSO) on health and safety issues.
- Allocate resources for correction of identified unsafe work conditions.
- Ensure ARCADIS site workers have all training necessary for the project.
- Report all injuries, illnesses and near-misses to the Client H&S Resource or Project H&S Manager (PHSM), lead incident investigations, and ensure that any recommendations made are implemented.

3.2 Other Project Team Responsibilities

Additional personnel designated to carry out H&S job functions for the project, and their responsibilities are listed below. The same person may fill more than one role:

ARCADIS Project Team	Responsibility and Tasks
To Be Determined	**SSO** • Reviews and works in accordance with the components of this HASP. • Ensures that this HASP is available to and reviewed by all site personnel including subcontractors. • Ensures that necessary site-specific training is performed (both initial and "tailgate" safety briefings. • Ensures site visitors have been informed of the hazards related to ARCADIS work, and have signed the Site Visitors Log. • Ensures that work is performed in a safe manner and has authority to stop work when necessary to protect workers and/or the public. • Coordinates activities during emergency situations. • Ensures that all necessary permits and safety information provided by the client is disseminated to other site personnel and is maintained in an organized manner. • Communicates with the PM, Client H&S Resource and/or the PHSM on health and safety issues. • Reports all injuries, illnesses and near-misses to the PM, Client H&S Resource and PHSM. • Ensures that necessary safety equipment is maintained and used at the site. • Contacts a health and safety professional for assistance in establishing the respiratory cartridge change schedule as required.
To Be Determined	**Site Workers** • Reads and works in accordance with the components of this HASP. • Reports all unsafe working conditions to the SSO. • Reports all injuries, no matter how minor, to the SSO. • Works in a safe manner. • Signs the HASP acceptance log in Appendix G.

ARCADIS Project Team	Responsibility and Tasks
Chuck Webster	**Project Health and Safety Manager (PHSM)** The PHSM oversees all aspects of the site safety program, and prepares site-specific health and safety guidance documents or addenda to this plan. The PHSM does not report to the Project Manager, and is separately accountable to the ARCADIS project team for site health and safety. The PHSM acts as the sole contact to regulatory agencies on matters of safety and health. Other responsibilities include: • Overall authority for health and safety compliance and HASP conformance for the project. • General health and safety program administration. • Conducts project health and safety audits as warranted. • Determines the level of personal protection required. • Updates equipment or procedures based on information obtained during site operations. • Establishes air-monitoring parameters based on expected contaminants. • Assists in injury, illness and near-miss investigations and follow-up.
Chuck Webster	**Client Health and Safety Resource** The designated Client H&S Resource is responsible for : • Assisting the SSO in issues as they arise. • Performing site audits and assessments. • Assisting with near-miss/incident investigations. • Serves as the liaison with corporate during H&S regulatory issues as they may arise.

4. Hazard Control

Figure 1. HARC- Risk Assessment Matrix (H&S Procedure ARC HSMS002)

Risk Assessment Matrix

Consequences Ratings*		Likelihood Ratings**				
		A	B	C	D	E
People	Property	Never heard of in the world	Heard of incident in industry	Incident has occurred in ARCADIS Group	Happens several times a year in ARCADIS OpCo	Happens several times a year at ARCADIS Worksite
0 - No health effect	0 - No damage	Low	Low	Low	Low	Low
1 - Slight health effect	1 - Slight damage	Low	Low	Low	Low	Low
2 - Minor health effect	2 - Minor damage	Low	Low	Low	Medium	Medium
3 - Major health effect	3 - Local damage	Low	Low	Medium	Medium	High
4 - PTD or 1 fatality	4 - Major damage	Low	Medium	Medium	High	High
5 - Multiple fatalities	5 - Extensive damage	Medium	Medium	High	High	High

4.1 Job Safety Analyses (JLAs), H&S Procedures and PPE

A JLA has been completed for each safety critical task, and are included in Appendix C. Hazards identified on the Project Hazard Analysis Worksheet are addressed in the JLAs as well as control methods to protect employees and property from hazards. The JLA also lists the type of personal protective equipment (PPE) required for the completion of the project. A detailed list of PPE for the project is located in Appendix D. Site-specific chemical hazards are presented in Table 1.

ARCADIS H&S Procedures applicable to this project are listed below. These procedures should be reviewed by the project manager, task manager and site personnel. The Client H&S Resource should be contacted with any questions concerning the procedures.

- ARC HSFS019 – Utility Location
- ARC HSCS005 – Excavation and Trenching
- ARC HSGE007 – Hazard Communication
- ARC HSGE024 – Motor Vehicle
- ARC HSIH003 – Benzene
- ARC HSIS008 – Hearing Conservation
- ARC HSGE004 – First Aid / CPR
- ARC HSMS010 – Incident Reporting and Investigation

- ARC HSGE015 – Personal Protective Equipment (PPE)

4.2 Field Health & Safety Handbook

The Field H&S Handbook is an ARCADIS document containing information about topic-specific health and safety requirements for the field. This handbook contains relevant general topics and is used as part of the overall HASP process. To aid in the consistency of the HASP process the handbook will be used as an informational source in conjunction with this HASP. The following four handbook sections are minimally required reading for this project:

- Section III-F. General Housekeeping, Personal Hygiene and Field Sanitation
- Section III-G. Site Security, Work Zone and Decontamination for HAZWOPER Sites
- Section III-GG. HAZWOPER and HAZMAT Response
- Section III-II. Drums and other Material Handling

The following handbook sections are additional required reading for this project:

- Section II (A – P). Health and Safety Administration
- Section III A. Daily Safety Meetings/Tailgates
- Section III-C. First-aid/CPR
- Section III-D. Blood-borne Pathogens (ARCHSIH005)
- Section III-E. General Health and Safety Rules and Safe Work Permits
- Section III-H. Personal Safety and Other Unique Site Conditions
- Section III-I. Severe Weather
- Section III-J. Fire Prevention
- Section III-K. Hazard Communication
- Section III-L. Noise
- Section III-M. Heat and Cold Stress
- Section III-N. Biological Hazards
- Section III-P. Medical Surveillance (ARCHSGE010)
- Section III-R. Personal Protective Equipment (ARCHSGE015)
- Section III-S. Travel Safety-Domestic and International (ARCHSGE022)
- Section III-T. Vehicle Safety Inspection
- Section III-U. Driving
- Section III-V. Trailer Safety

- Section III-AA. Electrical Safety (ARCHSFS006)
- Section III-CC. Hand and Power Tools
- Section III-DD. Vegetation Management
- Section III-EE. Ergonomics
- Section III-FF. Site Storage and Hazardous Chemicals, Gases and Solvents
- Section III-GG. HAZWOPER and HAZMAT Response (ARCHSSF012)
- Section III-II. Drum and Other Material Handling
- Section III-KK. Signs, Signals and Barricades
- Section III-LL. Traffic Control (ARCHSFS017)
- Section III-MM. Utility Location (ARCHSF019)
- Section III-NN. Backing Safety
- Section IV-E. Heavy Equipment (ARCHSCS006)
- Section IV-L. Temporary Working Surfaces
- Section III-O. Rollover and Overhead Protection
- Section III-Q. Permit to Work
- Section V-G. Water Operations Work
- Section V-F. Roadway
- Section V-I. Industrial Hygiene and Monitoring Equipment

4.3 Tree and Brush Removal

Trees, brush, and shrubbery will be cleared, as necessary to facilitate completion of soil borings and soil sample collection. For further guidance, a tree and brush removal JLA is provided as a part of Appendix C.

Hazards

- Working Outdoors: sun, heat, cold, insects, hazardous plants, animals

- Personnel injury, including slips/trips/falls, hand and eye injury, noise levels, pinch points, line of fire, projectile debris, back strain

- Working with machinery and blade bearing hand tools.

- Malfunctioning machinery and blade bearing hand tools.

- Ignition of equipment fuel leading to fire/explosion from improper handling of fuel/gas for clearing machinery.

- Injury or exposure to public or other onsite personnel from thrown/falling debris.

- Property damage to other field equipment/vehicles from thrown/falling debris.
- Damage to and injury from contact with existing site utilities.
- Fuel and/or lubricant releases to the surrounding ecosystem.

To protect against the above hazards all personnel will be briefed on and follow the guidelines listed below:

Control

- An SPSA will be performed prior to starting a task or if the conditions of the task change.
- Weather conditions will be reviewed prior to mobilization to the site and all personnel will dress properly. Work in extreme weather conditions will be avoided and work will be stopped if extreme weather is imminent. Work areas will be inspected for hazardous plants, animals, and insects prior to starting work in a particular area on site. If hazardous plants, animals, or insects are discovered, an SPSA will be performed and appropriate control measures will be implemented.
- All personnel performing clearing operations on site will don the required PPE which includes, but is not limited to, safety glasses, hard hat, reflective vest, safety boots, cut-retardant chaps, leather gloves, ear plugs, face shield, and padded clothing made of a cut-retardant material.
- Proper lifting techniques will be used and awkward or heavy vegetation will be moved with the assistance of other on site personnel.
- Clear walking paths between work areas will be established. All potential hazards will be removed or flagged.
- Employees performing clearing operations will have the training, experience and tools necessary for performing this task.
- Walking while operating a chainsaw will be prohibited and the bar will be kept locked when not in use. Two hands will be maintained on the chainsaw during operation and the operator will be attentive of the position of bodily limbs to avoid contact with chainsaw. Cutting with the chainsaw at or above head-level will be prohibited.

- Employees must maintain at least 25 feet between each other while using powered equipment.

- Inserting tip of saw directly into vegetation (i.e., use base of bar for cutting) will be prohibited. A sharp blade will be maintained on the chainsaw to avoid saw kickback and saw blade will be kept well lubricated by replenishment with bar and chain oil in the appropriate port on the saw.

- Proper operation and safety checks will be performed on all equipment (chainsaw has a properly operating chain, kickback guard is in good condition, blades on equipment sharp and lubed, etc.) to be used during clearing operations according to manufacturer's specifications.

- Hands will be maintained on the appropriate locations on all hand tools used to avoid hand contact with the cutting blade. Hand tool cutting blades will be kept sharp to ease the pressure required to make a cut and kept well lubricated.

- Equipment fuel will be kept away from open flame to reduce the risk of ignition. Equipment fuel storage containers will be moved away from the work area prior to initiating clearing operations.

- Exclusion zones will be implemented where clearing operations are being performed so that personnel, equipment and vehicles are kept at a safe distance to avoid injury and property damage from thrown/falling objects. No vegetation with limbs greater than 6-inch diameter and/or 25-feet tall are to be dropped as part of this work task.

- Work areas will be observed and reviewed for overhead utilities and other potential overhead hazards (e.g., stairways, pipe bridges, utility poles, etc.) that could be contacted by falling vegetation. Project management will be contacted if any falling vegetation could potentially be within 25 feet of any utilities or other potential overhead hazards.

- Clearing equipment will be periodically inspected for leaks while performing cutting operations to avoid releases to the surrounding ecosystem. Work will be stopped if a leak is observed or suspected and the source of the leak will be repaired.

- Stop work authority can be used at any time during clearing operations.

4.4 Test Pit Excavation

During site activities ARCADIS and applicable subcontractor personnel may be working in areas of active excavation. This task involves excavating at specified locations to obtain sub-surface soil samples from a designated area, thereby creating a man-made cut, trench, or depression in the earth's surface. Excavation activities will be conducted in accordance with this section and all OSHA regulations.

The physical hazards involved in the excavation of soils are related to the excavation itself and the operation of heavy equipment. The presence of overhead utilities such as power lines requires careful positioning of the excavating equipment in order to maintain a safe distance between the lines and the closest part of the equipment. The presence of underground utilities such as gas lines, power lines, water lines, and sewer pipes must be determined prior to beginning the excavation.

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse if it is not dug properly, sloped, benched, or shored as required by 29 CFR 1926 Subpart P. Protective systems, as required by 29 CFR 1926 Subpart P, must be utilized if the potential for hazardous cave-ins exist. The excavation also is a fall hazard, and employees must pay careful attention to what they are doing or they risk a fall into the excavation. Fall protection, as required by 29 CFR 1926 Subpart M, will be required.

Activities shall be done remotely whenever feasible.

Noise also may present a hazard. Heavy equipment operation frequently results in noise levels exceeding 85 dBA, requiring the use of hearing protection.

At the end of each workday, open test pit excavations will be backfilled and equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.

Airborne concentrations of COC in the site soil and the dust from the excavation procedure pose the potential for inhalation exposure. Airborne particulate generation will be controlled during site excavations. Dry, dusty soil will be wetted with a water spray from a potable water source to control the generation of dust. Soil will not be wetted to a degree that will cause runoff or erosion.

Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines shall be determined. Dig Safely New York must be contacted at least one week, but no more than two weeks, prior to subsurface activities. The SSO will meet with electrical and natural gas locators onsite prior to marking out the underground utilities. During this meeting, the SSO will provide the electric and natural gas locators with a site figure that shows the locations where excavation activities will be completed. The SSO will conduct a site walkover with the electrical and natural gas locators to visually identify each location where excavation activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Appendix G) shall be used to document that nearby utilities have been marked on the ground, and that the excavation areas have been cleared. The completed Underground/Overhead Utility Checklist will be in the possession of the SS prior to commencement of any intrusive investigation.

All excavation activities shall be conducted in accordance with 29 CFR 1926 Subpart P. If excavation operations are located near underground installations, the exact location of the installations must be determined by safe and acceptable means. While the excavation is open, underground installations must be protected, supported, or removed as necessary to safeguard employees.

4.4.1 Inspections by a Competent Person

Daily inspections of excavations, the adjacent areas, and protective systems must be made by the exaction contractor’s competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection must be conducted by the competent person prior to the start of work and as needed throughout the shift (see attached Periodic Excavation Inspection Form in Appendix G). We do not anticipate entering excavations during this sampling program; however, unanticipated circumstances may develop whereby entry will be required (e.g., fixing a ruptured water pipe or other utility). Should entry be required by ARCADIS, the ARCADIS competent person will evaluate the excavation and determine whether ARCADIS employees can enter safely. ARCADIS competent person inspections are solely for the use of ARCADIS employees.

Inspections also must be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated. Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees must be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

Walkways must be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with 1926.502(b) must be provided. Adequate barrier protection must be provided at all remotely located excavations. All wells, pits, shafts, etc., must be barricaded or covered. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc., must be backfilled.

4.4.2 Soil Classification

29 CFR 1926 Subpart P, Appendix A describes methods of classifying soil and rock deposits based on site and environmental conditions and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils. This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with Appendix C to Subpart P of Part 1926, and when aluminum hydraulic shoring is designed in accordance with 29 CFR Subpart P Appendix D. This appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in 1926.652(c), and the use of the data are predicated on the use of the soil classification system set forth in Appendix A of 29 CFR 1926.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H: V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from Table B-1. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope which is at least horizontal to one vertical (1/2H: 1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope, and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P Appendix B.

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]
Stable Rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1½:1 (34 degrees)

Notes:
1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.
3. A short-term maximum allowable slope of 1/2H: 1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H: 1V (53 degrees).

4.4.3 Overhead Electrical Clearances

If excavation activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up/guaranteed, and grounded or the equipment must be positioned such that no part, including excavation boom, can come within the minimum clearances as follows:

Nominal System Voltage	Minimum Required Clearance
0-50kV	10 feet
51-100kV	12 feet
101-200kV	15 feet
201-300kV	20 feet
301-500kV	25 feet
501-750kV	35 feet
751-1,000Kv	45 feet

4.4.4 Excavation Entry Procedure

Persons entering an excavation must do so under controlled conditions. The excavation must be properly sloped, benched, or shored, and ladders or ramps must be available every 25 feet laterally in the excavation. Each entry shall have an attendant who observes the entrant(s) and is prepared to render assistance.

Duties of Workers Entering an Excavation

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants.
- Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space.
- Alert the attendant whenever:
  - The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.
  - The entrant detects a prohibited condition.
- Exit from the excavation as quickly as possible whenever:
  - An order to evacuate is given by the attendant or the supervisor.
  - The entrant recognizes any warning sign or symptom of exposure to a dangers situation.
  - The entrant detects a prohibited condition.

Duties of Attendants

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants.
- Continuously maintains a count of entrants in the excavation.
- Remains outside the excavation during entry operations until relieved by another attendant.
- Communicates with authorized entrants as necessary to monitor entrant status to alert entrants of the need to evacuate the excavation under any of the following conditions, if:

- The attendant detects a prohibited condition.
- The attendant detects the behavioral effects of hazard exposure in an entrant.
- The attendant detects a situation outside the excavation that could endanger the entrants.
- The attendant cannot effectively and safely perform his duties.

- Summon rescue and other emergency services if the attendant determines that entrants may need assistance to evacuate the excavation.

4.5 Water Level Measurement, Groundwater Sampling, and NAPL Gauging

Collecting water level measurements, sampling groundwater, and conducting NAPL gauging will involve uncapping, purging (pumping water out of the well), and sampling and monitoring existing monitoring wells. A mechanical pump may be utilized to purge the wells and can be hand-, gas-, or electric-operated. Water samples taken from the wells are then placed in containers and shipped to analytical laboratory for analysis. The physical hazards of these operations are primarily associated with the sample collection methods and procedures utilized. For further guidance, a JLA is provided as a part of Appendix C

Hazards

Inhalation and absorption (contact) of COCs are the primary routes of entry associated with groundwater sampling due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During the course of this project, several different groundwater sampling methodologies may be utilized based on equipment accessibility and the types of materials to be sampled. These sampling methods may include hand or mechanical bailing. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with groundwater sampling procedures are generally limited to strains/sprains from hand bailing and potential eye hazards. Exposure to soil and water containing COCs is also possible.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Freezing weather hazards include frozen, slick, and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil.

Control

To control dermal exposure during groundwater sampling and monitoring activities, a minimum of Modified Level D will be worn. The well should be approached, opened and sampled from the upwind side. The photoionization detector (PID) will be used to determine exposure potential to the worker. If necessary, based on field observations and site conditions, air monitoring may be conducted during groundwater sampling and monitoring activities to assess the potential for exposure to airborne COCs. If the results of air monitoring indicate the presence of organic vapors in a concentration causing concern, personnel will upgrade to Level C protection. Refer to Section 6.1, Air Monitoring, for a description of air monitoring requirements and action levels. Control procedures for environmental and general hazards are discussed in the JLA provided in Appendix C of this HASP.

4.6 Sediment Coring/Sampling

Creek reconnaissance, sediment probing, sediment coring, and sediment and surface water sampling will be conducted using a float-mounted drill rig. In addition, installing surface water gauges and measuring surface water levels will require working adjacent to the creek. The physical hazards of these activities are primarily associated with the sample collection methods, procedures used, and the environment itself. For further guidance, a sediment sampling JLA is provided as a part of Appendix C

Hazards

In general, the primary hazards for creek activities include the following:

- Working near and around water: drowning, hypothermia
- Overhead hazards
- Ergonomic stresses
- Exposure to biological hazards: water-borne bacteria and microorganisms, extreme weather, plants and insects

Inhalation and absorption of COCs are the primary routes of entry associated with surface water and sediment sampling, probing, coring, and measuring due to the manipulation of sample media and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. During this project, several different sampling methodologies may be used based on equipment accessibility and the types of materials to be sampled. These sampling methods may include sampling probes, sediment traps, or sampling poles. The primary hazards associated with these specific sampling procedures are not potentially serious; however, other operations in the area or the conditions under which samples must be collected may present chemical and physical hazards. The hazards directly associated with sediment and surface water sampling procedures are generally limited to strains or sprains and potential eye hazards. Potential chemical hazards may include contact with sediments and surface water containing site COCs and potential contact with chemicals used for equipment cleaning. In addition to the safety hazards specific to sample collection, hazards associated with working on, in, or near water or in a boat will be a concern. Of particular concern will be boating safety and operation of other support equipment.

The flora and fauna of the site may present hazards of poison ivy, poison oak, ticks, fleas, mosquitoes, wasps, spiders, and snakes. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Control

The primary controls for these hazards include the following:

- Using only United States Coast Guard- (USCG-)approved equipment, including boats and personal flotation devices (PFDs)
- Proper work practices for overhead activities
- Completion of the Sediment Sampling Checklist (Appendix G)
- Use of the buddy system and internal and external communication systems
- Appropriate PPE for each task

To control dermal exposure during sediment sampling activities, a minimum of Modified Level D protection will be worn. If necessary, based on field observations and site conditions, air monitoring may be conducted during sediment and surface water sampling, probing, coring, and monitoring activities. If the results of air monitoring indicate the presence of airborne contaminants in a concentration causing concern, personnel will upgrade to Level C protection. Section 6.1 (Air Monitoring) describes air monitoring requirements and action levels. Control procedures for environmental and general hazards are discussed in the JLA provided as Appendix C of this HASP. The following sections provide general safety procedures for boat-based sampling, wader use, and working near water.

4.6.1 Water and Boating Hazards/Controls

ARCADIS personnel and subcontractors working over, adjacent to, or near water (within 6 feet of the edge), where the danger of drowning exists, must wear a USCG-approved life jackets or buoyant work vests. Prior to and after each use, the buoyant work vests or life preservers must be inspected for defects that would alter their strength and buoyancy. Defective units must be removed from service. Ring buoys with at least 90 feet of line must be provided and readily available for emergency rescue operations. Distance from ring buoys must not exceed 200 feet. At least one boat must be immediately available at locations where employees are working over or adjacent to water.

4.6.2 Boating Hazards and Safety Precautions

Working from a boat presents the obvious hazard of drowning, but several other hazards exist. Powered craft carry a fuel supply, with the potential for fire or explosion if vapors accumulate and reach an ignition source. Weather, currents, and other watercraft may also pose significant hazards to the crew.

In land-based field operations, proper training and equipment are essential to completing a project efficiently and safely. This also holds true for operations conducted on or adjacent to bodies of water. ARCADIS is strongly committed to familiarizing all employees, who operate boats or conduct work adjacent to bodies of water, with the hazards of water operations and the proper protective measures that must be taken to prevent injury. This section outlines the precautions that will be taken to maintain the safety of ARCADIS personnel and subcontractors. Subcontractors may implement their own boating safety procedure provided they meet the requirements of this section.

At a minimum, each employee working from a boat or barge is required to participate in a boating safety training session conducted prior to beginning field operations. The training session shall provide instruction on the following topics: proper boat and safety equipment inspections; content and frequency of equipment safety inspections; proper use of onboard safety equipment, including fire extinguisher, radio or cellular phone, flares, horn, etc.; proper procedures on the completion and filing of a float plan; appropriate boating "rules-of-the-road;" emergency procedures in the event of capsizing or being thrown overboard; and different types of PFD and their proper inspection and use.

Prior to each day or shift of operations, a boat inspection must be conducted by the boat operator/skipper/SSO. This inspection must be conducted in accordance with accepted USCG and any applicable state boating safety inspection procedures. The inspection must verify that necessary safety equipment is aboard, functioning properly, and that all crew members are aware of proper procedures that are to be followed on the water. In addition, this information must be reviewed during the daily tailgate safety meeting to confirm that the procedures have been followed and all crew members are satisfied as to its completion.

It will be the responsibility of the SSO to confirm that daily boat and equipment inspections are completed and documented, and daily tailgate safety meetings are conducted. Each day, prior to departure, a float plan will be filed with ground-based personnel. The float plan template can be found at Appendix G. The following safety procedures must be observed at all times:

- Boat(s) must not be overloaded with equipment or personnel.
- Loads must be distributed evenly throughout the boat.
- Personnel must wear appropriate footwear (e.g., rubber-soled boots) with good traction on wet surfaces.
- Anytime the watercraft is moving, hands and feet must be kept within the boundaries of the craft. In addition, hands should be kept off of lines and other potential pinch points.
- PFD Types I, II, or III must be worn at all times when working on or adjacent to the water.
- All PFDs must be properly inspected to confirm that appropriate USCG approvals and ratings information is available.
- At least one Type IV PFD (seat cushion, ring buoy) must be available on board.

- An audible signal or alarm (capable of being heard up to ½ mile away) must be maintained in each boat.
- Each boat must be equipped with a ship-to-shore radio, cellular phone, and/or "walkie-talkie" capable of contacting the USCG, Marine police, or other onshore station to call for help in an emergency.
- Each boat must be equipped with some type of visual display signal or device (e.g., flares or appropriate distress flag).
- All powerboats must have a valid state registration. This registration must be maintained on the boat and, as necessary, be made available for USCG or Marine police inspection.
- At a minimum, each powerboat must be equipped with a Type 4-A, 10-B, C-rated fire extinguisher.
- When working on a barge, have available a ladder that overboard personnel can use to climb on board safely.
- When working on a barge, all equipment should be secured to the barge deck (to the extent possible).
- Boats must not be operated at night without proper lighting and the capability for making visual distress signals.
- Mooring of a barge must be performed in accordance with applicable navigation rules and in a USCG-approved location.

In addition to PFDs, personnel who are working in boats over water when water temperatures are below 50°F must be equipped with thermal-protective clothing and equipment (wet suits, dry suits, etc.). The thermal-protective clothing must be adequate to protect personnel from hypothermic effects of immersion in water at the temperatures encountered.

In the event that a Small Craft Advisory is issued by the National Weather Service, all work from a small craft vessel will be halted and the vessel will return to shore as quickly as possible. If a Small Craft Advisory is issued before work on a small craft commences, work will be rescheduled following lifting of

the advisory. At all times, work from a vessel is at the discretion of the vessel operator.

4.6.3 Waders

Sampling activities may be done using hip waders and the required level of PPE. Waders must be inspected prior to donning for holes, punctures, tears, or any other defect (i.e., missing straps) that would allow water to enter. Personnel must wear a USCG-approved PFD or buoyant work vest during all activities conducted in water. Prior to each use, the PFD or work vest must be inspected for defects that may alter its strength or buoyancy. Defective units must be tagged "**Do Not Use**" and removed from service. The "buddy system" will be strictly adhered to during any water-related activities. At no time will anyone enter the water without another individual readily available to contact emergency services.

In addition to the drowning hazards associated with working on or near the water, there exists the possibility for slips, trips, or falls caused by slippery, unstable, and irregular walking surfaces. Waders used for sampling activities must be properly sized and provide the wearer with adequate traction.

4.6.4 Crane and Hoist Safety

Some sediment probing and coring activities may require use of a boat-mounted crane or hoist. Such equipment poses hazards in addition to those related to work over water.

Hazards

The primary physical hazards for crane operations are associated with overhead hoisting. Accidents can occur as a result of failing to adequately secure the crane to the boat prior to the start of operations. Tools and equipment, such as booms, cables, and slings have the potential for striking, pinning, or cutting personnel. Loads may swing and strike personnel or equipment. Large waves may make the entire platform unstable and cause equipment or loads to strike persons or other equipment.

- Overhead Hazards – Equipment being hoisted poses a hazard to personnel underneath the raised load.

- Slings, Hooks and Cables – Worn slings, hooks or cables present the hazard of a dropped load. Wire rope presents a laceration hazard if loose wires protrude from the main bundle.

- Working Surfaces – Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls.

- Load Lifting – The most common type of accident is the “caught between” situation when a load is being handled and a finger or toe gets caught between two objects.

Controls

General Requirements

- Only qualified and licensed individuals will be permitted to operate cranes.

- The design of the crane or hoist will comply with the requirements of American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) B30 standards and Crane Manufacturer's Association of America standards.

- Crane lifts will not be made when the operator judges that the sea state precludes safe operation.

- All personnel in the vicinity of the crane will wear hard hats, safety-toe shoes, and safety glasses.

- Crane and hoist hooks will have safety latches.

- Crane pendants shall have an electrical disconnect switch or button.

- Cranes and hoists shall have a main electrical disconnect switch. This switch shall be in a separate box that is labeled with lockout capability.

- Crane must be labeled on both sides with the maximum capacity.

- Each hoist-hook block shall be labeled with the maximum hook capacity.

- Personnel must remain away from overhead loads.

- Tag lines must be used to stabilize loads during lifts.

Operator Responsibilities

The operator is responsible for the safe operation of the crane and adherence to the requirements of this HASP. The crane operator must possess a license to operate the particular crane in use. The operator must verify that all safety equipment is in proper condition and is properly used. The crane operator must participate in the Daily Safety Meetings and be aware of all emergency procedures. The operator must operate the hoisting equipment safely, conduct functional tests prior to using the equipment, and select and using rigging equipment appropriately.

At the start of each work shift, the operator will complete the following steps before making lifts:

- Test the upper-limit switch. Slowly raise the unloaded hook block until the limit switch trips.
- Visually inspect the hook, load lines, and derrick.
- Test all direction and speed controls.
- Test all limit switches and the emergency stop.
- Test the hoist brake to verify there is no drift without a load.
- Lock out and tag for repair any crane or hoist that fails any of the above tests.

The crane operator will:

- Not engage in any practice that will divert attention while operating the crane.
- Respond to signals only from the person who is directing the lift, or any appointed signal person. Obey a stop signal at all times, no matter who gives it.
- Not move a load over people.
- Ensure that the rated load capacity of a crane's bridge, individual hoist, or any sling or fitting is not exceeded.

- Check that all controls are in the OFF position before closing the main-line disconnect switch.

- Avoid side pulls. These can cause the hoist rope to slip out of the drum groove, damaging the rope or destabilizing the crane or hoist.

- Prevent shock loading and avoid sudden stops or starts. Shock loading can occur when a suspended load is accelerated or decelerated, and can overload the crane or hoist. When completing an upward or downward motion, ease the load slowly to a stop.

Rigging Safety Requirements

Rigging equipment must be maintained in good condition. Rigging equipment must be inspected at least annually; defective equipment is to be removed from service and destroyed. Nylon slings must be inspected and removed from service if they exhibit abnormal wear, torn stitching, broken or cut fibers, or discoloration or deterioration. Wire-rope slings must be removed from service if the exhibit kinking, crushing, bird-caging, or other distortions, evidence of heat damage, cracks, deformation or worn end attachments, six randomly broken wires in a single rope lay, or three broken wires in one strand of rope. Hooks must be removed from service if they are opened more than 15% at the throat or twisted sideways more than 10 degrees from the plane of the unbent hook. Alloy steel chain slings must be removed from service if they exhibit cracked, bent, or elongated links or components or cracked hooks.

Rigging a Load

When rigging a load the operator must:

- Determine the weight of the load.

- Determine the proper size for slings and components.

- Verify that shackle pins and shouldered eye bolts are installed in accordance with the manufacturer's recommendations.

- Verify that ordinary (shoulderless) eye bolts are threaded in at least 1.5 times the bolt diameter.

- Use safety hoist rings (swivel eyes) as a preferred substitute for eye bolts wherever possible.
- Pad sharp edges to protect slings.
- Avoid using slings, eye bolts, shackles, or hooks that have been cut, welded, or brazed.
- Install wire-rope clips with the base only on the live end and the U-bolt only on the dead end.
- Determine the center of gravity and balance the load before moving it.
- Initially lift the load only a few inches to test the rigging and balance.

Moving a Load

When moving a load the operator must:

- Check the travel path in order to avoid personnel and obstructions.
- Center the hook over the load to keep the cables from slipping, and to prevent the load from swinging when it is lifted.
- Use a tag line when loads require precise control or when the sea state dictates.
- Lift the load only high enough to clear the tallest obstruction in the travel path.
- Start and stop slowly.
- Land the load when the move is finished.
- Choose a safe landing.
- Never leave suspended loads unattended.

Hand Signals

Signals to the operator shall be in accordance with the standard hand signals unless voice or radio communication is used. Signals shall be discernible or audible at all times. If special signals are established they will be agreed upon and thoroughly understood by both the person giving the signals and the operator, and cannot be in conflict with the standard signals.

Crane Overloading

Cranes or hoists shall not be loaded beyond their rated capacity for normal operations. Any crane or hoist suspected of having been overloaded shall be removed from service by locking open and tagging the main disconnect switch. Additionally, overloaded cranes shall be inspected, repaired, load tested, and approved for use before being returned to service.

Inspection, Maintenance, and Testing

All tests and inspections shall be conducted in accordance with the manufacturer's recommendations. All in-service cranes and hoists shall be inspected monthly and the results documented. Defective cranes and hoists shall be locked and tagged "out of service" until all defects are corrected. The inspector shall initiate corrective action by notifying the facility manager or building coordinator.

Annual inspection records must be available. Annual tests and inspections must include:

- hoisting and lowering mechanisms.
- limit switches and locking and safety devices.
- structural members.
- bolts or rivets.
- sheaves and drums.
- parts such as pins, bearings, shafts, gears, rollers, locking devices, and clamping devices.
- brake system parts, linings, pawls, and ratchets.
- load, wind, and other indicators over their full range.
- gasoline, diesel, electric, or other power plants.
- chain-drive sprockets.
- crane and hoist hooks.
- electrical apparatus such as controller contractors, limit switches, and push button stations.
- wire rope.
- hoist chains.

Load Testing

Newly installed cranes and hoists shall be load tested at 125% of the rated capacity by designated personnel. Slings shall have appropriate test data when purchased. It is the responsibility of the purchaser to verify that the appropriate test data are obtained and maintained. Cranes or hoists that have had major modifications or repair shall be load tested to 125% of the rated capacity. Cranes and hoists that have been overloaded shall be inspected prior to being returned to service.

4.7 Surveying

Well identification and evaluation activities will include accessing and surveying of the soil borings and sediment sampling locations. Hazards that may be associated with these activities are included below. For further guidance, a surveying JLA is provided as a part of Appendix C.

Hazards

Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Walking surfaces may involve slip, trip, or fall hazards. Slippery walking surfaces can increase the possibility of slips and falls. The immediate proximity of the Owasco Outlet increases the possibility of slipping and falling into the Outlet itself and drowning.

Environmental hazards may include plants such as poison ivy and poison oak; aggressive fauna such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather conditions such as lightning, rain, tornados, snow, sleet, frost, and ice; weather-related effects such as sunburn, windburn, frostbite, and other heat or cold-related illnesses; and pathogens such as rabies, Lyme disease, and blood-borne pathogens.

Control

Prior to the start of survey and staff gauge installation activities, the environmental conditions will be discussed with all affected employees. Potential hazards will be identified, and protective measures will be explained and implemented. Control procedures for environmental and general hazards are discussed in the JLA provided as Appendix C of this HASP.

5. Tailgate Meetings

Tailgate safety briefings will be conducted at least daily at the beginning of the work day, or as tasks/hazards change. Each tailgate safety briefing will be documented on the form included in Appendix G.

6. Air and Work Space Monitoring

6.1 Air Monitoring

Air monitoring will be conducted continuously at the site during any land-based intrusive work to determine employee exposure to airborne constituents. The monitoring devices to be used are an MIE Mini RAM particulate monitor (or equivalent) and a Rae Systems MultiRAE detector (PID with a **11.7 eV** lamp/ oxygen/ LEL/ Hydrogen Sulfide Sensors). All work activity must stop where tests indicate the concentration of flammable vapors exceeds 10% of the LEL at a location with a potential ignition source. Such an area must be ventilated to reduce the concentration to an acceptable level. In areas where petroleum hydrocarbons are suspected, benzene detector tube readings may be taken if PID readings exceed 1 part per million (ppm), and are sustained for 15 minutes in the breathing zone.

In addition to the monitoring discussed above, additional VOC and particulate monitoring will be conducted during test pit excavations to be compliant with the New York State Department of Health's (NYSDOH's) Generic Community Air Monitoring Plan (CAMP) (NYSDOH, 2000). The additional monitoring to be performed in accordance with the NYSDEC's CAMP are provided in Appendix H. Appendix H also contains information on the instrumentation to be used during implementation of the CAMP.

The ARCADIS HSS will be responsible for utilizing the air monitoring results to determine appropriate health and safety precautions for ARCADIS personnel and subcontractors. Air monitoring results will be recorded in the field notebook or on an air monitoring log (see Appendix G).

6.2 Noise Monitoring

Noise monitoring may be conducted as required. Hearing protection is mandatory for all employees in noise hazardous areas, such as around heavy equipment. As a general rule, sound levels that cause speech interference at normal conversation distance should require the use of hearing protection.

6.3 Monitoring Equipment Maintenance and Calibration

All direct-reading instrumentation calibrations should be conducted under the approximate environmental conditions the instrument will be used. Instruments must be calibrated before and after use, noting the reading(s) and any adjustments that are necessary. All air monitoring equipment calibrations, including the standard used for calibration, must be documented on a calibration log or in the field notebook. All completed documentation/forms must be reviewed by the HSS and maintained by the SS.

All air monitoring equipment will be maintained and calibrated in accordance with the specific manufacturer's procedures. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturer's procedures. When applicable, only manufacturer-trained and/or authorized personnel will be allowed to perform instrument repairs or preventive maintenance.

If an instrument is found to be inoperative or suspected of giving erroneous readings, the HSS must be responsible for immediately removing the instrument from service and obtaining a replacement unit. If the instrument is essential for safe operation during a specific activity, that activity must cease until an appropriate replacement unit is obtained. The HSS will be responsible for ensuring a replacement unit is obtained and/or repairs are initiated on the defective equipment.

6.4 Action Levels

The table at the end of this section presents airborne constituent action levels that will be used to determine the procedures and protective equipment necessary based on conditions as measured at the site.

6.5 Onsite Monitoring Plan and Response Activities

Soil borings will be completed at locations as part of the field investigation activities. These activities have the potential to generate organic vapors and particulates. As mentioned above, air monitoring will be conducted in the worker breathing zone to determine the level of protection required for personnel observing completion of monitoring wells, soil vapor points, or soil borings. If action levels in the worker breathing zone are exceeded for organic vapors or particulates, air monitoring will be required at various onsite/perimeter locations to determine appropriate response activities that are protective of personnel onsite who are not directly involved with the investigation, personnel at adjacent commercial sites, and the surrounding community. If action levels for the remaining monitoring parameters listed in the table at the end of this section are exceeded, work will stop, the HSO/HSM will be contacted, and perimeter monitoring will be performed. With the exception of test pitting, the procedures given below will be used during all ground intrusive activities. As mentioned above, additional monitoring will be implemented during test pit excavations in accordance with the NYSDOH's Generic CAMP. Procedures for CAMP monitoring are provided in Appendix H.

Total Organic Vapors

If the sustained level of total organic vapors in the worker breathing zone exceeds 1 ppm above background, then the level of total organic vapors will be manually recorded at the downwind perimeter of the work area (i.e., exclusion zone) at 15 minute intervals. If the sustained level of total organic vapors at the downwind perimeter of the work area exceeds 1 ppm above background, then work activities will be halted and additional downwind monitoring will be performed. Efforts will be undertaken to mitigate the source of organic vapors. The work area will be enlarged, if necessary, to mitigate the potential for people who are not involved with the investigation from being exposed to organic vapor levels exceeding 1 ppm above background.

During the investigation, it is possible that the downwind perimeter of the work area will coincide with the site perimeter. If, at any time, the sustained level of total organic vapors adjacent to the downwind site perimeter reaches 5 ppm above background, then the level of total organic vapors adjacent to the nearest downwind occupied building or property from the work zone will be monitored. If after 30 minutes, the total organic vapor level adjacent to the nearest occupied building or property has not subsided below 1 ppm above background, then the HSS will inform the local emergency response contacts [in addition to project managers from NYSEG, the NYSDEC, the NYSDOH, and ARCADIS] and persons who may be exposed will be notified to evacuate occupied buildings or properties. These persons will not be permitted to return to the properties until after the level of total organic vapors on the properties subsides to below 1 ppm above background.

Particulates

If the level of particulates in the worker breathing zone exceeds 100 micrograms per cubic meter ($\mu g/m^3$) above background, then the level of particulates will be manually recorded at the downwind perimeter of the work area at 15 minute intervals. If the level of particulates at the downwind perimeter of the work area is 150 $\mu g/m^3$ or greater, then work activities will cease and dust suppression techniques must be employed to maintain particulate levels below 150 $\mu g/m^3$. In addition, the work area will be enlarged if necessary to keep the public from being exposed to particulate levels greater than 150 $\mu g/m^3$.

6.6 Odor Control

If any odor complaints are received from members of the surrounding community and are related to the field investigation activities described herein, then the potentially odor-causing activity will be suspended, subsurface openings will be covered, and onsite personnel (in consultation with NYSEG and ARCADIS PM) will evaluate an alternative course of action.

Parameter	Reading in Breathing Zone (BZ)	Action
Total Organic Vapors	0 ppm to < 1 ppm	Normal operations; record breathing zone monitoring measurements every hour
	> 1 ppm to 5 ppm	Increase recording frequency to at least every 15 minutes and use benzene Drager tube to screen for the presence of benzene
	≥ 5 ppm to 50 ppm	Upgrade to level C PPE, continue screening for benzene
	> 50 ppm	Stop work; evacuate work area, investigate cause of reading, reduce through engineering controls, contact HSO
Benzene (as determined by colorimetric tube)	≥ 1 ppm to 5 ppm	Upgrade to Level C PPE
	>5 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; contact HSO
Total Particulate	0 to 0.100 mg/m^3 above background	Normal operations
	> 0.100 mg/m^3 above background	Initiate wetting of work area to control dust; upgrade to Level C if dust control measures do not control dust within 15 minutes, monitor downwind impacts.
	> 0.15 mg/m^3 in breathing zone or at downwind perimeter of work area	Stop work; investigate cause of reading; contact PM and HSO

Parameter	Reading in Breathing Zone (BZ)	Action
Oxygen	≤ 19.5 %	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
	> 19.5% to < 23.5 %	Normal operations
	≥ 23.5 %	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Carbon Monoxide	0 ppm to ≤ 20 ppm	Normal operations
	> 20 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Hydrogen Sulfide	0 ppm to ≤ 5 ppm	Normal operations
	> 5 ppm	Stop work; evacuate confined spaces/work area, investigate cause of reading; ventilate area; contact HSO
Flammable Vapors (LEL)	< 10% LEL	Normal operations
	≥ 10% LEL	Stop work; ventilate area; investigate source of vapors

Notes:

If action levels in the worker breathing zone are exceeded for organic vapors or particulates, air monitoring will be required at various onsite/perimeter locations to determine appropriate response activities that are protective of personnel onsite who are not directly involved with the investigation, personnel at adjacent commercial sites, and the surrounding community.

ppm= parts per million.

mg/m3= milligrams per cubic meter.

LEL= Lower explosive limit.

7. Medical Surveillance

Medical surveillance requirements for the project are provided on the Project Manager/Task Manager H&S Stewardship Checklist & Project Hazard Analysis Worksheet (Appendix B). All medical surveillance requirements as indicated on the worksheet must be completed and site personnel medically cleared before being permitted on the project site.

8. General Site Access and Control

The SSO will coordinate access and control security at the work site. As the work dictates, the SSO will establish a work area perimeter. The size of the perimeter will be based on the daily task activities and will be discussed with all project personnel during the tailgate meeting and then documented on the tailgate meeting form. Control zones for Level C or above will be demarcated by either visual or physical devices and will be monitored for effectiveness by the SSO.

Only authorized personnel will be allowed beyond the perimeter. Other site workers and visitors to the site should be kept out of the work site. If visitors need access to the site, the SSO will escort the visitor at all times. All visitors will log in and out with the SSO. The visitor log sheet is included in Appendix G.

9. Decontamination Control Zones and Procedures

Part of required reading for this HASP includes reviewing the Field H&S Handbook, Section III-G Site Security, Work Zones and Decontamination for HAZWOPER site zones. The decontamination procedures outlined in the Field H&S Handbook are provided for typical Level D and Level C ensembles.

The zones for Level C and above will be designated by traffic cones, barricades, signs, caution tape, or other means effective in identifying the different areas. The SSO will establish control boundaries for the exclusion zone, contamination reduction zone, and the support zone. The zones will be identified by the SSO during tailgate meetings and documented on the meeting form. Entrance and exit to the exclusion zone will only be through controlled access points established for each work area.

10. Emergency Action Plan (EAP)

In the event that an injury, over-exposure or spill has occurred, an EAP will be implemented. Appendix F provides the EAP and notifications for the project. All employees working on this project must be shown the location and proper use of all emergency equipment prior to beginning work on the project.

11. Department of Transportation (DOT) Dangerous Goods Shipping Requirements

ARCADIS has policies in place for transporting small quantities of hazardous materials and for offering for shipping via ground or air. These policies are designed to meet the applicable requirements. As such, only ARCADIS staff that have been trained in the proper methods to prepare and ship hazardous materials are authorized to do so. Tasks associated with the packaging, labeling, marking, and preparation of hazardous materials for shipping or transport must have all appropriate and applicable training.

11.1 Materials of Trade (MOT)

DOT allows for a small amount of hazardous materials that are used in or an inherent part of our work to be transported in company vehicles. This includes things like gasoline, paint, small compressed gas cylinders, calibration gas, etc. To transport these:

- Staff will complete Materials of Trade training.
- Vehicles used in transportation to and from off-site work locations will be in conformance with ARCADIS vehicle safety procedures.

Hazardous materials will be transported as described above as a result of the activities covered in this HASP. Site personnel who transport materials mentioned above will complete the Hazardous Materials Transportation Form included in Appendix G.

11.2 Department of Transportation

Staff who collect, prepare, package, mark, label, complete shipping declarations, offer shipments to a transporter, directly transport or are engaged in other activities associated with the transportation of Hazardous Materials (referred to as Dangerous Goods in Canada and by the International Air Transport Association [IATA]) will have appropriate and applicable training. DOT requires all individuals who participate in hazmat shipping including activities such as completing the paperwork (but not signing it), filling a container with a hazardous material (including filling a drum with drill cuttings or purge water), marking, labeling, and packaging the hazardous material, etc., have awareness level training on the DOT requirements. DOT requires additional job function training for those who conduct specific activities including:

- Staff who have to sign shipping papers or manifests, are listed as the 24-hour emergency contacts on shipping and have the responsibility for identifying, classifying, packaging, marking, and labeling HazMat packages, and/or are directing or overseeing others who do these tasks will become certified through the completion of additional training.

- The above training allows the offering employee to ship only by ground. If the shipment is to be offered for air transport, additional training is required.

Shipments as described above will be made as a result of the activities covered in this HASP. Site personnel shipping hazardous materials will complete the Hazardous Materials Shipment Form included in Appendix G.

12. Loss Prevention System^{TM} (LPS^{TM}) and Loss Prevention Observations (LPOs)

As part of any project, no matter how simple or complex, LPOs should be conducted when practical and when able to integrate into normal business activities. LPOs should be scheduled based on the risk of the tasks being performed, and should be conducted for different tasks and at different times. Completion of LPOs should be documented on the tailgate meeting form.

The following table outlines the LPO plan for the project:

Identified Task for LPO	Schedule Date	Observer Name	Observee Name	Feedback Supervisor Name
Soil Boring	TBD	TBD	TBD	TBD
Sediment Coring	TBD	TBD	TBD	TBD
Test Pit Excavation	TBD	TBD	TBD	TBD
NAPL Gauging	TBD	TBD	TBD	TBD

13. Subcontractors

A copy of this HASP is to be provided to all subcontractors prior to the start of work so that the subcontractor is informed of the hazards at the site. While the ARCADIS HASP will be the minimum health and safety requirements for the work completed by ARCADIS and its subcontractors, each subcontractor, in coordination with ARCADIS health and safety personnel, is expected to perform its operations in accordance with its own HASP, policies and procedures unique to the subcontractor's work to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to ARCADIS for review prior to the start of on-site activities.

In the event that the subcontractor's procedures/requirements conflict with requirements specified in this HASP, the more stringent guidance will be adopted after discussion and agreement between the subcontractor and ARCADIS project health and safety personnel. Hazards not listed in this HASP, but known to the subcontractor or known to be associated with the subcontractor's services, must be identified and addressed to the ARCADIS project or task manager and SSO prior to beginning work operations.

If the subcontractor prefers to adopt this HASP, the **"Subcontractor Acknowledgement Memo" must be signed and dated by the subcontractor's management and placed in the project file.** Once the signed memo is received by the project manager, an electronic version of our HASP can be submitted to the subcontractor to use as their own. Subcontractors working at the site will need to have this plan with them, and will also need to sign the Subcontractor HASP receipt signature page of the ARCADIS HASP (Appendix G). Subcontractors are responsible for the H&S of their employees at all times, and have the authority to halt work if unsafe conditions arise.

The Project/Task Manager and SSO (or authorized representative) has the authority to halt the subcontractor's operations and to remove the subcontractor or subcontractor's employee(s) from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

14. Project Personnel HASP Certification

All site project personnel will sign the certification signature page provided in Appendix G of this HASP.

Table 1
Chemical Hazard Information

NYSEG – Clark Street Former MGP Site – Auburn, New York

Substance [CAS Number]	IP[1] (eV)	Odor Threshold (ppm)	Route[2]	Symptoms of Exposure	Treatment	TWA[3]	STEL[4]	Source[5]	IDLH (NIOSH)[6]
enzene [71-43-2]	9.24	34-119	Inh Abs Ing Con	Irritated eyes, nose, and respiratory system; giddiness; headache; nausea; staggered gait; fatigue; anorexia, lassitude; dermatitis; bone marrow depression–carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (0.5 ppm) NIC-0.1 skin 0.1 ppm	2.5 ppm	PEL TLV REL	Ca (500 ppm)* *OSHA 29 CFR 1910.1028
Coal-tar-pitch volatiles (benzene-soluble fraction) (polynuclear aromatic hydrocarbons [PAH]) [65996-93-2]	ND	ND	Ing Con	Eye sensitivity to light; eye and skin irritation, dermatitis, bronchitis; carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3 0.2 mg/m^3 0.1 mg/m^3		PEL TLV REL	Ca [80 mg/m^3]
Cyanides: calcium, potassium, and sodium [592-01-8; 151-50-8; 143-33-9]	NA	ND	Inh Abs Ing Con	Asphyxiation and death can occur; weakness, headache, and confusion; nausea and vomiting; increased respiratory rate; slow respiratory gasping; irritated eyes and skin	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	5 mg/m^3 5 mg/m^3 (skin)	C5 mg/m^3* C5 mg/m^3 *10 min	PEL TLV REL	25 mg/m^3
Ethylbenzene [100-41-4]	8.76	0.09-0.6	Inh Ing Con	Irritated eyes, mucous membranes; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm
Hydrogen Cyanide [74-90-8]	13.6	1	Inh Abs Ing Con	Asphy; lass, head, conf; nausea, vomiting; increased rate of respiration, spasms, coma, convulsions, paralysis, respiratory failure	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	10 ppm 4.7 ppm, 5mg/m3; skin, as CN 4.7 ppm, 5mg/m3; skin, as CN	4.7 ppm, 5mg/m3; skin, as CN	PEL TLV REL	50 ppm
Toluene [108-88-3]	8.82	0.16-37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness; headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	500 ppm
Xylene (o-, m-, and p-isomers) [1330-20-7; 95-47-6; 108-38-3; 106-42-3]	8.56 8.56 8.44	1.1-20	Inh Abs Ing Con	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	150 ppm 150 ppm 150 ppm	PEL TLV REL	900 ppm

Table 1
Chemical Hazard Information

NYSEG – Clark Street Former MGP Site – Auburn, New York

[1]IP	=	Ionization potential (electron volts).
[2]Route	=	Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; and Con, Skin and/or eye contact.
[3]TWA	=	Time-weighted average. The TWA concentration for a normal workday (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[4]STEL	=	Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a workday, even if the TWA is not exceeded.
[5]PEL	=	Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
[5]TLV	=	American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value – TWA.
[5]REL	=	National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[6]IDLH (NIOSH)	=	Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE	=	None established. No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990, 1997).
C	=	Ceiling limit value which should not be exceeded at any time.
Ca	=	Carcinogen.
NA	=	Not applicable.
ND	=	Not Determined.
LEL	=	Lower explosive limits.
LC_{50}	=	Lethal concentration for 50 percent of population tested.
LD_{50}	=	Lethal dose for 50 percent of population tested.
NIC	=	Notice of intended change (ACGIH).

<u>References</u>:

American Conference of Governmental Industrial Hygienists Guide to Occupational Exposure Values, 2003, compiled by the American Conference of Governmental Industrial Hygienists.

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ARCADIS

Appendix A

HASP Addendum Pages and Log Table

ARCADIS

Addendum Page

This form should be completed for new tasks associated with the project. The project manager and/or task manager should revise the Project Hazard Analysis Worksheet with the new task information and attach to this addendum sheet. JLAs should be developed for any new tasks and attached as well.

Review the addendum with all site staff, including subcontractors, during the daily tailgate briefing, and complete the tailgate briefing form as required. Attach a copy of the addendum to all copies of the HASP including the site copy, and log in the Addendum Log Table A-1 on the next page.

Addendum Number: ____________________ Project Number: ____________________

Date of Changed Conditions: ____________________ Date of Addendum: ____________________

Description of Change that Results in Modifications to HASP:

Signed: ______________________________
Project Manager

Signed: ______________________________
Site Safety Officer

Signed: ______________________________
H&S Plan Writer

Signed: ______________________________
H&S Plan Reviewer

Addendum Log Table

Addendums are to be added to every copy of the HASP, and logged on Table A-1 to verify that all copies of the HASP are current:

Table A-1 Addendum Log Table

Addendum Number	Date of Addendum	Reason for Addendum	Person Completing Addendum
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Make additional copies of this form as necessary.

Appendix B

Project Hazard Analysis Worksheet

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Hazard Analysis Page

Project Name:	**Clark Street Former MGP Site**		**Project Number:**	**B0013091**	
Client:	**NYSEG**		**Principal-In Charge:**	**Kieth White, PG**	
Project / Task Manager:	**Jason Brien, PE**	**Completed By:**	**Jason Golubski, EIT**	**Date:**	**24-Jul-09**

ARCADIS Project Hazard Analysis Worksheet

TRACK

Recognize and Assess the Hazards for the Project

For each potential hazard, determine the worst case conditions for the entire project and all of the tasks and assess them using High (H), Medium (M), Low (L). Use the drop down list in each "Assess" cell. If a hazard is not expected on the site, leave the "Assess" box blank.

	Recognize the Hazards	Assess	Recognize the Hazards	Assess	List Types of other Physical Hazards Below
Physical Hazards:	Heat	Medium	Holes/Pits	Medium	
	Cold	Medium	Ionizing Radiation		
	Noise	Medium	Non-ionizing Radiation		
	Walking/Working surfaces (includes slip/trip/fall & floor/wall openings)	High	Electricity	High	
	Visible Dust	Low	Poor lighting	Low	
	LASER		Severe Weather	Medium	
	Other:		Overhead Hazards	High	
	Other:		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Site workers should exercise proper work/rest cycles for hot and cold weather. Site workers should be aware of their surroundings to aviod slip/trip/fall type accidents as well as overhead obstructions and utilities lines.

					List the Names of the Major Chemicals Below
Chemical Hazards:	Flammable/ Combustible		Corrosive		
	Compressed gas		Toxic	Medium	BTEX
	Explosive		Highly toxic		
	Organic peroxide		Irritant	Medium	BTEX
	Oxidizer		Sensitizer		
	Water reactive		Carcinogen		
	Unstable reactive		Mutagen		
	Dust/Fumes/ Particulates		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Site workers should limit exporsure to and contact with impacted site media (i.e., soil and groundwater) through the use of proper PPE

					List Types of Other Environmental / Equipment Hazards Below
Environmental/ Equipment Hazards:	Heavy machinery	Medium	Cranes/Hoists/Rigging	High	
	Trenching/excavation	Medium	Ladders		
	Docks – marine operations	High	Scaffolding		
	Construction activities		Manlifts		
	Diving operations	Low	Welding		
	Drilling	High	Gas cylinders		
	Forklifts		Roadway work		
	Water operations work		Railroad work		
	Heights (fall protection)	Medium	Mining work		
	Overhead/ Underground utilities	High	Energized / Pressurized equip (LO/TO)		
	Confined spaces		Drums and containers	Low	
	Power tools		Other		
	Other		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

All site workers should be familiar with drilling equipment operational procedures and safte work practicies. Site workers should take care while

other storage containers.

Biological Hazards	Animal/Human fluids or blood		Contaminated Needles		**List Types of Other Biological Hazards Below**
	Animal/Human tissue(s)		Live Bacterial Cultures		
	Poisonous/irritating plants	Low	Insects/rodents/snakes		
	Other:		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Aviod poison ivy.					
Ergonomic Hazards	Repetitive motion		Limited movement		**List Types of Other Ergonomic Hazards Below**
	Awkward position		Forceful exertions		
	Heavy lifting		Vibration		
	Frequent lifting		Other:		
	Other:		None: Mark with an "X"	X	
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Personal Safety/Security	Personal safety	Medium	Employees working early/late	Medium	**List Types of Other Personal Safety / Security Hazards Below**
	Security issue		Potentially dangerous wildlife	Low	
	Project site in isolated area		Guard or stray dogs in area		
	Employees working alone		No/limited cell phone service		
	Fatigue	Medium	Other:		
	Other		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
All site workers should keep personal safety in mind while conducting site work. Long days may potentially cause fatique, use proper					
Be aware of potential wildlife surrounding the site.					
Driving Safety	Driving early/late	Medium	City driving		**List Types of Other Driving Hazards Below**
	Driving long trips		Pulling a trailer		
	Driving off-road	Low	ATV driving:		
	Bad weather driving		Other		
	Other		None: Mark with an "X"		
Control the Hazard: (Briefly describe how the identified hazards will be controlled)					
Follow Smith System Driving Keys while operating motor vehicles					
Training Required	40 hour HAZWOPER	Yes	Bloodborne pathogens		**List Types of Other Training Required Here**
	24 hour HAZWOPER		Confined space		
	HAZWOPER site supervisor		Lockout/tagout		
	OSHA 30 hour Construction		Electrical Safety		
	OSHA 10 hour Construction		Fire Extinguishers		
	PPE	Yes	Fall Protection		
	Respiratory protection		Noise exposure		
	Chemical hygiene		Forklifts		
	Hazard communication		Asbestos		
	Hazardous waste		Lead		
	First-aid/CPR	Yes	Cadmium		
	DOT/IATA hazmat transportation		SPCC		
	MSHA		Radiation safety		
	Diving		Client specific		
	FRA		None: Mark with an "X"		
Medical Screening	Medical Surveillance Exam (HAZWOPER)	Yes	Other hazardous substance		**List Types of other Medical Screening Here**
	Pulmonary Function Test if wearing respirator and employee not part of HAZWOPER		Audiometric test if noise is a hazard and employee not part of HAZWOPER		
	Client required drug and/or alcohol testing	No	Blood and/or urine screening		
	Hepatitis B Immunization (or declination on file)		None: Mark with an "X"		

Keep Safety First In All Things

Appendix C

Job Loss Analysis

General

Client Name	NY STATE ELECTRIC & GAS
JSA ID	653
Job Name	Environmental-Sediment sampling
Task Description	Sediment Sampling
Project Number	B00130910000
Project Name	ENERGYEAST / CLARK STREET
PIC Name	WHITE, KEITH
Project Manager	BRIEN, JASON
Status Name	(3) Completed
Creation Date	7/27/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Falzarano, Aaron	8/17/2009	7/27/2009		Preston, Lindsay	True		

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Placement of boat for sediment sampling	1	Slip/trip/falls can occur when accessing or egressing boat	Wear anti-slip footwear with ankle support. Plan route onto and off of boat, do not hurry through task.	Field H&S Handbook V(G)
		2	Clutter and equipment on boat can cause tripping hazard including location and placement of equipment cables, ropes, or chains.	Maintain good housekeeping and aisle space. Secure objects to prevent shifting or movement that could impair walkway. Keep materials clear of designated walkways, cover if practical.	
		3	Boat can be damaged from encountering objects and other protuberances in water during boat operation	Use qualified boat operator, and use spotters if navigating in areas with shallow depths, felled trees in water or rock hazards, use depth finders as appropriate	
		4	Muscle strains from moving vibracore components or other equipment onto or off of boat	Use proper techniques by keeping back straight, use buddy system for large or bulky items, avoid awkward twisting or stooping.	

2	Setup/demobilize of vibracore sampling device	1	Pinch/crush hazards while erecting tripod, installing Vibracore barrel, placing spuds (if equipped).	Wear protective gloves that maintain dexterity. Identify and keep hands clear, do not hurry through task or take shortcuts,	
		2	Wet surfaces on boat can cause slipping	Wear anti-slip footwear with ankle support. Do not hurry through task. Ensure adequate illumination if working in non-daylight hours	
		3	Muscle strain from lifting barrel, tripod or moving other equipment.	Use buddy system to lift bulky objects or objects weighing more than what you are capable of lifting alone. Team lift items greater than 50 lbs.	
		4	Hand injuries can be caused from rough edges on equipment, metal sheeting or during the cutting of rope	Wear protective gloves that maintain dexterity. Identify and keep hands clear, do not hurry through task or take shortcuts, take the time to correct/protect protruding or sharp edges	
3	Collection of Sediment samples	1	Wet surfaces can cause slipping	Wear anti-slip footwear with ankle support. Do not hurry through task. Ensure adequate illumination if working in non-daylight hours	
		2	Hand injury including cuts and lacerations can occur when extracting samples	Wear protective gloves, do not reach into nose of devices with cutting edges or teeth, do not hurry or takes shortcuts during extraction. If cutting liners, use proper tool for the job.	
		3	Muscle strain can occur when lifting barrel, or large volume of sample	See above. Break sample volume down into manageable portions if large volume of sediment is collected.	
		4	Chemical exposure can occur from contact with potentially impacted media	Wear protective clothing prescribed by HASP. Avoid conditions that create splashing.	
4	Sediment sample management and logging	1	Awkward bending for prolong periods can cause muscle strain.	Take the time to setup preparation/logging area where neutral body positions can be maintained (work at waist height when possible) keep sample coolers and equipment out of areas that promote work to be performed in awkward positions.	
		2	Hands and knees can become sore or stiff when kneeling and working with equipment for extended periods of time.	See neutral positions above, if kneeling required use knee pads or padding, do not rest body weight on hands for extended periods.	
		3	Tripping hazards from equipment and IDW.	Maintain good housekeeping , keep used mixing bowls and similar devices organized and out of walkways. Keep garbage controlled and secure. Ensure sample coolers are out of designated walkways	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	boots		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	personal flotation device		Required

Supplies

Type	Supply	Description	Required
Communication Devices	walkie talkie		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)		Required

Job Loss Analysis

General

Client Name	NY STATE ELECTRIC & GAS
JSA ID	652
Job Name	Environmental-Groundwater Sampling and free product recovery
Task Description	Water Level Measurement and Sampling
Project Number	B00130910000
Project Name	ENERGYEAST / CLARK STREET
PIC Name	WHITE, KEITH
Project Manager	BRIEN, JASON
Status Name	(3) Completed
Creation Date	7/27/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Falzarano, Aaron	8/17/2009	7/27/2009		Preston, Lindsay	True		

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	personnel could be hit by vehicluar traffic.	Set-up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess and changes	
2	Open wells to equilibrate and gauge wells	1	When squatting down, personnel can be difficult to see by vehicular traffic.	Wear Class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	pinchpoints on well vault can pinch or lacerate fingers	Use correct tools to open well vault/cap. Wear leather gloves when removing well vault lids, and chemical protective gloves while guaging. Wear proper PPE including safety boots, knee pads and safety glasses.	

2	Open wells to equilibrate and gauge wells	3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	
		4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with sorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	
		4	lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. When possible wear work gloves, leather type.	
		5	purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses	
4	Collect GW or Free Product Sample	1	Working with bailer rope can cause rope burns on hands.	Slowly raise and lower the rope or string for the bailer. Wear appropriate gloves for the task.	
		2	sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves	
5	Recovery of Free Product from well	1	exposure to free product	Additional chemical protection may be necessary based on the type of product. Additionally, safety goggles, a faceshield, or respiratory protection may be required. Verify in the HASP.	
6	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JLA for movement of drums.	Drum handling JLA

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)		Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
Traffic Control	traffic cones		Required

Job Loss Analysis

General

Client Name	NY STATE ELECTRIC & GAS
JSA ID	650
Job Name	General Industry-Site clearing (tree/brush/vegetation) removal
Task Description	Tree and Brush Removal
Project Number	B00130910000
Project Name	ENERGYEAST / CLARK STREET
PIC Name	WHITE, KEITH
Project Manager	BRIEN, JASON
Status Name	(3) Completed
Creation Date	7/24/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Falzarano, Aaron	8/14/2009	7/24/2009		Preston, Lindsay	True		

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Prepping equipment for clearing activities	1	Improperly maintained tools and equipment increase risk for injury to workers using tools/equipment	Maintain tools and equipment according to manufacturer recommendations, including proper oiling and inspection of tool/equipment. Ensure cutting blades are sharp.	
		2	Cuts to hands, fingers, forearms from sharpening tool/equipment blades	Wear protective gloves suitable for the tool/device being sharpened, use proper sharpening techniques and do not hurry through the sharpening process.	
		3	Falls accessing from egressing from large equipment like tractors or bulldozers	Always use 3 points of contact when access/egressing large heavy equipment. Never attempt to access/egress form moving equipment, wear footwear with good anti-slip tread and ankle support, keep mud off of stepping surfaces. Promptly affix seatbelt when sitting in seat.	
		4	Exposure to fuel during refueling activities	Wear protective gloves during refueling activities, avoid breathing fuel vapors by standing in up wind position when practical, promptly wash exposed skin or clothing.	

2	Clearing large brush/trees with heavy equipment	1	Struck by vegetation under tension during clearing	Stand at least 100 ft from clearing activity. Keep unnecessary workers away from clearing activity in all directions.	
		2	Trip fall hazards on uneven ground surfaces	Plan route and avoid walking over down trees and into vegetation where ground surface can not be seen. Wear footwear with good tread and ankle support, don't carry tools in a manner that can obstruct vision of ground	
		3	Slip or trip on muddy or sloped surfaces	Plan route, wear footwear as above, keep hands out of pockets to balance and brace falls,	
		4	Contact with poisonous or physically damaging plants	Identify and avoid contact, if brush containing poisonous plants being burned, do not stand down wind and inhale smoke, wear long pants and long sleeve shirt, in heavy briar infested areas requiring walking, wear briar chaps.	
		5	Contact with poisonous or biting insects	Watch for and avoid hazardous insects, keep cab doors closed, if equipped, to reduce exposure potential.	
		6	Struck by falling trees or large brush	Keep clear of planned fall direction, assume tree can fall in any direction and keep clear in all fall directions	
3	Clearing large brush/trees with hand tools/chainsaws	1	Cuts to arms, legs, hands from cutting tools or chainsaw	Wear protective gloves. When using chainsaw, using chainsaw chaps and helmet equipped with face shield. When using manual tools cut away form body, maintain large distance between workers using hand tools or chainsaw. When using chainsaws, don't reach over running saw, saw over head height, use saw in low visibility situations, use chainsaws on ladders or use one handed.	
		2	Physical stresses from repetitive motion or excessive push/pulling during clearing	Use job or task rotation or frequent rest breaks. Don't use excessive force pulling or pushing on vegetation.	
		3	Scrapes, cuts to skin from vegetation	Wear protective gloves, long pants and long sleeve shirt. Wear briar chaps in thorny vegetation.	
		4	Noise form chainsaws	Wear hearing protection, keep unnecessary workers away form sawing activity	
4	Clearing small brush/tall grass with mowers/bush hogs	1	Struck by flying debris form mowing activity	Keep unnecessary worker 100 ft form mowing activities	
		2	Foot hazards from slipping into cutting blades using walk behind mowers	Do not remove and promptly repair guards that reduce potential for foot entry into blade housing of mowers. Plan mowing to reduce situations that increase risk of foot slippage towards mower housing, wear steel toe boots with good tread	
		3	Noise from mowing activitie	Wear hearing protection	
5	Using wood chippers	1	Struck by debris being chipped or chips emanating form the chipper	Stand clear of material being drawn into the chipper, stand to the side of the chipper table during vegetation entry. Maintain swinging baffles that prevent throwback of material.	

5	Using wood chippers	2	Cuts/amputation of hands/arm inserting brush into chipper	Only use chippers with a 36 inch or more feed throw at from the cutting knives. Never place hand, feet on top the feed table of the chipper wear protective gloves.	
		3	Noise from chipping activity.	Wear hearting protection	
		4	Injury caused form unplanned movement of chipper.	Chock tires of chipper when operating.	
6	Using herbicides	1	Worker exposure to herbicide during mixing or application.	Follow manufacturer mixing and application instructions, review product MSDS for additional hazards or PPE requirements, wear impermeable gloves and clothing during mixing and application, promptly wash any skin exposed to herbicide, wear safety goggles and face shield during mixing and application	
		2	Fatigue and physical stresses form carrying hand applicator for prolonged period of time.	Use job or task rotation to reduce fatigue. For applicators carried by hand, switch hands periodically, opt for backpack versions of applicators when possible.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	coveralls	when using herbicides	Required
Eye Protection	faceshield	when using herbicides	Required
	safety glasses		Required
	safety goggles	when using herbicides	Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	other	chainsaw chaps	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required

Job Loss Analysis

General

Client Name	NY STATE ELECTRIC & GAS
JSA ID	649
Job Name	General Industry-Surveying - land
Task Description	Surveying
Project Number	B00130910000
Project Name	ENERGYEAST / CLARK STREET
PIC Name	WHITE, KEITH
Project Manager	BRIEN, JASON
Status Name	(3) Completed
Creation Date	7/24/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Falzarano, Aaron	8/14/2009	7/24/2009		Preston, Lindsay	True		

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Site reconnaissance and walk-around	1	Slips/trips/falls can occur from walking on uneven ground surface.	Survey the site upon arrival. Note any site conditions that may pose a potential hazard.	JLA-Roadway Work ARCHSFS017
		2	Site workers or equipment can be struck by site vehicular traffic	Wear Class II traffic vest and cone off the work area. Follow the JLA and Field H&S Handbook for roadway work.	
2	Deployment and retrieval of traffic control devices during roadway work	1	Stuck by vehicles	Face traffic and use spotter if not facing traffic, stay off the travelled roadway to extent practical, wear Class II (minimum) traffic vest. Familiarize yourself with work zone control layout prior to deploying devices.	
		2	Slips trips and falls on uneven road or land surfaces	Do not carry objects that obscure visibility of ground surface when walking, wear footgear with ankle support and good tread, use buddy system when carrying large bulky objects.	

2	Deployment and retrieval of traffic control devices during roadway work	3	Lifting heavy or bulky signage or traffic channeling device	Brake down load to manageable size. Do not over reach to grab cones from the interior of the project vehicle. Use proper lifting techniques, maintain good vehicle housekeeping to easily retrieve control devices. Use buddy system to move heavy objects like barrels.	
		4	Pinch points to hands on folding components of sign stands	Wear leather gloves or other suitable glove. Watch for hazard and avoid placing hands in pinch areas. Do not hurry through setup/take down task.	
3	Sharpen machete, brush axe or other cutting tool	1	Sharpening machete can cause lacerations and can generate metal shavings that can cause eye abrasions.	Secure blade to a sturdy fixture such as work bench and use vice. Make sure that sharp edge does not come in contact with fingers/body when sharpening. Sharpen blade 4"-10" above handle. Tip is not sharpened. Use Kevlar gloves and safety glasses.	
		2	Cuts from unsheathed/uncovered cutting tool upon completion of sharpening activity	Promptly sheath or cover cutting blade of cutting tool upon completion of sharpening task, do not "stick" machetes in ground until needed for use.	
4	Line cutting with machete	1	Improper use of the machete can cause lacerations	Do not reach or over-extend when cutting, and cut away from the body at 45 degree angle. Always keep machete sharpened. Do not use tool if the handle becomes wet/slippery. Never stick the blade into the ground--sheath machete when not in use. See the Field H&S Handbook for detailed machete use instructions (section DD).	Field H&S Handbook Section III M
		2	Utility lines can be accidentally severed during cutting	Inspect area for location of overhead lines prior to starting the task. Do not use machete when cutting vegetation that is close to utility lines. Use more appropriate tools such as garden clippers or shears.	
		3	Biologicals such as poisonous plants, bees/wasps, and other insects can be encountered during cutting of vegetation or brush.	Attempt to identify biological concerns prior to starting task. Use identification techniques outlined in the Field H&S Handbook.	
		4	Cardio and muscle fatigue can be experience from prolonged use of machete or when using machete for cutting of thick vegetation.	Take proper rest breaks, and rotate work jobs with co-workers. For thick vegetation, make sure the machete is the best tool for the job.	
		5	Impalement hazards from falls onto stumps of cut vegetation	Be aware of hazard and avoid walking in cut areas where vegetation exists that could present an impalement hazard. In areas where longer term work areas are cleared, take time to cut vegetation closer to ground surface without an angular cut.	
		6	Objects can fall once cut, or particles can become airborne getting into eyes or puncturing skin.	Wear hard hat, safety glasses and steel-toe shoes. Determine a safe fall zone. Do not use hard strokes when cutting with the machete to limit flying particles.	
		7	Fallen branches and vegetation can cause tripping hazard	Remove freshly cut limbs and brush from the work area to ensure balance, reduce slips and falls, and reduce obstructions.	

5	Line cutting using brush axe or chainsaw (must be approved by Party Chief).	1	Improper use of the bush axe or chainsaw can cause serious injury	Inspect equipment before use, and keep chain sharp. Hold the chainsaw with both hands, never cut above shoulder height. Keep saw close to your body. Carry brush axes sheathed and blade facing away from body. Do not carry brush axes when carrying other large or bulky objects.	Site clearing JLA
		2	Struck by brush axe	Maintain proper separation distance when cutting, ensure anti-slip tape or other material on handles of brush axe to prevent slipping out of hands , wear gloves with good gripping capability.	
		3	Utility lines can be accidentally severed during cutting	Inspect area for location of overhead lines prior to starting the task. Note direction of fall for trees and ensure contact with utility lines will not occur	
		4	Objects can fall once cut, or particles can become airborne getting into eyes or puncturing skin.	Wear hard hat, safety glasses and steel-toe shoes. Determine a safe fall zone. to limit flying particles.	
		5	Fallen branches and vegetation can cause tripping hazard	Remove freshly cut limbs and brush from the work area to ensure balance, reduce slips and falls, and reduce obstructions.	
		6	Noise hazards (chainsaw)	Wear hearing protection (ear plugs or ear muffs)	
6	Removal of manhole covers	1	Pinch points and scrape hazards when removing MH cover.	Do not place fingers under lid during removal, use shovels, pry bars, etc to place under lid edge to lift. Wear sturdy work glove. Wear steel toe boot, do not purposely drop lids.	
		2	Back/neck/arm/shoulder strains and hand blisters could occur from over lifting, or not lifting properly.	Use proper lifting techniques, keep back straight, lift with legs, use “J” Hook or pry bar, Buddy System required	
7	Equipment set-up, calibration and survey of target area	1	Slips/trips/falls can occur from walking on uneven ground surface.	Watch for uneven ground, debris, and trip hazards. If possible clear area of trip hazards. Wear gloves and heavy denim work pants to avoid cuts when working in heavy brush/briers. Use buddy system to spot for uneven ground while surveying.	
8	Placement of stakes	1	Hands/fingers/arms can get struck by hammer/mallet. Splinters and lacerations can occur if stake splints during hammering.	Wear leather work gloves and safety glasses when placing stakes.	
9	Placement of monuments	1	Back strain from digging holes or mixing concrete	Use proper shoveling techniques and keep back straight, Use right tool for the job.	refer to Concrete work JLA
		2	Exposure to concrete can cause skin irritation or illness	Wear impermeable glove during mixing and concrete placement, promptly wash exposed skin. Do not use bare hands to mix, place, or finish concrete.	
		3	Inhalation of concrete dust during mixing	Keep face away from concrete when poured out of bag, Promptly wet concrete to be mixed.	

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	Kevlar for machete use, leather for cutting	Required
Head Protection	hard hat		Required
Miscellaneous PPE	other	chainsaw chaps	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	Other	snake chaps depending on work location	Recommended
Personal	water/fluid replacement		Required
Traffic Control	traffic cones	for roadway surveying	Required

1. POLICY

It is ARCADIS US policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, any work involving trenching and excavation that is under the control or direction of ARCADIS or an ARCADIS subcontractor will be accomplished following, at a minimum, this procedure.

It is ARCADIS' policy that ARCADIS staff will not enter excavations and trenches unless it is absolutely necessary. If there are no suitable alternatives and it becomes necessary to enter excavations or trenches, this procedure, at a minimum will be strictly followed.

It is also the policy of ARCADIS to ensure an OSHA-defined Excavation Competent Person is on-site for all excavation work under ARCADIS contractual control. The competent person will be provided by the entity on site responsible for performing the excavation work unless otherwise required by the client. Thus, if an ARCADIS subcontractor is conducting the excavation work, that subcontractor will provide the competent person. If ARCADIS is self-performing the excavation services, then ARCADIS will provide a competent person whether a specialized subcontractor or authorized employee.

2. PURPOSE AND SCOPE

2.1 Purpose

To effectively control or eliminate the hazards presented by working near or entry into excavations or trenches, this procedure sets forth the accepted practice for and establishes the requirements for workplace safety near excavations and trenches and employee and subcontractor entry into such.

2.2 Scope

This procedure along with associated checklists and the Utility Location procedure (ARC HSFS019) apply to all employees of ARCADIS-US. Only trained and authorized personnel are permitted to work near or enter excavations and trenches, perform rescue services, or act as the excavation competent person.

3. DEFINITIONS

Exhibit 1 includes relevant definitions to this procedure including that for competent person qualifications.

4. RESPONSIBILITIES

4.1 Corporate H&S with Division and Practice Experts

On an annual basis, review and update, as necessary, this procedure. In addition, review cancelled checklists periodically to ensure conformance to this procedure. Provide the excavation competent person and qualified person training and retraining, or recommend qualified training provider. Provide technical assistance regarding excavation and trench protocol, atmospheric testing equipment, PPE, hazard assessment and research information on unusual hazards. Audit project-specific excavation sites for compliance with this procedure.

4.2 Principal in Charge (PIC), Project Manager (PM), and Task Manager (TM)

PIC, PM and TMs are responsible to:

- Verify that all excavation and trench protocols are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.
- Verify that their divisional or project team employees have received the proper training provided by Corporate Health & Safety or qualified training source prior to conducting excavation/trenching entry activities.
- Verify that any ARCADIS employee acting as the Excavation Competent person has been authorized and trained to do so as noted in Exhibit 1
- Verify that the proper entry equipment, including personal protective equipment (PPE), atmospheric testing equipment and safety equipment, is available for use by their divisional employees.
- Verify that copies of the completed checklists are available for Corporate Health and Safety review and retained with the project files

4.3 Health and Safety Plan Writers and Reviewers

Utilize this procedure as guidance to ensure the appropriate identification, assessment and control of excavation and trenching hazards for documentation in project HASPs

4.4 Entry/Work Supervisors (also see Training and Duties of Entry Supervisor)

- Work in direct coordination with and under the direction of the project excavation competent person
- Interface with the client representative to identify hazards associated with the client's excavation and trenching and/or work permit programs.
- Review existing soil sampling (if any) data or other pertinent hazard characterization information recorded by the client.
- Investigate the client's excavation/trenching protocol, to verify that any identified hazards and previous experience with earthwork at the site is properly communicated.
- Coordinate entry operations with the client's employees when both client and ARCADIS employees will be working in or near an excavation/trench.

- Coordinate necessary rescue assistance with either the client's in-house rescue team and/or the offsite rescue assistance specified by the client. The offsite rescue assistance specified by the client must have applicable rescue experience and be within a reasonable response distance.

- Verify that the client takes the necessary precautions in notifying their employees that our employees will be installing an excavation or trench.

- Review the lockout/tagout and isolation measures implemented by the client as necessary based on proximity of utilities or other energy sources in the area of the excavation/trench

- Immediately report any unusual or unforeseen excavation or trenching hazards to Corporate Health and Safety prior to authorizing entry

- Verify that all tests and precautionary measures identified on the Daily/Periodic Inspection Checklist located in Exhibit 1 and the ARCADIS Utility Location Policy and Procedure ARC HSFS019 has been performed prior to authorizing subsurface work or entry into an excavation or trench

- Offer all entrants an opportunity to review the applicable control measures and testing results and an opportunity to request a reevaluation as necessary

- Issue, authorize, and have the Utility Clearance and Daily/Periodic Inspection forms readily available for review

- Verify that copies of the completed clearance forms and checklists are properly disseminated to Corporate Health and Safety and retained with the project files, as specified in Section 8.0 – Records.

4.5 Entrants

- Qualified Employee Entrants must have training and instruction in their duties and responsibilities regarding the following:

- Recognize the hazards which may be faced during entry, as well as the signs and symptoms of exposure to the hazard(s).

- Maintain visual contact and/or verbal communications with the attendant at all times.

- Use the PPE, air monitoring and testing equipment that has been provided or have access to the information.

- Maintain an awareness of all required hazard controls and consult with the Competent Person as necessary

- Obey evacuation orders given by the Attendant, automatic alarm activation, or when self-perceived.

4.6 Competent Person

Meet all of the requirements specified for the Qualified Employee Entrants plus adequate training and experience for their duties and responsibilities to complete the following tasks:

- Anticipation, identification and control of excavation and trenching hazards, as well as the signs and symptoms of exposure to the hazard(s), and the Authority to implement all corrective actions including Stopping Work.
- Implement the ARCADIS Utility Clearance Policy and Procedure and complete the Daily/Periodic Excavation Inspection Checklist
- Verify adequate training and experience of all Entrants prior to entry

4.7 Attendants

- An attendant must be stationed outside the excavation and be available to monitor operations above and below ground. The attendant may have no other duties besides those listed in this section.
- All attendants must have training and instruction in their duties and responsibilities regarding excavation/trenching entry. The following are assigned duties.
- Maintain an accurate count of all entrants in the excavation
- Monitor activities both inside and outside the excavation/trench to verify the continued safety of entrants
- Maintain visual contact or verbal communication with all entrants
- Order evacuation of the excavation/trench if an uncontrolled hazard develops, either within or outside the space, or upon observing a behavioral effect of hazard exposure among entrants
- Keep unauthorized persons away from the excavation area
- Participate in non-entry rescue as appropriate
- Summon rescue and other emergency services
- Attendants must maintain current certification in basic first aid and cardiopulmonary resuscitation (CPR).

4.8 All ARCADIS Employees

Use the TRACK process described below regularly and frequently. In addition, employees read and understand all documented hazard identification and risk assessments conducted using the HARC process and documented in HASPs, JSAs, and other written plans that are associated with their work. ARCADIS employees will:

- Recognize the hazards of trenches and excavations
- Understand and follow the methods for working near trenches and excavations
- Notify the PIC, PM, TM or entry/work supervisor if they have not received appropriate training
- Participate in entry operations only if trained and authorized to do so
- Never enter an excavation/trench without completion of the required Utility Location Procedure, Daily/Periodic Inspection Checklist and have an authorized attendant
- Never attempt entry rescue within a excavation unless trained in entry rescue with appropriate equipment available
- If unexpected conditions arise during entry, immediately notify other entrants, evacuate the space and inform the designated Competent Person

5. PROCEDURE

5.1 General Safety Requirements for all Excavations

- All surface obstructions must be moved or supported so as to protect employees and equipment.
- Prior to excavation, all underground installations (water, electric, telephone, gas, etc.) must be located and documented in accordance with ARCADIS Utility Clearance Policy and Procedure ARC HSFS019.
- When excavating in areas near underground installations, proper precautions must be taken to determine the exact location of the installations and to adequately protect and support them. While an excavation is open, underground installations shall be protected, supported or removed as necessary to protect employees.
- Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person.
- Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.
- Ladders used for access and egress from the excavation must extend at least 36” (3 feet) above the landing surface.

- If personnel are working in a location exposed to vehicular traffic they must be provided with and be required to wear reflective safety vests. Adequate, signs, barriers or other equivalent traffic controls must be used to protect employees.

- Personnel are not permitted to be beneath elevated loads handled by equipment or be in excavations when heavy equipment is digging in or near the excavation.

- Mobile equipment located near open excavations must be adequately protected from falling or rolling into excavations by the use of barricades or warning devices.

- All excavations over 4 feet in depth must be tested for hazardous atmospheres whenever personnel are required to enter and a potential exists for the existence of hazardous contaminants or oxygen deficiency. Excavations less than 4 feet in depth must be evaluated by the competent person and at the competent person's discretion be tested for hazardous atmospheres whenever personnel are required to enter and a potential exists for the existence of hazardous contaminants or oxygen deficiency.

- Means of rescue including a lifeline and body harness must be used by personnel entering excavations with a potential for air hazards. A standby person must be stationed outside the excavation to tend the lifeline(s).

- Water must not be allowed to accumulate in open excavations where employees are working. When necessary, means such as diverting natural drainage around the excavation or actively pumping water must be used to prevent or control water accumulation.

- All structures adjacent to an open excavation must be supported, or a registered professional engineer (PE) must determine that the structure will not be affected by the excavation activities.

- Excavated materials (spoil) must be placed no closer than 2 feet from the edge of an open excavation, and otherwise retained to prevent loose material from falling into the excavation.

- Protection such as guardrails, barricades or covers must be in place to protect personnel from possible falls into open excavations, pits, wells and shafts.

- Work tasks will be designed to limit the number of personnel required to enter any excavation. All tasks that can be completed remotely from outside the excavation (such as soil sampling) will be conducted in such a manner.

- Personnel will not be allowed to enter any excavation unless adequate protective systems and procedures are utilized to prevent accidents and injury.

- All excavations over four feet in depth shall be provided with a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel. As deemed necessary by the competent person, excavations less than 4 feet in depth will be provided with a stairway, ladder, ramp, or other safe means of egress so as to require no more than 25 feet of lateral travel.

5.2 Excavations Requiring Protective Systems

This section defines excavations that require protective systems.

- All excavations into which employees will enter, regardless of depth, where the potential for cave-in exists.

- Any excavation over 4 feet in depth into which employees will enter that is not entirely in stable rock as defined in this procedure.

- Any excavation near a structure, (e.g. foundations, piers, footers, walls, sidewalks, tanks, roadways, etc.), as required by the registered professional engineer reviewing the stability of the excavation and the structure.

- All excavations over 20 feet in depth must be designed by a registered professional engineer regardless of whether personnel will enter it or not.

- All excavations with adjacent structures which are located a distance less than 6 times the depth of the excavation away shall be reviewed by a registered professional engineer to determine if the stability of the structure will be affected by the excavation.

- Support systems for an adjacent structure must be designed by a registered professional engineer.

5.3 Selection and Use of Protective Systems

5.3.1 Shoring or Shielding

- If shoring or shielding is selected as the protective system for an excavation, soil classification in accordance with 1926 Subpart P Appendix A (see Section 9 of this procedure) is required.

- One of the following options must be utilized for all excavations which will be shored or shielded.

  - Timber shoring as specified in 1926 Subpart P Appendix C must be utilized

  - Hydraulic shoring, trench jacks, air shores, or shields as required in 1926.652 (c)(2) must be utilized following the system manufacturer’s data

- A system which follows other tabulated data (approved by a registered professional engineer) must be utilized

- The excavation must be designed by a registered professional engineer

5.3.2 Sloping

- If sloping is selected as the protective system for an excavation, the excavation sides must be sloped at a maximum of 34 degrees (1.5 Horizontal: 1 Vertical), unless the procedure listed above is followed.

- Soil classification in accordance with Section 10 of this procedure) is required for all excavations with sides which will be sloped greater than 34^{o} (1.5 Horizontal: 1 Vertical). If it will be sloped greater than 34^{o}, the one of the following options must be utilized:

  - Option 1 - assume Type C and slope 1.5/1 - probably the most common and preferred method for us

  - Option 2 - classify soil according to the standard and use Type A/B sloping requirements

  - Option 3 – use other tabulated data with PE approval

  - Option 4 – PE approval of sloping/benching design

5.4 Atmospheric Testing for Entry

Any excavation over 4 feet in depth with a potential for hazardous contaminants or oxygen deficiency must be tested for hazardous atmospheres prior to and during activities involving entry. After atmospheric testing, if the area is found to be oxygen deficient or a hazardous atmosphere exists or could exist a confined space permit must be obtained if the area will be entered.

The site designated "competent person" will document initial and periodic air monitoring results for all activities requiring entry into the excavation. All atmospheric testing of excavations must be conducted in the following sequence and meet the following air quality criteria.

- Oxygen content must be 19.5 to 23.5%

- Combustible gas or vapor must not exceed 10% of its lower explosive limit (LEL)

- Toxic air contaminant levels must not exceed 50% of the PEL or TLV for the specific contaminant whichever is lower

- Carbon monoxide must not exceed 10 ppm for a 5 minute average or ceiling value of 25 ppm

- Hydrogen sulfide must not exceed 0.5 ppm

5.5 Location of Underground/Overhead Utilities

- The competent person and the project manager shall both verify that local underground facilities location/protection agencies are notified within the required time frame prior to the initiation of excavation activities and meet all requirements in the ARCADIS Utility Location Policy and Procedure ARC HSFS019.

- Prior to initiation of excavation or trenching operations the competent person shall verify that all utilities have been located.

5.6 Daily/Periodic Inspections

- Prior to initiation of daily excavation or trenching operations the competent person shall complete a daily inspection of the excavation.

- During excavation or trenching operations the competent person shall complete a periodic inspection after any event (e.g., thunderstorm, vibration, excessive drying) that may affect excavation stability.

- The competent person shall complete the daily/periodic inspection checklist (A copy of the checklist is attached to this Policy as Exhibit A– Subcontractors must complete an equivalent inspection form) is completed for each inspection of excavation and trenching activities.

5.7 Soil Classification for Selection of Protective Systems

5.7.1 Soil Classification

This section describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. This section contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

This section applies when a sloping, benching or shoring system is utilized as a method of protection for employees from cave-ins.

5.7.2 Soil Classification Definitions

5.7.2.1 Types/Classes of Soil

Type/Class A Soils are cohesive soils with an unconfined, compressive strength of 1.5 ton per square foot (tsf) (144kPa) or greater. Examples of cohesive soils are: Clay, silty clay, sandy clay, clay loam and in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if the following apply.

- The soil is fissured
- The soil is subject to vibration from heavy traffic, pile driving, or similar effects
- The soil has been previously disturbed
- The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4 Horizontal:1 Vertical) or greater
- The material is subject to other factors that would require it to be classified as a less stable material

5.7.2.1.1 Type Class B Soils

- Cohesive soils with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa)
- Granular cohesionless soils including angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam
- Previously disturbed soils except those which would otherwise be classed as Type C soil
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration
- Dry rock that is not stable
- Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4 Horizontal:1 Vertical), but only if the material would otherwise be classified as Type B

5.7.2.1.2 T ype/Class C Soils

- Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less
- Granular soils including gravel, sand, and loamy sand
- Submerged soil or soil from which water is freely seeping

- Submerged rock that is not stable
- Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4 Horizontal:1 Vertical) or steeper

5.7.2.2 Methods for Classifying Soils

Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in this section. The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis conducted by a competent person using tests described below, or in other recognized methods of soil classification and testing such as those adopted by the American Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

The visual and manual analyses, such as those noted as being acceptable in this section, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits. Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

Observe the following:

- Samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine grained material is cohesive material. Soil composed primarily of coarse grained sand or gravel is granular material.
- Soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.
- The side of the open excavation and the surface area adjacent to the excavation. Crack like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.
- The area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

- The open side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

- The area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

- The area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

5.7.2.3 Classifications

A. Plasticity. Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8 inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of 1/8 inch thread can be held on one end without tearing, the soil is cohesive.

B. Dry strength. If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

C. Thumb penetration. The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a minimum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

D. Other strength tests. Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand operated shearvane.

E. Drying test. The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

1. If the sample develops cracks as it dries, significant fissures are indicated.

2. Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as an unfissured cohesive material and the unconfined compressive strength should be determined by using the thumb penetration or other test.

5.7.2.4 If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

5.7.2.5 Layered system

A layered system shall be classified in accordance with its weakest layer. Each layer may be classified individually where a more stable layer lies under a less stable layer.

5.7.2.6 Reclassifying Soils

A layered system shall be classified in accordance with its weakest layer. Each layer may be classified individually where a more stable layer lies under a less stable layer.

In most instances the ARCADIS designated Excavation/Trenching Competent person will assume Type C soil, unless they have conclusive data to validate Type A or B.

5.7.2.7 Excavation Construction Based on Soil Type

The Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from the table provided below. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope which is at least horizontal to one vertical (1/2H:1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope, and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P, Appendix B.

EXCAVATION SLOPE TABLE 2 29 CFR 1926 SUBPART P APPENDIX B MAXIMUM ALLOWABLE SLOPES	
Soil or Rock Type	**Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]**
Stable Rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1:½ (34 degrees)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.
3. A short-term maximum allowable slope of 1/2H:1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H:1V (53 degrees).

6. TRAINING

6.1 Project - Specific Training

All staff working on a site where trenching and excavation activities are being conducted by ARCADIS or its subcontractors will be pr ovided with site orientation on excavation projects shall include a discussion of the following:

- Site excavation hazards and procedures
- Requirements for conducting activities remotely whenever possible
- Client requirements and procedures for excavation activities

- This Procedure

Daily Safety Meetings on projects involving excavation activities shall include a discussion of:

- Site excavation hazards and procedures
- Requirements for conducting activities remotely whenever possible
- Client requirements and procedures for excavation activities
- This Excavation and Trenching Procedure, as appropriate

6.2 Additional Training

Besides site orientation training, additional training will be provided as follows based on the employee's activities:

- All employees who work in the area of potential excavation/trenching sites will receive awareness level training as provided and/or approved by ARCADIS Corporate H&S in order to recognize and to understand the hazards.
- Entrants, Attendants, and Entrant Supervisors will receive additional training as approved by Corporate H&S. This training will be classroom in nature and cover the details of trenching and excavation hazards and controls
- Qualified Competent Persons will be provided training as follows:

  In order to be assigned duties as a competent person with respect to excavation and trenching, in addition to the criteria noted in Exhibit 1, personnel must complete an ARCADIS approved training course or an equivalent course approved by Corporate Health and Safety including but not limited to the following topics:

  - Introduction to trenches and excavations
    - Definition of trenches and excavations
    - General requirements of OSHA 29 CFR 1926 Subpart P
  - Responsibilities and requirements of a competent person
    - Ne cessary authority
    - When other/outside resources may be necessary
  - Hazard Identification and Assessment
    - Cave-In Hazards including nearby structures
    - Und erground utilities

  - Confined Space
  - Hazardous atmospheres
  - Water accumulation
  - Vehicular traffic and falling loads
- Hazard controls
  - Soil analysis and testing (visual and manual
  - Protective systems
    - Shoring
    - Sloping
    - Shielding
    - Benching
  - Personal protective equipment
  - Utility location
  - Atmospheric testing
  - Water drainage and pumping
  - Site housekeeping and management
    - Spoils
    - Traffic control
    - Overhead hazard protection
  - Communications
    - Verbal
    - Signaling
  - Access and egress
- Emergency Procedures
  - Warning signs of cave-in
  - Evacuation procedures

  - Rescue
- Inspections
  - Checklists
  - Potential deficiencies

All training provided must be reviewed and approved by Corporate Health & Safety and will be managed through ARCHIMEDES.

Documentation of training certification received by attendance at any training course including externally provided training courses will be kept by the employee with copies provided to ARCHIMEDES.

7. REFERENCES

7.1 ARCADIS Health and Safety Procedure ARC HSFS010– Health and Safety Planning

7.2 ARCADIS Health and Safety Procedure ARC HSFS004 – Control of Hazardous Energy (Lockout/Tagout)

7.3 ARCADIS Utility Clearance Policy and Procedure ARC HSF019

7.4 ARCADIS Confined Space Policy and Procedure ARC HSF003

7.5 OSHA 29 CFR Part 1926 Subpart P - Excavations

8. RECORDS

8.1 Training records will be kept by the individual employee with copies of such certificates kept by ARCHIMEDES. Training dates and times will be kept by ARCHIMEDES.

8.2 Completed clearance forms and checklists will be kept in the project files with copies available for Corporate H&S review.

8.3 Copies of all HASPs that document excavation trenching procedures will be kept in the project files.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Michael Thomas, CIH, CPEA

Michael A Thomas

History of Change

Revision Date	Revision Number	Reason for change
12 May 2008	01	Original document
13 June 2008	02	Modified Section 5.1 – 4th bullet related to structural ramps. Modified Section 5.2 to designate a 6x factor for structural integrity of structures near the excavation. Revised Exhibit 1 to modify the definition of a Competent person
9 January 2009	03	Cleaned up definitions, deleted training requirements from Section 5.0 and moved them to Section 6.0, modified purpose statement

Exhibit 1 – Definitions

Attendant is a trained qualified individual stationed outside the excavation whose duty is to monitor authorized entrants inside the excavation or trench and have a means of communication with the designated rescue services.

Benching/Benching system means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury or otherwise injure and immobilize a person.

Competent person means one who, through education, training, and/or experience, is capable of identifying existing and predictable hazards or working conditions which are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them. All ARCADIS employee's, must meet the following minimum requirements to be considered a Competent Person:

- Be nominated to the appropriate Division H&S Director by their supervisor or project manager to be considered as a competent person. The nomination will include the submittal of various documentation that describes why the person should be nominated and to provide evidence that they have met the criteria listed below.
- Be jointly approved by the appropriate Division H&S Director and the appropriate Practice/Client H&S Manager or resource.
- Attend ARCADIS Competent Person training or an equivalent course approved by Corporate Health and Safety
- Have a minimum of 1 year of supervised field experience and approval from their supervisor to fill the role of competent person
- If on an Environmental project where HAZWOPER training is required by ARCADIS, completed a 40 Hour HAZWOPER and HAZWOPER Supervisor training course and be current on their annual 8 Hour refresher
- Attended a 10 or 30 Hour OSHA Construction Safety Course or have equivalent training to that provided by the 10 or 30 hour course
- If a hazardous atmosphere is present, or there is limited entry or exit and the excavation or trench must be entered as a confined space, the person must also be Confined Space trained and authorized as per the ARCADIS Confined Space procedure ARC HSFS003

Excavation means any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal into which a person can bodily enter. **Entry** constitutes the act by which an employee proceeds into an excavation or trench. Consideration of hazards, especially cave-ins and fall protection must still be considered and accounted for when equipment or personnel are near an excavation or trench, even if personnel will not be entering.

Entrants are employee's who are trained and authorized to enter a trench or excavation. Entrants must have attended a Qualified Excavation Training course offered or approved by Corporate Health and Safety.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous Atmosphere is an atmosphere which exposes employees to a risk of death, incapacitation, injury, or acute illness from one or more of the following:

- An atmospheric concentration of any substance in excess of 50% of its established permissible exposure limit (PEL); or its assigned threshold limit value (TLV) or other value listed on the Material Safety Data Sheet (MSDS) for the chemical constituent, whichever is lower.
- A flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).
- An airborne combustible dust at a concentration that obscures vision at a distance of 5 feet or less.
- An atmospheric oxygen concentration below 19.5% (oxygen-deficient atmosphere) or above 23.5% (oxygen-enriched atmosphere).
- An atmosphere which is immediately dangerous to life and health.

Immediately Danger to Life and Health (IDLH) means any condition which poses an immediate threat to loss of life; may result in irreversible or immediate-severe health effects; may result in eye damage, irritation, or other conditions which could impair escape from the space.

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems and other systems that provide protection.

Ramp means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce. To oversee an excavation/trench activity the PE must have experience with and expertise in excavation, soil and stability considerations.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shield can be either pre-manufactured or job-built in accordance with 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields".

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sloping (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Support system means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Trench means a narrow excavation (in relation to its length) made below the surface of the ground to which a person can bodily enter. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 meters). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 meters) or less (measured at the bottom of the excavation), the excavation is considered to be a trench.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sides, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Soil classification system means, for the purpose of this procedure, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the characteristics of the deposits and the environmental conditions of exposure.

Submerged soil means soil which is underwater or is free seeping.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

Exhibit 2 – Daily / Periodic Excavation Inspection Checklist

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Daily / Periodic Excavation Inspection Checklist

Project Name:	**Date / Time:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist must be completed for all excavations. It documents that daily and post-event / periodic inspections are conducted.

Soil Classified As: Stable Rock Type A Type B Type C

Soil Classified On: By:

Type of Protective System in Use: Sloping Shoring Other _______________

Description:

Inspection Item	YES	NO	Comments
Has the ARCADIS Utility Clearance Procedure been completed?			
Are underground installations protected from damage?			
Are adequate means of entry / exit available in the excavation – at least every 25 feet?			
If exposed to traffic, are personnel wearing reflective vests and adequate barriers/traffic controls installed?			
Do barriers exist to prevent equipment from rolling into the excavation?			
Was air monitoring conducted prior to and during excavation entry?			
Was the stability of adjacent structures reviewed by a registered P.E.?			
Are spoil piles at least 2 feet from the excavation edge?			
Is fall protection in use near excavations deeper than 6 feet?			
Are work tasks completed remotely if feasible?			
Is a protective system in place and in good repair?			
Is emergency rescue (lifeline / body harness) equipment used due to potential atmospheric hazard?			
Is excavation exposed to vibration?			
Are employees protected from falling / elevated material?			
Is soil classification adequate for current environmental / weather conditions?			
Do portable ladders extend at least 4 feet above the excavation?			
Are portable ladders or ramps secured in place?			
Have all personnel attended safety meeting on excavation hazards?			
Are support systems for adjacent structures in place?			
Is the excavation free from standing water?			
Is water control and diversion of surface runoff adequate?			
Are employees wearing required protective equipment?			

ARCADIS Excavation Competent Person:	**Date/Time:**

Job Loss Analysis

General

Client Name	ARCADIS
JSA ID	44
Job Name	Environmental-Drilling, soil sampling, well installation
Task Description	drilling with drill rig
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC Name	
Project Manager	NO PROJECT MANAGER
Status Name	(3) Completed
Creation Date	2/4/2009

User Roles

Role Name	Employee	Due Date	Completed	Approve	Supervisor	Active Employee	Comments	Comment Date
Created By	Coppola, Mija	2/6/2009	2/4/2009		Leichner III, Charles	True		
Developer	Moyers, Samuel	2/7/2009	2/4/2009		Coppola, Mija	True		
Developer (Primary Contact)	Coppola, Mija	2/7/2009	2/4/2009		Leichner III, Charles	True		
HASP Reviewer	Coppola, Mija	2/6/2009	2/2/2009	True	Leichner III, Charles	True		2/2/2009 12:00:00 AM

Job Steps

Job Step	Job Step Description		Potential Hazard	Critical Action	HSP Reference
1	Set up necessary traffic and public access controls	1	Struck by vehicle due to improper traffic controls	Use a buddy system for placing site control cones and/or signage. Position vehicle so that you are protected from moving traffic. Wear Class II traffic vest	
2	Utility Clearance	1	Potential to encounter underground or aboveground utilities while drilling	Complete utility clearance in accordance with the ARCADIS H&S procedure	ARCADIS H&S Procedure ARCHSFS019
3	General drill rig operation	1	Excessive noise is generated by rig operation.	When the engine is used at high RPMs or soil samples are being collected, use hearing protection.	

3	General drill rig operation	2	During drill rig operation, surfaces will become hot and cause burns if touched, and COCs in the soils more readily vaporize generating airborne contaminates.	Due to friction and lack of a drilling fluid, heat will be produced during this method. Mainly drill augers. Be careful handling split spoons. Wear proper work gloves. When soils and parts become heated, the COC could volatilize. Air monitoring should always be performed in accordance with the HASP.	
		3	Moving parts of the drilling rig can pull you in causing injury. Pinch points on the rig and auger connections can cause pinching or crushing of body parts.	Stay at least 5 feet away from moving parts of the drill rig. Know where the kill switch is, and have the drillers test it to verify that it is working. Do not wear loose clothing, and tie long hair back. Avoid wearing jewelry while drilling. Cone off the work area to keep general public away from the drilling rig	
		4	Dust and debris can cause eye injury and soil cuttings and/or water could contain COCs.	Wear safety glasses and stay as far away from actual drilling. W operation as practicable. Wear appropriate gloves to protect from COCs.	
		5	Drilling equipment laying on the ground (i.e. augers, split spoons, decon equipment, coolers, etc), create a tripping hazard. Water from decon buckets generate mud and cause a slipping hazard.	Keep equipment and trash picked up, and store away from the primary work area.	
		6	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
4	Mudd rotary drilling	1	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		2	This technology uses fluid, which collects with sediments in large basin. Fluid can splash out and cause slipping/mud hazard. Liquid mixture can splash into your eyes.	Wear rubber boots if needed, and keep clear of muddy/wet area as much as practicable. If area becomes excessively muddy, consider mud spikes or covering the area with a material that improves traction. Wear safety glasses.	
5	Hollow stem auger drilling	1	All hazards in step 3 apply. Additionally,The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
6	Air rotary drilling	1	this drilling method works with high air pressure and can generate flying debris that can strike your body or get debris in your eyes.	When the drill rig is being driven into media, it will produce flying debris. The flaps behind the drill rig should stay closed whenever possible to reduce the risk of flying debris. Safety glasses and hard hat should always be worn when the drill rig is operating. When penetrating asphalt protect surrounding cars that may be present to avoid debris damage to paint or winshields.	

6	Air rotary drilling	2	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
		3	When drilling through bedrock prior to groundwater dust can be produced from pulverization. Inhalation of dusts/powder can occur	Supplemental water should be used to manage dust creation and/or dust masks if necessary.	
7	Reverse rotary drilling	1	This method will use fresh water to pump out drill cuttings through the center of the casing. Water/sediment mixture is generated and could cause contact with impacted soils or groundwater	Ensure the pit construction can hold the amount of cuttings that are anticipated. Air monitoring should also be used of pit area	
		2	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately.	
		3	Settling pit construction can cause tripping hazard from excavated soils, and plastic sheeting can cause slipping.	cone off the area to keep the general public/visitors away from the settling pit. Ensure proper sloping of excavation.	
		4	The raised derrick can strike overhead utilities, tree limbs or other elevated items	Never move the rig with the derrick up. Ensure there is proper clearance to raise the derrick, and that you are far enough away from overhead power lines. See the Utility Location H&S policy and procedure for guidance.	
8	Rotosonic drilling	1	Fire hydrants are often used for water source. Hydrants deliver water at high pressure. Pressurized water can cause flying parts/debris and excessive slipping hazards.	Water usage from fire hydrants should be cleared with local muncipalities prior to use. Only persons that know how to use the hydrant should be performing this task. Ensure all connections are tight, and hose line is not run over to cut by traffic. Any leaks from the hydrant should be reported immediately	
		2	This method requires a lot of clearance. The drill head can turn 90 degrees to attach to the next drill flight or casing. This usually requires a large support truck to park directly behind the rig. As the drill head raises the new casing flight is angled down at the same time until it can be turned completely vertical.	Ensure sufficient overhead clearance.	

8	Rotosonic drilling	3	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
		4	The rotosonic drill head can move very quickly up and down while working on a borehole. Moving parts can strike someone or catch body parts	The operator and helper must communicate and stay clear of the path of the drill head. The drill utilizes two large hydrualic clamps to continuously hold casings while load/unloading previous casings. Do not wear loose clothing.	
9	Direct push drilling	1	The drill rods will be handled by workers most of the time rather than the rig doing it, therefore pinch points can cause lacerations and crushing of fingers/body parts.	Keep a minimum of 5 feet away from drill rig operation and moving parts.	
		2	The direct push rigs are uaually meant to fit in spaces where larger rig can't. Tight spaces can pin workers.	Do not put yourself between the rig and a fixed object. Use Spotters or a tape measure to ensure clearances in tight areas. Pre-plan equipment movement from one location to the next.	
		3	some direct push equipment is controlled by wireless devices. These controls can fail and equipment can strike workers or cause damage to property.	The drill rig should be used in a large open area to test wireless controls prior to moving to boring locations. The operator of the rig will test the kill switch with wireless remote prior to use. Operator will stay in range of rig while moving so that wireless signal will not be too weak and cause errors to the controls.	
		4	Sampling sleeves must be cut to obtain access to soil. Cutting can cause lacerations.	Preferably let the driller cut the sleeves open. Many drillers have holders for the sleeve to allow for stability when cutting. If we cut the sleeves, use a hook blade, change blade regularly, and cut away from the body.	
10	Rock Coring	1	flying debris can hit workers or cause debris to get in eyes.	Rock chips or overburden may become airborne from drilling method. Wear safety glasses and hard hat and remain at a safe distance from back of drill rig.	
		2	Heavy lifting of cores can cause muscle strain.	Always use 2 people to move core containers. Use caution moving core samples to layout area. Plan layout area to ensure adequate aisle space between core runs for logging. Keep back straight and use job rotation.	
11	Sample collection and processing	1	Injuries can result from pinch points on sampling equipment, and from breakage of sample containers.	Care should be taken when opening sampling equipment. Look at empty containers before picking them up, and do not over-tighten container caps. Use dividers to store containers in the cooler so they do not break.	Sample cooler handling JLA
		2	lifting heavy coolers can cause back injuries	Use two people to move heavy coolers. Use proper lifting techniques.	
12	Monitoring well installation	1	Same hazards as in Step 3 with general drill rig operation	See step 3	
		2	monitoring well construction materials can clutter the work area causing tripping hazards.	Well construction materials should be picked up during the well installation process.	

12	Monitoring well installation	3	Heavy lifting can cause muscle strains, and cutting open bags can cause lacerations.	Well construction materials are usually 50 lbs or greater. Team lift or use drill rig to hoist bags. Always use work gloves while cutting open bags.	
		4	Well pack material (i.e. sand, grout, bentonite) can become airborne and get in your eyes.	Wear safety glasses for protection from airborne sand and dust.	
		5	Cutting the top of the well to size can cause jagged/sharp edges on the top of the well casing.	Wear gloves when working with the top of the well casing, and file any sharp jagged edges that resulted from cutting to size.	
13	Soil cutting and purge water management	1	Moving full drums can cause back injury, or pinching/crushing injury.	Preferably have the drilling contractor move full drums with their equipment. If this is not practicable, use lift assist devices such as drum dollys, lift gates, etc. Employ proper lifting techniques, and perfrom TRACK to identify pinch/crush points. Wear leather work gloves, and clear all walking and work areas of debris prior to moving a drum.	Drum handling JLA

Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)		Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	traffic vest--Class II or III		Required
Respiratory Protection	dust mask		Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)	bottle	Required
Traffic Control	traffic cones		Required

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Appendix D

PPE Equipment List

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PPE Checklist

R = Equipment required to be present on the site. **O** = Optional equipment. Subcontractors must have the same equipment listed here as a minimum.

Description (Put Specific Material or Type in Box)	**Level Of Protection**		
	D	**C**	**B**
Body			
Coveralls	O	O	
Chemical Protective Suit		R	
Splash Apron		O	
Rain Suit	O		
Traffic Safety Vest (reflective)	R		
Head			
Hard Hat (if does not create other hazard)	R	R	R
Head Warmer (depends on temperature and	0		
Eyes & Face			
Safety Glasses (incorporate sun protection as	R		
Goggles (based on hazard)	R		
Splash Guard (based on hazard)			
Ears			
Ear Plugs	R	R	
Ear Muffs	O	O	
Hands and Arms			
Outer Chemical Resistant Gloves	R	R	R
Inner Chemical Resistant Gloves		R	R
Insulated Gloves	O	O	
Work Gloves*	R	R	
Foot			
Safety Boots (steel toe and shank)	R	R	R
Rubber, Chemical Resistant Boots		R	R
Rubber Boots			
Disposable Boot Covers	O	O	
Respiratory Protection			
1/2 Mask APR			
Full Face APR		R	
Dust Protection			
Powered APR			
SCBA			
Air Line			

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Appendix E

MSDSs

1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2005-05

Benzene
BEN2200

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Benzene **CAS Number:** 71-43-2
Chemical Formula: C_6H_6
Structural Chemical Formula: C_6H_6
EINECS Number: 200-753-7
ACX Number: X1001488-9
Synonyms: Benzene; BENZENE; (6)ANNULENE; BENZEEN; BENZEN; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
General Use: Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzene	71-43-2	99.9

OSHA PEL
TWA: 1 ppm; STEL: 5 ppm.

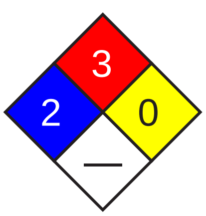
NIOSH REL
TWA: 0.1 ppm; STEL: 1 ppm.

DFG (Germany) MAK
Skin.

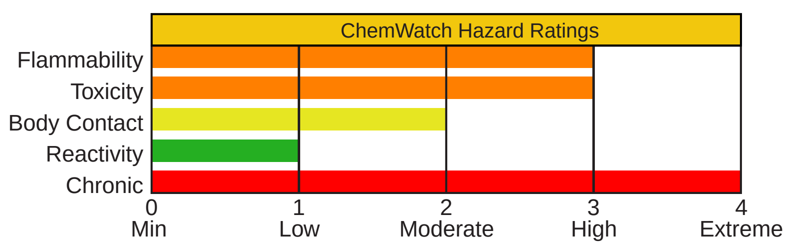
ACGIH TLV
TWA: 0.5 ppm; STEL: 2.5 ppm; skin.

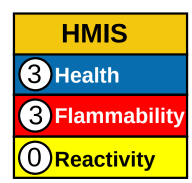
IDLH Level
500 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: headache, dizziness, drowsiness. Absorbed through skin. Chronic Effects: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

Potential Health Effects

Target Organs: blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

Inhalation hazard is increased at higher temperatures.

The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.

Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks.

Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.

Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.

Exposure to toxic levels has also produced chromosome damage.

Eye: The liquid is highly discomforting to the eyes, may be harmful following absorption and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is moderately discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.

Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.

Toxic effects may result from skin absorption.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.

Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.

Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals.

Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue. Leukemia may develop.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

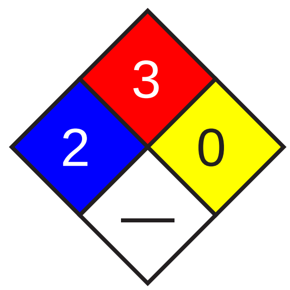
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
Consider complete blood count. Evaluate history of exposure.

Section 5 - Fire-Fighting Measures

Flash Point: -11 °C Closed Cup
Autoignition Temperature: 562 °C
LEL: 1.3% v/v
UEL: 7.1% v/v

See DOT ERG



Fire Diamond

Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

Large Spills: Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.

No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Storage Requirements: Store in original containers in approved flame-proof area.
No smoking, bare lights, heat or ignition sources.
DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.
Store away from incompatible materials in a cool, dry well ventilated area.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Nitrile gloves; Neoprene gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Note: must change cartridge at beginning of each shift

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:
PE/EVAL/PE .... Best selection
PVA .... Best selection
TEFLON .... Best selection
VITON .... Best selection
VITON/NEOPRENE .... Best selection

NITRILE+PVC .... Poor to dangerous choice for other than short-term immersion
BUTYL .... Poor to dangerous choice for other than short-term immersion
NITRILE .... Poor to dangerous choice for other than short-term immersion
NEOPRENE.............................. Poor to dangerous choice for other than short-term immersion
PVC.. Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER............... Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE .... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

Physical State: Liquid
Vapor Pressure (kPa): 9.95 at 20 °C
Vapor Density (Air=1): 2.77
Formula Weight: 78.12
Specific Gravity (H_2O=1, at 4 °C): 0.879 at 20 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 80.1 °C (176 °F)
Freezing/Melting Point: 5.5 °C (41.9 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.18 g/100 g of water at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

<u>Toxicity</u>
Oral (man) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 930 mg/kg
Inhalation (rat) LC_{50}: 10000 ppm/7h
Inhalation (human) LC_{Lo}: 2000 ppm/5m
Inhalation (man) TC_{Lo}: 150 ppm/1y - I
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

<u>Irritation</u>
Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See *RTECS* CY 1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

Ecotoxicity: LC_{50} Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); LD_{50} Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.3 $x10^{-3}$

BCF: eels 3.5

Biochemical Oxygen Demand (BOD): 1.2 lb/lb, 10 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.13

Soil Sorption Partition Coefficient: K_{oc} = woodburn silt loam 31 to 143

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Benzene
ID: UN1114
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U019 Toxic Waste, Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: Coal Tar Creosote **CAS Number:** 8001-58-9
Chemical Formula: No data found.
EINECS Number: 232-287-5
ACX Number: X1002891-0
Synonyms: AWPA #1; BRICK OIL; COAL TAR CREOSOTE; COAL TAR CRESOTE; COAL TAR OIL; CREOSOTE; CREOSOTE OIL; CREOSOTE P1; CREOSOTE,FROM COAL TAR; CREOSOTUM; CRESYLIC CREOSOTE; DEAD OIL; EPA PESTICIDE CHEMICAL CODE 025004; HEAVY OIL; HODGSONS CREOSOTE; LIQUID PITCH OIL; NAPHTHALENE OIL; PRESERV-O-SOTE; SAKRESOTE 100; TAR OIL; WASH OIL
Derivation: By distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking.
General Use: Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, tap hole refractory cement, and lubricant for die molds. Used only in limited quantities as an animal and bird repellent, animal dip, and insecticide (ovicide).

Section 2 - Composition / Information on Ingredients

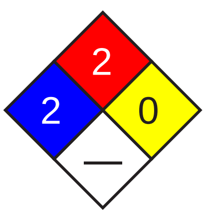
Name	CAS	%
Coal tar creosote	8001-58-9	Consists of aromatic hydrocarbons,

anthracene, naphthalene, and phenanthrene derivatives; some tar acids; and tar bases. Polycylic aromatic hydrocarbons make up at least 75%. * Creosote contains several carcinogenic polycyclic aromatic hydrocarbons including benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene.

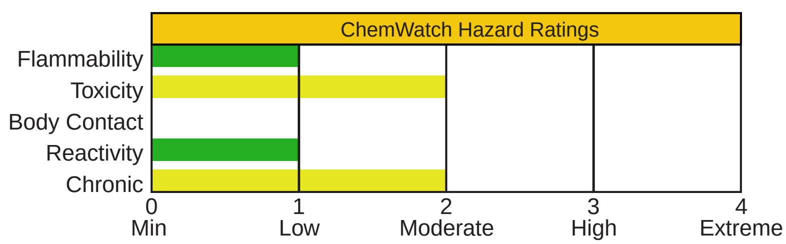
OSHA PEL **NIOSH REL**

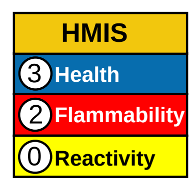
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless (pure) or yellow to black (industrial) liquid; aromatic smoky smell. Severely irritating to eyes/skin/respiratory tract. Probable human carcinogen. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, bladder, kidneys, and respiratory system
Primary Entry Routes: Inhalation, skin absorption, and skin and/or eye contact
Acute Effects *Note! Phenol and phenolic derivatives of various aromatic hydrocarbons (tar acids), present in low concentrations, are the constituents most likely to be responsible for acute toxicity.*
Inhalation: Inhalation of vapors causes moderate irritation to the nose, throat, and upper respiratory tract.
Eye: Contact with liquid causes conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. May cause loss of vision.
Skin: Contact causes irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur.

Ingestion: Causes salivation, nausea; vomiting; gastrointestinal tract irritation or bleeding; abdominal pain; rapid, thready pulse; vertigo; headaches; loss of pupillary reflexes; hypothermia; cyanosis; respiratory distress; shock and mild convulsions. Large doses may be fatal.

Carcinogenicity: NTP - Not listed; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B1, Probable human carcinogen based on epidemiologic studies; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.

Chronic Effects: Include dermatitis and, possibly, skin cancer or other forms of cancer. An increased risk of scrotal cancer for creosote-exposed brick makers was indicated in a worker mortality analysis. Epidemiological studies of coke oven workers reveal increased incidences of lung, bladder, prostate, pancreas, and intestinal cancer.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove contaminated clothing. Prior to washing and if readily available, use undiluted polyethylene glycol 300 to 400. Wash affected area with soap and flooding amounts of water for at least 15 min. *Do not* rub or apply pressure to the affected skin, apply any oily substance or use hot water to rinse. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Rinse the mouth several times with cold water. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not induce vomiting!* Keep victim warm and at rest.

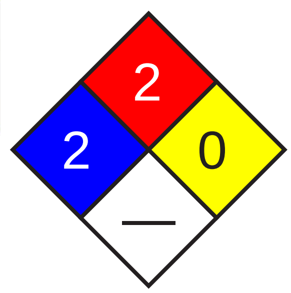
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Creosote may be detected in urine.

Special Precautions/Procedures: An exposed person should examine their skin periodically for growths, changes in warts or moles, and sores that do not heal.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: 165.2 °F (74 °C), Closed Cup
Autoignition Temperature: 637 °F (336 °C)
LEL: None reported.
UEL: None reported.
Flammability Classification: OSHA IIIA combustible liquid

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or regular foam. For large fires, use water spray, fog or regular foam.

General Fire Hazards/Hazardous Combustion Products: Include carbon oxides. Coal tar creosote may present a vapor explosion hazard indoors, outdoors, and in sewers. Vapors may travel to an ignition source and flash back.

Fire-Fighting Instructions: If feasible and without undue risk, remove containers from fire hazard area. Otherwise use water spray to cool fire-exposed containers until well after they are extinguished. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration as a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Fully decontaminate or properly dispose of personal protective clothing.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin and eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal.

Large Spills: Consider initial downwind evacuation for at least 300 meters (1000 feet). For large spills, dike far ahead of liquid spill for later disposal. Water spray may reduce vapor. *Do not* release into sewers or waterways. Use nonsparking tools during clean-up.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation and skin and eye contact. Use ventilation sufficient to reduce airborne exposures to nonhazardous levels (Sec. 2). Wear protective gloves, goggles, and clothing to avoid contact. Wear respiratory protection when necessary (Sec. 8). Consult your industrial hygienist. Practice good personal hygiene procedures to avoid inadvertently ingesting this material. Keep away from ignition sources.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and ignition sources. Store coal tar creosote as close to area of use as possible to minimize transporting distance. Avoid physical damage to containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all operations and/or ventilate at the site of release to avoid vapor dispersion into the work area. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about the health and safety hazards associated with coal tar creosote.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. With breakthrough times of >8 hr, butyl rubber, Teflon, and Viton are recommended materials. Frequent change of protective garments is an additional protective measure. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. (The following respirator recommendations are for coal tar pitch volatiles.) For concentrations above the NIOSH REL or at any detectable concentrations, wear a SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless (pure) or yellow to black (industrial); aromatic smoky smell.

Physical State: Oily liquid

Specific Gravity (H_2O=1, at 4 °C): 1.07 to 1.08 at 68 °F (20 °C)

Boiling Point: 381 to 752 °F (194 to 400 °C)

Water Solubility: Slightly soluble

Other Solubilities: Soluble in alcohol; ether; glycerin; dimethyl sulfate; fixed or volatile oils; in solution of fixed alkali hydroxides.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid excessive heat and contact with chlorosulfonic acid.

Storage Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.

Hazardous Decomposition Products: Thermal oxidative decomposition of coal tar creosote can produce carbon oxides and thick, black, acrid smoke.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 725 mg/kg.
Mouse, oral, LD_{50}: 433 mg/kg.

Other Effects:
Tumorgenicity, mouse, oral: 2 g/kg administered on gestational days 5-9 produced maternal effects and fetotoxicity.
Reproductive Effects - Hamster, ovary cell: 10 mg/L induced sister chromatid exchange.
Tumorigenicity: Mouse, skin, 99 g/kg/33 weeks administered intermittently produced tumors on skin and appendages (carcinogenic by RTECS criteria).
S. typhimurium: 20 µg/plate (-S9) produced mutations.

See *RTECS* GF8615000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TL50, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; TL50, rainbow trout (*Salmo gairdneri*), 3.72 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Octanol/Water Partition Coefficient: log K_{ow} = 1.0

Section 13 - Disposal Considerations

Disposal: Coal tar creosote is a good candidate for rotary kiln and fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Corrosive liquids, n.o.s.
ID: UN1760
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 8 - Corrosive
Special Provisions: A7, B10, T14, TP2, TP27
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 0.5 L **Cargo aircraft only:** 2.5 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Corrosive liquids, n.o.s.
ID: UN1760
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 8 - Corrosive
Special Provisions: B2, IB2, T11, TP2, TP27
Packaging: **Exceptions:** 154 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Corrosive liquids, n.o.s.
ID: UN1760
Hazard Class: 8 - Corrosive material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 8 - Corrosive

Special Provisions: IB3, T7, TP1, TP28
Packaging: **Exceptions:** 154 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2005-05

Ethylbenzene
ETH3050

Section 1 - Chemical Product and Company Identification

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5 \bullet C_2H_5$
EINECS Number: 202-849-4
ACX Number: X1003016-1
Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE
General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.
Component of many petroleum hydrocarbon solvents, thinners.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 125 ppm; 545 mg/m^3.

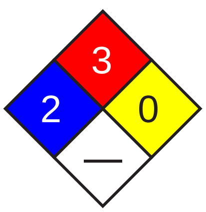
ACGIH TLV
TWA: 100 ppm; STEL: 125 ppm.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 125 ppm, 545 mg/m^3.

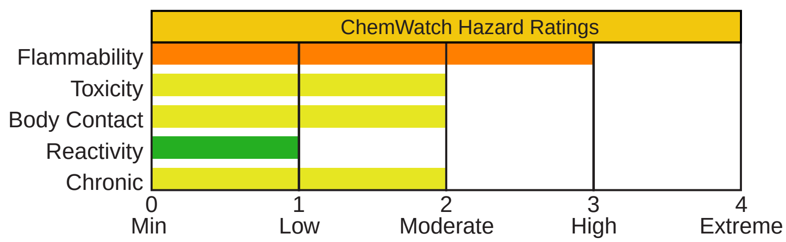
IDLH Level
800 ppm (10% LEL).

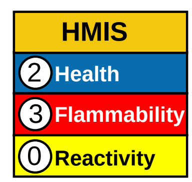
DFG (Germany) MAK
Skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: chest constriction, vertigo, narcosis, cramps, respiratory paralysis. Chronic Effects: fatigue, sleepiness, headache, blood disorders, lymphocytosis. Flammable.

Potential Health Effects

Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Primary Entry Routes: inhalation, skin contact, eye contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.
When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.
Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).
Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.
Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid may produce considerable gastrointestinal discomfort and may be harmful or toxic if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.
Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.
Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.
Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

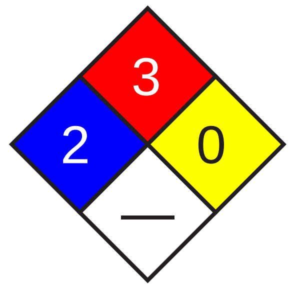
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.



Fire Diamond

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.

Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Eyewash unit.

Glove Selection Index:
VITON .... Best selection
TEFLON .... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.

Physical State: Liquid
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Evaporation Rate: Fast
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point: -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.01% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 3500 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm/8h
Inhalation (rat) LC_{Lo}: 4000 ppm/4h
Intraperitoneal (mouse) LD_{50}: 2642 mg/kg~
Dermal (rabbit) LD_{50}: 17800 mg/kg~
Liver changes, utheral tract, effects on fertility, specific developmental abnormalities (musculoskeletal system) recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

Irritation

Skin (rabbit): 15 mg/24h mild
Eye (rabbit): 500 mg - SEVERE

See *RTECS* DA 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it exist predominantly in the vapor phase based on its vapor pressure where it will photochemically degrade by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially return to earth in rain. It will not be subject to direct photolysis. Releases into water will decrease in concentration by evaporation and biodegradation. The time for this decrease and the primary loss processes will depend on the season, and the turbulence and microbial populations in the particular body of water. Representative half-lives are several days to 2 weeks. Some may be adsorbed by sediment but significant bioconcentration in fish is not expected to occur based upon its octanol/water partition coefficient. It is only adsorbed moderately by soil. It will not significantly hydrolyze in water or soil.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 275 mg/l 96 hr in a static unmeasured bioassay; LC_{50} Pimephales promelas (fathead minnow) 12.1 mg/l/96 hr (confidence limit 11.5 - 12.7 mg/l), flow-through bioassay with measured concentrations, 26.1 °C, dissolved oxygen 7.0 mg/l, hardness 45.6 mg/l calcium carbonate, alkalinity 43.0 mg/l; Toxicity threshold (cell multiplication inhibition test): Pseudomonas putida (bacteria) 12 mg/l ; LC_{50} Palaemonetes pugio (grass shrimp, adult) 14,400 ug/l/24 hr in a static unmeasured bioassay; LC_{50} Palaemonetes pugio (grass shrimp, larva) 10,200 ug/l/24 hr in a static unmeasured bioassay; Toxicity threshold (cell multiplication inhibition test): Microcystis aeruginosa (algae) 33 mg/l; Scenedesmus quadricauda (green algae) > 160 mg/l

Henry's Law Constant: 8.44×10^{-3}
BCF: goldfish 1.9
Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days
Octanol/Water Partition Coefficient: $\log K_{ow} = 3.15$
Soil Sorption Partition Coefficient: $K_{oc} = 164$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethylbenzene
ID: UN1175
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Section 1 - Chemical Product and Company Identification

Material Name: n-Hexane **CAS Number:** 110-54-3
Chemical Formula: C_6H_{14}
Structural Chemical Formula: $H_3C(CH_2)_4CH_3$
EINECS Number: 203-777-6
ACX Number: X1001498-5
Synonyms: DIPROPYL; ESANI; GETTYSOLVE-B; HEKSAN; HEXANE; N-HEXANE; N-HEXANE; HEXANEN; HEXYL HYDRIDE; NORMAL HEXANE; NORMAL-HEXANE; SKELLYSOLVE-B; SKELLYSOLVE B
General Use: An incidental component of many aliphatic solvent mixes used as lacquer, paint and enamel thinners, also in ink reducers and cleaning solvents.
Also used for solvent extraction of oil seeds and in pesticide residue analysis and gas chromatography.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
n-hexane	110-54-3	> 95

OSHA PEL
TWA: 500 ppm; 1800 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 50 ppm; 180 mg/m^3.

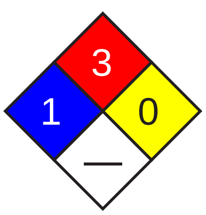
ACGIH TLV
TWA: 50 ppm; skin.

NIOSH REL
TWA: 50 ppm, 180 mg/m^3.

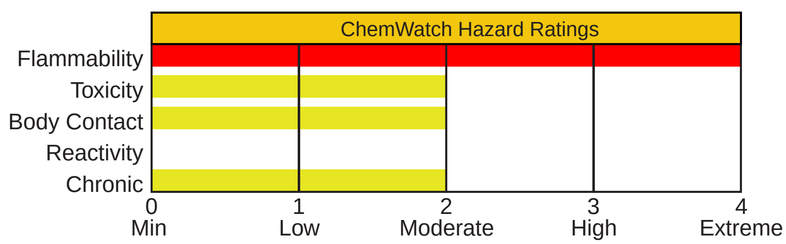
IDLH Level
1100 ppm (10% LEL).

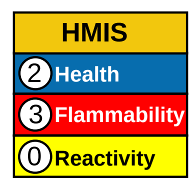
DFG (Germany) MAK
TWA: 50 ppm; PEAK: 400 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; sweet/gasoline odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, fatigue, muscle weakness, hallucinations. Chronic Effects: muscle weakness, motor loss, sensory disturbances. Flammable.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, central nervous system (CNS), peripheral nervous system
Primary Entry Routes: inhalation, skin contact/absorption, eyes, ingestion
Acute Effects
Inhalation: The vapor is discomforting and harmful to the upper respiratory tract.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is irritating to the eyes and may cause smarting, painand redness.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Toxic effects may result from skin absorption.

Ingestion: The liquid is highly discomforting and harmful if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.
Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic inhalation or skin exposure to n-hexane may cause peripheral neuropathy, which is damage to nerve ends in extremities, e.g. fingers, with loss of sensation and characteristic thickening. Nerve damage has been documented with chronic exposures of greater than 500 ppm.
Improvement in condition does not immediately follow removal from exposure and symptoms may progress for two or three months. Recovery may take a year or more depending on severity of exposure, and may not always be complete.
Exposure to n-hexane with methyl ethyl ketone (MEK) will accelerate the appearance of damage, but MEK alone will not cause the nerve damage.
Other isomers of hexane do not cause nerve damage.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

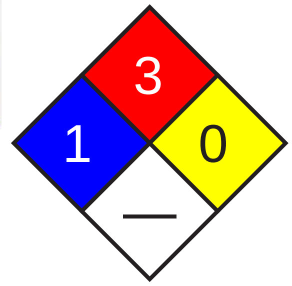
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Following acute or short-term repeated exposures to n-hexane:
1.Large quantities of n-hexane are expired by the lungs after vapor exposure (50-60%). Humans exposed to 100 ppm demonstrate an n-hexane biological half life of 2 hours.
2. Initial attention should be directed towards evaluation and support of respiration. Cardiac dysrhythmias are a potential complication.
INGESTION:
1.Ipecac syrup should be considered for ingestion of pure hexane exceeding 2-3 mL/kg. Extreme caution must be taken to avoid aspiration since small amounts of n-hexane intratracheally, produce a severe chemical pneumonitis
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
2,5-hexanedione in urine	5 mg/gm creatinine	End of shift	NS
n-Hexane in end-exhaled air			SQ

NS: Non-specific determinant; Metabolite observed following exposure to other materials.
SQ: Semi-quantitative determinant; Interpretation may be ambiguous - should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: -22 °C
Autoignition Temperature: 225 °C
LEL: 1.1% v/v
UEL: 7.5% v/v
Extinguishing Media: Dry chemical powder. Foam.
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). May emit clouds of acrid smoke.
Fire Incompatibility: Avoid reaction with oxidizing agents.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Pollutant - clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable products into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.

Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Avoid concurrent exposure to materials containing Methyl Ethyl Ketone MEK

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Polyethylene gloves. Wear chemical protective gloves, eg. PVC.
Wear safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >500 to <1100 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 1100 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:
PE/EVAL/PE .... Best selection
PVA .... Best selection
SARANEX-23 2-PLY............... Best selection
VITON .... Best selection
VITON/CHLOROBUTYL .... Best selection
TEFLON .... Satisfactory; may degrade after 4 hours continuous immersion
NITRILE .... Satisfactory; may degrade after 4 hours continuous immersion
NEOPRENE.............................. Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL.......... Poor to dangerous choice for other than short-term immersion
NITRILE+PVC .... Poor to dangerous choice for other than short-term immersion
PVC.. Poor to dangerous choice for other than short-term immersion
BUTYL .... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with typical paraffinic odor; floats on water. Mixes with most other organic solvents, chloroform, ether, alcohol. A very volatile liquid, it readily forms explosive vapor /air mixes.

Physical State: Liquid
Vapor Pressure (kPa): 13.33
Vapor Density (Air=1): 2.97
Formula Weight: 86.17
Specific Gravity (H_2O=1, at 4 °C): 0.6603 at 20 °C
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 68.89 °C (156 °F)
Freezing/Melting Point: -100 °C (-148 °F) to -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.002% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and ignition source. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 28710 mg/kg
Inhalation (human) TC_{Lo}: 190 ppm/8W
Inhalation (rat) LD_{50}: 48000 ppm/4h

Irritation
Eye (rabbit): 10 mg - mild

See *RTECS* MN9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Photolysis, hydrolysis or bioconcentration are not expected to be an important environmental fate processes. Biodegradation may occur in soil and water; however, volatilization and adsorption are expected to be far more important fate processes. A K_{oc} range of 1250 to 4100 indicates a low to slight mobility class in soil. In aquatic systems it may partition from the water column to organic matter contained in sediments and suspended materials. A Henry's Law constant of 1.81 atm-cu m/mole at 25 °C suggests rapid volatilization from environmental waters. The volatilization half-lives from a model river and a model pond, the latter considers the effect of adsorption, have been estimated to be 2.7 hr and 6.8 days, respectively. It is expected to exist entirely in the vapor-phase in ambient air. Reactions with photochemically produced hydroxyl radicals in the atmosphere have been shown to be important (average estimated half-life of 2.9 days). Data also suggests that nighttime reactions with nitrate radicals may contribute to atmospheric transformation, especially in urban environments.
Ecotoxicity: No data found.
Henry's Law Constant: calculated at 1.81
BCF: estimated at 2.24 to 2.89
Biochemical Oxygen Demand (BOD): theoretical 0%, 7 days
Octanol/Water Partition Coefficient: log K_{ow} = 4.11
Soil Sorption Partition Coefficient: K_{oc} = estimated at 1250 to 4100

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Hexanes
ID: UN1208
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** E **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: o-Xylene **CAS Number:** 95-47-6
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
EINECS Number: 202-422-2
ACX Number: X1001538-4
Synonyms: BENZENE,1,2-DIMETHYL-; 1,2-DIMETHYLBENZENE; O-DIMETHYLBENZENE; O-METHYLTOLUENE; 1,2-XYLENE; O-XYLENE; 2-XYLENE; O-XYLENE; ORTHO-XYLENE; O-XYLOL
General Use: Used as a general solvent in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
o-xylene	95-47-6	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 435 mg/m^3;
STEL: 150 ppm; 655 mg/m^3.

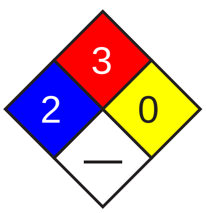
ACGIH TLV
TWA: 100 ppm; STEL: 150 ppm.

NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

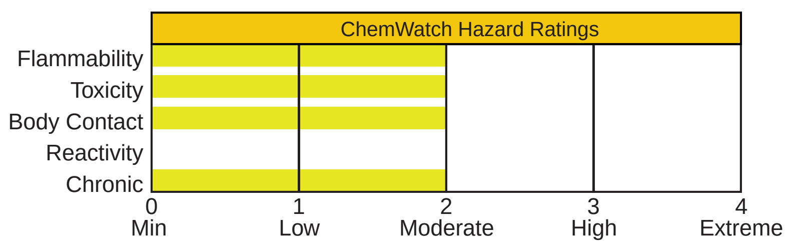
IDLH Level
900 ppm.

DFG (Germany) MAK
TWA: 100 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, nausea, drowsiness. Chronic Effects: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects based on animal data. Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.
Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is highly discomforting to the eyes.
Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.
Toxic effects may result from skin absorption.
Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting and toxic if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.
Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Small excess risks of spontaneous abortion and congenital malformation was reported among women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.
Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to xylene:
1.Gastrointestinal absorption is significant with ingestions.
For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended.
The use of charcoal and cathartics is equivocal.
2. Pulmonary absorption is rapid with about 60-65% retained at rest.
3. Primary threat to life from ingestion and/or inhalation is respiratory failure.
4. Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

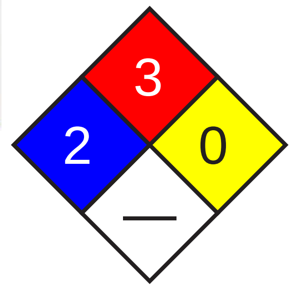
5. Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6. A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7. Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures

Flash Point: 32 °C Closed Cup
Autoignition Temperature: 463 °C
LEL: 1.0% v/v
UEL: 7% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

See DOT ERG



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

See DOT ERG

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.

If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.
Glove Selection Index:
PVA .... Best selection
VITON .... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless flammable liquid with aromatic odor. Miscible in most organic solvents.
Odor threshold: 0.2 to 2 ppm.
Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 144.4 °C (292 °F) at 760 mm Hg
Freezing/Melting Point: -25 °C (-13 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.02% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

<u>Toxicity</u>
Inhalation (human) LC_{Lo}: 6125 ppm/12h
Intraperitoneal (mouse) LD_{50}: 1364 mg/kg
Paternal effects recorded.

<u>Irritation</u>
Nil reported

See *RTECS* ZE 2450000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most is released into the atmosphere where it may photochemically degrade by reaction with hydroxyl radicals (half-life 1.5-15 hr). The dominant removal process in water is volatilization. It is moderately mobile in soil and may leach into groundwater where it has been known to be detectable for several years, although there is some evidence that it biodegrades in both soil and groundwater. Bioconcentration is not expected to be significant.
Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 35 ppm/7 days /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 11.0 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae stage I) 6 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 1.3 ppm/96 hr /Conditions of bioassay not specified
Henry's Law Constant: 5.1×10^{-3}
BCF: eels 1.33
Biochemical Oxygen Demand (BOD): 0 lb/lb, 5 days
Octanol/Water Partition Coefficient: log $K_{ow} = 3.12$
Soil Sorption Partition Coefficient: K_{oc} = soils 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Xylenes
ID: UN1307
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Xylenes
ID: UN1307
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: B1, IB3, T2, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 203 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

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(518) 842-4111

Issue Date: 2005-05

Toluene
TOL2320

Section 1 - Chemical Product and Company Identification

Material Name: Toluene **CAS Number:** 108-88-3
Chemical Formula: C_7H_8
Structural Chemical Formula: $C_6H_5CH_3$
EINECS Number: 203-625-9
ACX Number: X1001512-0
Synonyms: ANTISAL 1A; BENZENE,METHYL-; CP 25; METHACIDE; METHANE,PHENYL-; METHYL BENZENE; METHYL BENZOL; METHYLBENZENE; METHYLBENZOL; PHENYL METHANE; PHENYLMETHANE; TOLUEEN; TOLUEN; TOLUENE; TOLUENO; TOLUOL; TOLUOLO; TOLU-SOL
General Use: Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners; in gasoline and aviation fuel. Used in the manufacture of chemicals, dyes, explosives, benzoic acid.
Some grades of toluene may contain traces of xylene and benzene.
Odor threshold: 2 ppm approx. Odor is not a reliable warning property due to olfactory fatigue.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
toluene	108-88-3	> 99.5

OSHA PEL
TWA: 200 ppm; Ceiling: 300 ppm; 500 ppm, 10-minute maximum peak.

OSHA PEL Vacated 1989 Limits
TWA: 100 ppm; 375 mg/m^3; STEL: 150 ppm; 560 mg/m^3.

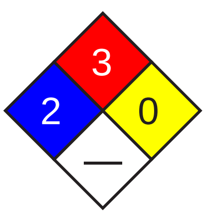
ACGIH TLV
TWA: 50 ppm; skin.

NIOSH REL
TWA: 100 ppm, 375 mg/m^3; STEL: 150 ppm, 560 mg/m^3.

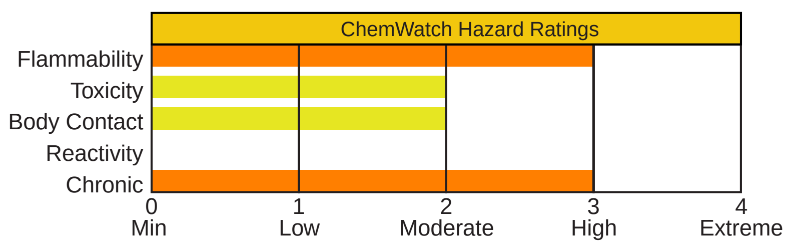
IDLH Level
500 ppm.

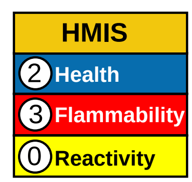
DFG (Germany) MAK
TWA: 50 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sickly, sweet odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: weakness, headache, dizziness, confusion, insomnia. Chronic Effects: liver/kidney damage, may cause birth defects. Flammable.

Potential Health Effects

Target Organs: Skin, liver, kidneys, central nervous system.
Primary Entry Routes: Inhalation, skin contact/absorbtion.
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness. Serious poisonings may result in respiratory depression and may be fatal.

Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The vapor is discomforting to the eyes if exposure is prolonged.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis and it is absorbed by skin.
Toxic effects may result from skin absorption.
Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.
Chronic toluene habituation occurs following intentional abuse (glue-sniffing) or from occupational exposure. Ataxia, incoordination and tremors of the hands and feet (as a consequence of diffuse cerebral atrophy), headache, abnormal speech, transient memory loss, convulsions, coma, drowsiness, reduced color perception, frank blindness, nystagmus (rapid, involuntary eye-movements), decreased hearing leading to deafness and mild dementia have all been associated with chronic abuse.
Peripheral nerve damage, encephalopathy, giant axonopathy, electrolyte disturbances in the cerebrospinal fluid and abnormal computer tomographic (CT) scans are common amongst toluene addicts. Although toluene abuse has been linked with kidney disease, this does not commonly appear in cases of occupational toluene exposures. Cardiac and hematological toxicity are however associated with chronic toluene exposure. Cardiac arrhythmia, multifocal and premature ventricular contractions and supraventricular tachycardia are present in 20% of patients who abused toluene-containing paints.
Previous suggestions that chronic toluene inhalation produced human peripheral neuropathy have largely been discounted. However central nervous system (CNS) depression is well documented where blood toluene levels exceed 2.2 mg%. Toluene abusers can achieve transient circulating concentrations of 6.5 mg%. Amongst workers exposed for a median time of 29 years to toluene no subacute effects on neurasthenic complaints and pyschometric test results could be established.
The prenatal toxicity of very high toluene concentrations has been documented for several animal species and man. Malformations indicative of specific teratogenicity have not generally been found. The toxicity described in the literature takes the form of embryo death or delayed fetal growth and delayed skeletal system development. Permanent damage of children has been seen only when mothers had suffered from chronic intoxication as a result of "sniffing".

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Following acute or short-term repeated exposures to toluene:

1. Toluene is absorbed across to alveolar barrier, the blood/air mixture being 11.2/15.6 (at 37 °C) The order of toluene, in expired breath, is of the order of 18 ppm following sustained exposure to 100 ppm.
The tissue/blood proportion is 1/3 except in adipose where the proportion is 8/10.
2.Metabolism by microsomal mono-oxygenation, results in the production of hippuric acid. This may be detected in the urine in amounts between 0.5 and 2.5 g/24hr which represents, on average 0.8 gm/gm of creatinine.
The biological half life of hippuric acid is in the order of 1-2 hours.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
8.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

BIOLOGICAL EXPOSURE INDEX - BEI

These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

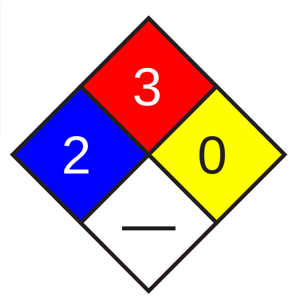
Determinant	Index	Sampling Time	Comments
Hippuric acid in urine	2.5 gm/gm creatinine	End of shift Last 4 hrs of shift	B,NS
Toluene in venous blood	1 mg/L	End of shift	SQ
Toluene in end-exhaled air		End of shift	SQ

NS: Non-specific determinant; also observed after exposure to other material
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 4 °C Closed Cup
Autoignition Temperature: 480 °C
LEL: 1.2% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

See DOT ERG



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Nitric acid with toluene, produces nitrated compounds which are explosive.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

See DOT ERG

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; Metal drum; Metal safety cans. Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area; local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.

In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:
Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE	Best selection
VITON/CHLOROBUTYL	Best selection
VITON	Best selection
PVA	Best selection
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23 2-PLY	Poor to dangerous choice for other than short-term immersion
CPE	Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE	Poor to dangerous choice for other than short-term immersion
SARANEX-23	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
NITRILE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 2.93 at 20 °C
Vapor Density (Air=1): 3.2
Formula Weight: 92.14
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 20 °C
Evaporation Rate: 2.4 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 111 °C (232 °F) at 760 mm Hg
Freezing/Melting Point: -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: < 1 mg/mL at 18 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 636 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm
Inhalation (man) TC_{Lo}: 200 ppm
Inhalation (rat) LC_{50}: > 26700 ppm/1h
Dermal (rabbit) LD_{50}: 12124 mg/kg
Reproductive effector in rats

Irritation
Skin (rabbit): 20 mg/24h-moderate
Skin (rabbit): 500 mg - moderate
Eye (rabbit): 0.87 mg - mild
Eye (rabbit): 2 mg/24h - SEVERE
Eye (rabbit): 100 mg/30sec - mild

See *RTECS* XS 5250000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be lost by evaporation from near-surface soil and by leaching to the groundwater. Biodegradation occurs both in soil and groundwater, but it is apt to be slow especially at high concentrations, which may be toxic to microorganisms. The presence of acclimated microbial populations may allow rapid biodegradation. It will not significantly hydrolyze in soil or water under normal environmental conditions. If released into water, its concentration will decrease due to evaporation and biodegradation. This removal can be rapid or take several weeks, depending on temperature, mixing conditions, and acclimation of microorganisms. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. If released to the atmosphere, it will degrade by reaction with photochemically produced hydroxyl radicals (half-life 3 hr to slightly over 1 day) or be washed out in rain. It will not be subject to direct photolysis.

Ecotoxicity: LC_{50} Aedes aegypti-4th instar (mosquito larvae) 22 mg/l /Conditions of bioassay not specified; LC_{50} Cyprinodon variegatus (sheepshead minnow) 277-485 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Calandra granaria (grain weevil) 210 mg/l /in air; LC_{50} Cancer magister (crab larvae stage I) 28 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 4.3 ppm 96 hr /Conditions of bioassay not specified; LC_{50} Artemia salina (brine shrimp) 33 mg/l 24 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (striped bass) 7.3 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnows) 55-72 mg/l (embryos), 25-36 mg/l (1-day posthatch protolarvae), and 26-31 mg/l (30-day-old minnows)/ 96 hour /Conditions of bioassay not specified

Henry's Law Constant: 0.0067

BCF: eels 13.2

Biochemical Oxygen Demand (BOD): 0%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.69

Soil Sorption Partition Coefficient: K_{oc} = silty loam 37

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Toluene
ID: UN1294
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U220 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Section 1 - Chemical Product and Company Identification

Material Name: Xylene **CAS Number:** 1330-20-7
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
EINECS Number: 215-535-7
ACX Number: X1001166-8
Synonyms: BENZENE,DIMETHYL-; COMPONENT 1 (83%): XYLENES; COMPONENT 2 (17%): ETHYL BENZENE; DIMETHYLBENZENE; DIMETHYLBENZENES; EPA PESTICIDE CHEMICAL CODE 086802; KSYLEN; METHYL TOLUENE; METHYLTOLUENE; VIOLET 3; XILOLI; XYLENE; XYLENEN; XYLOL; XYLOLE
General Use: A strong solvent for general use in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

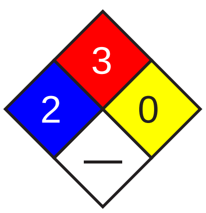
OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

ACGIH TLV
TWA: 100 ppm; STEL: 150 ppm.

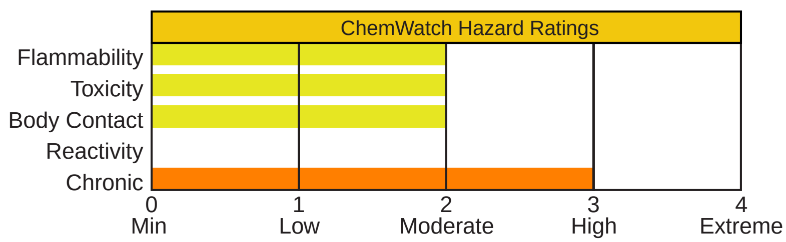
NIOSH REL
TWA: 100 ppm, 435 mg/m^3;
STEL: 150 ppm, 655 mg/m^3.

DFG (Germany) MAK
TWA: 100 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond



HMIS
2 Health
3 Flammability
0 Reactivity

ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, nausea, drowsiness. Chronic Effects: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects (animal data). Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.

Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.

Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is highly discomforting to the eyes.

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.

Toxic effects may result from skin absorption.

Open cuts, abraded or irritated skin should not be exposed to this material.

The material may accentuate any pre-existing skin condition.

The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.

Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.

Small excess risks of spontaneous abortion and congenital malformation was reported amongst women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.

Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.

Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove to fresh air.

Lay patient down. Keep warm and rested.

If available, administer medical oxygen by trained personnel.

If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to xylene:

1.Gastrointestinal absorption is significant with ingestions.

For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended.

The use of charcoal and cathartics is equivocal.

2.Pulmonary absorption is rapid with about 60-65% retained at rest.

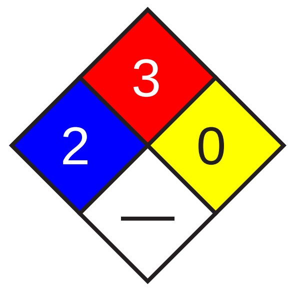
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures

Flash Point: 25.6 °C
Autoignition Temperature: 241 °C
LEL: 1.0% v/v
UEL: 7.0% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.

See DOT ERG

Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.

Glove Selection Index:

PE/EVAL/PE .... Best selection
PVA .... Best selection
VITON .... Best selection
TEFLON .... Best selection
PVDC/PE/PVDC .... Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE......... Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL.......... Poor to dangerous choice for other than short-term immersion
NITRILE+PVC .... Poor to dangerous choice for other than short-term immersion
HYPALON .... Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE .... Poor to dangerous choice for other than short-term immersion
BUTYL .... Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE .... Poor to dangerous choice for other than short-term immersion
NITRILE .... Poor to dangerous choice for other than short-term immersion
NEOPRENE.............................. Poor to dangerous choice for other than short-term immersion
PVC... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear colorless flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Evaporation Rate: 0.7 Bu Ac=1
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point: -47 °C (-53 °F)
Volatile Component (% Vol): 100
Water Solubility: Practically insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

__Toxicity__
Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 4300 mg/kg
Inhalation (human) TC_{Lo}: 200 ppm
Inhalation (man) LC_{Lo}: 10000 ppm/6h
Inhalation (rat) LC_{50}: 5000 ppm/4h
Reproductive effector in rats

__Irritation__
Skin (rabbit):500 mg/24h moderate
Eye (human): 200 ppm irritant
Eye (rabbit): 87 mg mild
Eye (rabbit): 5 mg/24h SEVERE

See *RTECS* ZE 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most of the xylenes are released into the atmosphere where they may photochemically degrade by reaction with hydroxyl radicals (half-life 1-18 hr). The dominant removal process in water is volatilization. Xylenes are moderately mobile in soil and may leach into groundwater where they are known to persist for several years, despite some evidence that they biodegrade in both soil and groundwater. Bioconcentration is not expected to be significant.
Ecotoxicity: LC_{50} Rainbow trout 13.5 mg/l/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 13 mg/l/24 hr /Conditions of bioassay not specified
Henry's Law Constant: 0.22
BCF: estimated at 2.14 to 2.20
Octanol/Water Partition Coefficient: log K_{ow} = 3.12 to 3.20
Soil Sorption Partition Coefficient: K_{oc} = 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Xylenes
ID: UN1307
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Xylenes
ID: UN1307
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: B1, IB3, T2, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 203 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
- **RCRA 40 CFR:** Listed U239 Ignitable Waste
- **CERCLA 40 CFR 302.4:** Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
- **SARA 40 CFR 372.65:** Listed
- **SARA EHS 40 CFR 355:** Not listed
- **TSCA:** Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser’s purposes are necessarily the purchaser’s responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser’s intended purpose or for consequences of its use.

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Appendix F

Emergency Action Plan and Route to Hospital

EMERGENCY ACTION PLAN
Emergency Contact List

Emergency Contact	Phone
Local Police – Auburn Police	911 (if appropriate) and 315.255.4705
Local Ambulance – EMS	911 (if appropriate) and 315.252.1106
Local Fire Department – Auburn Fire Department	911 (if appropriate) and 315.253.4031
Local Hospital – Auburn Memorial Hospital	315.255.7211 (Emergency Department)
Local Weather Data –	www.weatherunderground.com www.weather.com
Poison Control	800.332.3073
National Response Center (all spills in reportable quantities)	800.424.8802
U.S. Coast Guard (spills to water)	800.424.8802
Project Manager – Jason Brien	315.671.9114
Site Manager – TBD	
H&S Manager – Charles Webster	315.671.9297
Client Contact – John Ruspantini	607.762.8787

List the Emergency Notification Procedure for the project:

Step 1:Notify appropriate medical personnel
Step 2:Notify appropriate ARCADIS personnel
Step 3:Notify appropriate NYSEG personnel

If emergency attention is not needed but professional medical attention is necessary, the employee will be taken to (see hospital route):

Medical Facility: Auburn Memorial Hospital
Address: 17 Lansing Street
Auburn, New York
Phone Number: Emergency Department – 315.255.7211

Emergency Supplies and Equipment List

Emergency Supplies and Equipment (check all that apply)	Location on Project Site
☒ First Aid Kit (type):	Field Vehicle
☒ Fire Extinguisher	Field Vehicle
☒ Mobile Phone ☐ Satellite Phone	Field Vehicle
☐ Traffic Cones	
☐ Walkie Talkies	
☒ Water or Other Fluid Replenishment	Field Vehicle
☐ Eye Wash/Quick Drench Station	
☒ Eye Wash Bottle	Field Vehicle
☒ Wash and Dry Towelettes	Field Vehicle
☒ Sunscreen (SPF 15 or higher)	Field Vehicle
☒ Insect Repellant	Field Vehicle
☐ Chemical Spill Kit	
☐ *Other (specify):*	

MAPQUEST.

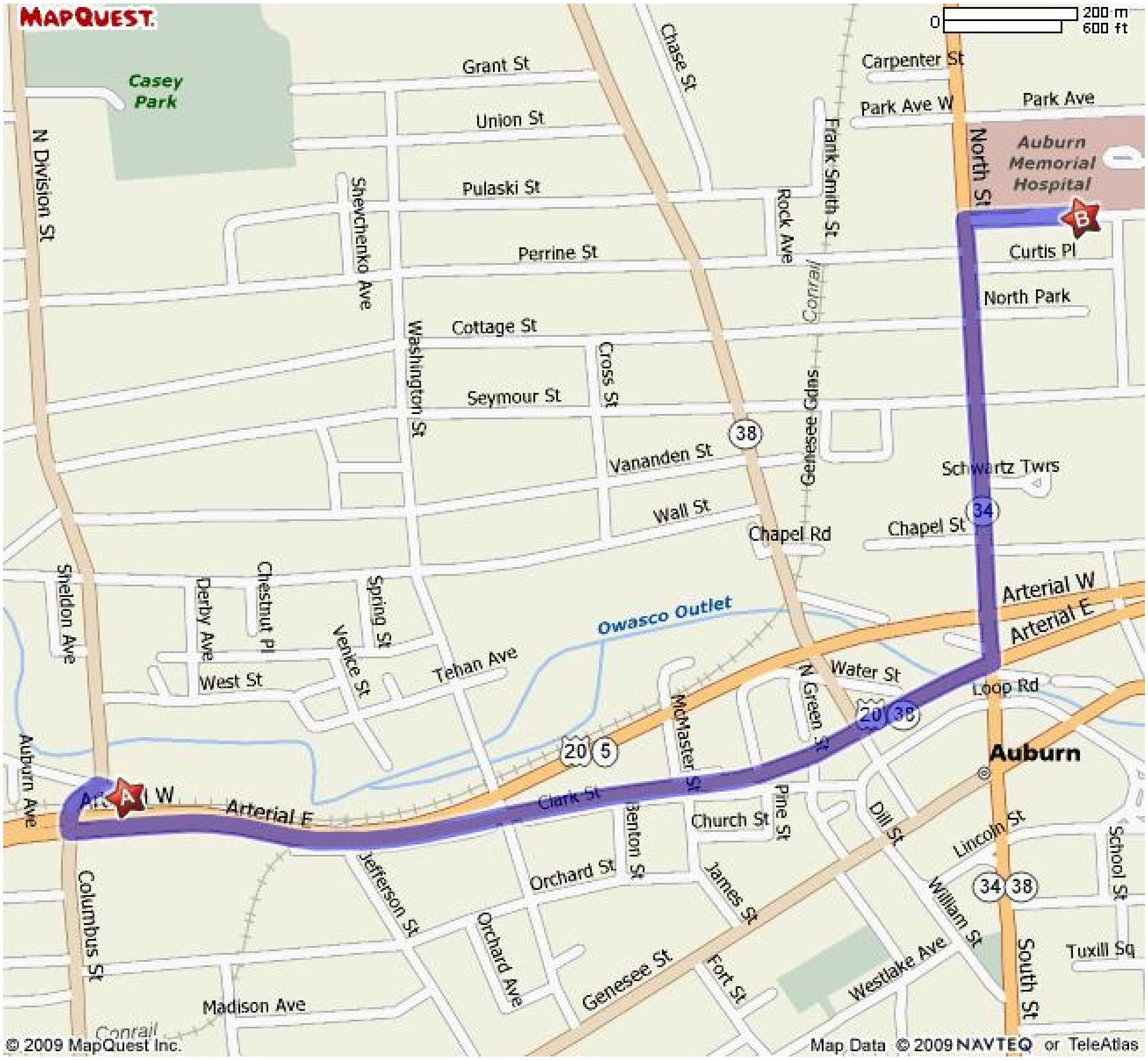
Total Time: 5 minutes **Total Distance: 1.71 miles**

A: [221-295] Clark St, Auburn, NY 13021

START	1:	Start out going WEST on CLARK ST toward N DIVISION ST.	0.0 mi
	2:	Turn LEFT onto N DIVISION ST.	0.1 mi
EAST 20	3:	Turn LEFT onto US-20 E/NY-5 E/ARTERIAL E.	1.0 mi
	4:	Turn LEFT onto NORTH ST/NY-34/NY-38. Continue to follow NORTH ST/NY-34.	0.5 mi
	5:	Turn RIGHT onto LANSING ST.	0.1 mi
END	6:	17 LANSING ST is on the LEFT.	0.0 mi

B: 17 Lansing St, Auburn, NY 13021-1983

Total Time: 5 minutes **Total Distance: 1.71 miles**


MAPQUEST.
0
200 m
600 ft
Casey Park
Grant St
Chase St
Carpenter St
Park Ave W
Park Ave
Union St
Frank Smith St
North St
Auburn Memorial Hospital
N Division St
Shevchenko Ave
Pulaski St
Rock Ave
Perrine St
Curtis Pl
North Park
Conrail
Cottage St
Washington St
Cross St
Seymour St
Genesee Gdns
38
Vananden St
Schwartz Twrs
34
Wall St
Chapel Rd
Chapel St
Sheldon Ave
Derby Ave
Chestnut Pl
Spring St
Venice St
Owasco Outlet
Arterial W
Arterial E
West St
Tehan Ave
Water St
N Green St
Loop Rd
McMaster St
20
5
Auburn
Auburn Ave
Clark St
Arterial E
Pine St
Benton St
Church St
Dill St
Lincoln St
School St
Columbus St
Jefferson St
Orchard St
James St
William St
Orchard Ave
Genesee St
Fort St
Westlake Ave
South St
Tuxill Sq
Madison Ave
Conrail
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Appendix G

HASP Forms and Checklists

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SITE ACTIVITIES TAILGATE HEALTH & SAFETY BRIEFING FORM

This briefing form documents the tailgate briefing conducted in accordance with the HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, at least daily.

Project Number:		**Project Name:**
Date:	**Time:**	**Briefing Conducted by:**
Company:		**Signature/Title:**

TRACKing the Tailgate Briefing

Think through the Tasks (list the tasks for the day):

1 ______ 3 ______ 5 ______

2 ______ 4 ______ 6 ______

Recognize the hazards (check all those that are discussed) and **Assess** the Risks (Low, Medium, High-circle risk level)

☐ Confined Space	(L M H)	☐ Buried/Overhead Utilities	(L M H)	☐ Excavation	(L M H)
☐ Walking/Working surfaces	(L M H)	☐ Chemical Exposure	(L M H)	☐ Noise	(L M H)
☐ Thermal Stress (Hot/Cold)	(L M H)	☐ Overhead Hazards	(L M H)	☐ Traffic/Roadway/Railway	(L M H)
☐ Severe Weather	(L M H)	☐ Chemical Usage	(L M H)	☐ Elevated work	(L M H)
☐ Hazardous Energy	(L M H)	☐ Heavy Machinery	(L M H)	☐ Biological/Animals	(L M H)
☐ Ergonomic	(L M H)	☐ Personal Safety/Security	(L M H)	☐ Mining	(L M H)
☐ Client/Other Site Activities	***List***	☐ Chemical Exposure	***List***	☐ Other	***Specify***
______	(L M H)	______	(L M H)	______	(L M H)
______	(L M H)	______	(L M H)	______	(L M H)
______	(L M H)	______	(L M H)	______	(L M H)

Control the hazards (Check all those methods to control the hazards that apply):

☒ **STOP WORK AUTHORITY** (Must be addressed in every Tailgate meeting-*See H&S Handbook for definition*)

☐ General PPE Usage	☐ Hearing Conservation	☐ Respiratory Protection
☐ Personal Hygiene	☐ Exposure Guidelines	☐ Decon Procedures
☐ Emergency Action Plan	☐ Fall Protection	☐ Work Zones/Site Control
☐ JSA to be developed/used ***(specify)***	☐ LPO conducted ***(specify job/JSA)***	☐ Other ***(specify)***
______	______	______
______	______	______
______	______	______

Personnel Sign-in List

Printed Name	Signature

Keep H&S 1st in all things

Use the back to add comments such as recent near misses, injuries or property damage, visitors to the site, etc

SITE ACTIVITIES TAILGATE HEALTH & SAFETY BRIEFING FORM

Additional Comments:

Discussion of recent results of LPOs conducted on the project:

Discussion of recent Near-miss, injuries, and/or property damage on the project:

List Visitors to Site Today:

Real Time Exposure Monitoring Data Collection Form

Document all air monitoring conducted on the Site below. Keep this form with the project file.

Site Name: ______________________________ Date: ______________

Instrument: ______________ Model: ______________ Serial #: ______________

Calibration Method: (Material used settings, etc.)	
Calibration Results:	
Calibrated By:	

Activity Being Monitored	Compounds/Hazards Monitored	Time	Reading	Action Required? Y/N

Describe Any Actions Taken as a Result of this Air Monitoring and Why (does it match Table 5-1):

____

____

Employee Signature Form

I certify that I have read, understand, and will abide by the safety requirements outlined in this HASP.

Printed Name	Signature	Date

Subcontractor Acknowledgement: Receipt of HASP Signature Form

ARCADIS claims no responsibility for the use of this HASP by others although subcontractors working at the site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this site. Strict adherence to the health and safety guidelines provided herein will reduce, but not eliminate, the potential for injury at this site. To this end, health and safety becomes the inherent responsibility of personnel working at the site.

Printed Name	Company	Signature	Date

Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release and discharge the owner of the site and ARCADIS and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Name	Company	Reason for Visit	Date/Time On Site	Date/Time Off Site

Hazardous Materials Transportation Form

	Vehicle (place X in box)	Type (pick-up, car, box truck, etc.)
Personal		
Rental		
ARCADIS owned/leased		
Government owned		
Trailer		

Materials Transported	Quantity	Storage/Transport Container

List Trained Drivers:

____

____

Hazardous Materials Shipment Form

Material Description and Proper Shipping Name (per DOT or IATA)	Shipment Quantity	DOT Hazard Classification	Shipment Method (air/ground)

List Shipper (i.e., who we are offering the shipment to):

____

____

List Trained Employee(s):

____

____

ARCADIS Infrastructure, environment, facilities		**Daily / Periodic Excavation Inspection Checklist**
Project Name:		**Date / Time:**
Project Number:		**Location:**
Prepared By:		**Project Manager:**

This checklist must be completed for all excavations. It documents that daily and post-event / periodic inspections are conducted.

Soil Classified As: Stable Rock Type A Type B Type C

Soil Classified On: By:

Type of Protective System in Use: Sloping Shoring Other ________________

Description:

Inspection Item	YES	NO	Comments
Is the underground / overhead utilities checklist completed?			
Are underground installations protected from damage?			
Are adequate means of entry / exit available in the excavation?			
If exposed to traffic, are personnel wearing reflective vests?			
Do barriers exist to prevent equipment from rolling into the excavation?			
Was air monitoring conducted prior to and during excavation entry?			
Was the stability of adjacent structures reviewed by a registered P.E.?			
Are spoil piles at least 2 feet from the excavation edge?			
Is fall protection in use near excavations deeper than 6 feet?			
Are work tasks completed remotely if feasible?			
Is a protective system in place and in good repair?			
Is emergency rescue (lifeline / body harness) equipment used due to potential atmospheric hazard?			
Is excavation exposed to vibration?			
Are employees protected from falling / elevated material?			
Is soil classification adequate for current environmental / weather conditions?			
Do portable ladders extend at least 4 feet above the excavation?			
Are portable ladders or ramps secured in place?			
Have all personnel attended safety meeting on excavation hazards?			
Are support systems for adjacent structures in place?			
Is the excavation free from standing water?			
Is water control and diversion of surface runoff adequate?			
Are employees wearing required protective equipment?			
BBL Excavation Competent Person:			**Date/Time:**

Underground / Overhead Utility Checklist

Project Name:	**Date:**
Project Number:	**Location:**
Prepared By:	**Project Manager:**

This checklist must be completed for any intrusive subsurface work such as excavation or drilling. It documents that overhead and underground utilities in the work area are identified and located. The Project Manager shall request utility markouts before the start of field operations to allow the client and utility companies sufficient time to provide them. If complete information is not available, a magnetometer or other survey shall be performed to locate obstacles prior to intrusive subsurface activities.

Procedure: A diagram of the work area depicting the proposed location of intrusive subsurface work sites (i.e., boring locations, excavation locations) must be attached to this form. The diagram must clearly indicate the areas checked for underground structures / utilities, and overhead power lines. This form and the diagram must be signed by the BBL Project Manager (if present), the BBL Site Supervisor, and the client representative.

Type of Structure	Present	Not Present	Method of Markout
Electric Power Line			
Natural Gas Line			
Telephone Line			
Water Line			
Product Line			
Sewer Line			
Steam Line			
Drain Line			
Underground Tank			
Underground Cable			
Overhead Power Line			
Overhead Product Line			
Other (Specify)			

Reviewed By

Name	Job Title	Date
	Client Representative	
	BBL Project Manager	
	BBL Site Supervisor	

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SEDIMENT/SURFACE WATER SAMPLING CHECKLIST

Project Name/Number____ Date________
Location____
Prepared By____________________________ Project Manager_______________________

This checklist must be completed for any sediment or surface water sampling. It documents that the required, permits, notifications, procedures and equipment are in place prior to commencing sampling activities. The Project Manager shall identify the need for and arrange to obtain sampling permits, clearance or right-of-way access from the appropriate entity during project planning.

Procedure

Prior to any work on a navigable waterway or any activity that requires access the following items will be completed:

Activity:	Required for project:	Completed:	Comments:
Access rights to property	YES NO	YES NO	
Activity planned that impedes traffic on navigable waterway	YES NO	YES NO	
Notification and approval obtained from United States Coast Guard and/or other regulating authority (County, US Parks Service, EPA)	YES NO	YES NO	
Buoys, signs markings or other forms of notification present	YES NO	YES NO	
Other (Specify)			

Boating/Water Safety Checklist:

Activity:	Required for project:	Requirement:	Comments:
Working on over or near water (within 6 feet)	YES NO	PFD Available for all personnel	
Boat has been current registration, has been inspected and loaded safely	YES NO	Capacity, load distribution PFDs and throwable floatation device available Fire extinguisher on board	
Boat operator has appropriate training (USCG Boating Safety Course or equivalent)	YES NO		
Sampling on or near water below 50 degrees Fahrenheit	YES NO	Cold water immersion suit for affected personnel	
Method of communication available	YES NO	Radio, cell phone or scheduled check-in	

Client Representative____ Date____________

BBL Project Manager____ Date____________

BBL Site Supervisor____ Date____________

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Float Plan

Complete this page, before going boating and leave it with a reliable person who can be depended upon to notify the Coast Guard or other rescue organization, should you not return as scheduled.
Do not file this plan with the Coast Guard.

1. Name of person reporting and telephone number: ______________________________

2. Description of boat:

   Type____________________ Color______________Trim_______________
   Registration No.________________________Length____________________
   Name____________________Make______________ Other Info.___________

3. Engine type:_________________________ H.P.___________________
   No. of engines________________________ Fuel Capacity______________

4. Survival equipment (check as appropriate):

   ❑ PFDs ❑ Anchor ❑ Water ❑ Food
   ❑ Smoke Signals ❑ Flares ❑ Raft or Dinghy ❑ Others
   ❑ Paddles ❑ Flashlight ❑ Mirror ❑ EPIRB

5. Radio ❑ yes ❑ no Type_______________________ Freqs.______________

6. Automobile License:____
   Type_____________________________Trailer License__________________
   Color____________________ and make of auto________________________
   Where parked____

7. Persons aboard:
   Name Age Address & Telephone No.
   ____
   ____
   ____

8. Do any of these persons aboard have a medical problem? ❑ yes ❑ no
   If yes, what?____

9. Trip Expectations: Leave at__________________ From___________________
   Going to________________________expect to return by__________________(time)
   and not later than ____

10. Any other pertinent info.____

11. If not returned by_____________________________(time) call the COAST GUARD, or (local authority)____

12. Telephone numbers____
____

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Appendix H

NYSDOH G-CAMP

New York State Department of Health
Generic Community Air Monitoring Plan

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

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical-specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all <u>ground intrusive</u> activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a **continuous** basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored **continuously** at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring partculate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

June 20, 2000

H:\Southern\gCAMPr1.doc