

National Fuel Gas Distribution Corporation

FINAL

Remedial Investigation Work Plan

Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

March 2013

New York State Department of Environmental Conservation

Division of Environmental Remediation

Remedial Bureau C, 11th Floor

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Joe Martens
Commissioner

March 12, 2013

Tanya B. Alexander, CHMM, REM
Manager, Environmental Services
National Fuel Gas Distribution Corporation
6363 Main St
Williamsville, NY 14221-5887

Dear Ms. Alexander:

Re: Dunkirk Former Manufactured Gas Plant Site
Chautauqua County, Site ID: 907035
Draft Remedial Investigation Work Plan (ARCADIS, March 11, 2013)

The New York State Department of Environmental Conservation (Department) and the New York State Department of Health have reviewed the referenced work plan. The work plan is acceptable, can be finalized, and is hereby approved with the following modification:

- Consistent with the language of the scope of work approved by the Department on February 27, 2013, National Fuel will deliver the brief letter reports of the SVI sampling results to each property owner.

Please notify the Department at least 7 days in advance of any field activities.

Please feel free to contact me with any questions via email at wxwu@gw.dec.state.ny.us, or via phone at (518) 402-9662.

Sincerely,



William Wu
Environmental Engineer
Remedial Bureau C
Division of Environmental Remediation

ec: G. Cross, NYSDEC
N. Freeman, NYSDOH

On behalf of National Fuel Gas Distribution Corporation (National Fuel), ARCADIS has prepared this work plan for conducting a Remedial Investigation (RI) at the Dunkirk Former Manufactured Gas Plant (MGP) Site (the “site”) in Dunkirk, New York. This RI Work Plan was prepared in response to the New York State Department of Environmental Conservation’s (NYSDEC’s) February 27, 2013 e-mail to National Fuel. The NYSDEC’s February 27th e-mail contained the following:

- An approval of the February 8, 2013 RI Scope of Work.
- A request that National Fuel submit a single bound RI Work Plan that would contain the RI scope of work and relevant appendices of the NYSDEC-approved Site Characterization (SC) Work Plan.

Following the NYSDEC’s February 27th e-mail, National Fuel submitted a draft RI Work Plan on March 11, 2013. The NYSDEC provided a conditional approval of the RI Work Plan as documented in a letter dated March 12, 2013 (inside cover). In their March 12th letter the NYSDEC requested that National Fuel submit letter reports of the Soil Vapor Intrusion (SVI) results to respective property owners, rather than the New York State Department of Health (NYSDOH) providing the submittals. This final RI Work Plan reflects the NYSDEC’s request.

This work plan contains the following documentation:

Attachment 1 **Table 1: RI Work Plan Table** — Presents the scope of the RI activities and provides a rationale for each of the activities. This is the same table that was provided in National Fuel’s February 7, 2013 RI Scope of Work letter to the NYSDEC.

Table 2: Target Analyte List and Reporting Limits for Soil Vapor Intrusion (SVI) sampling.

Figure 1: Onsite Investigation Locations — Shows the locations of onsite RI soil borings and monitoring wells.

Figure 2: Offsite Investigation Locations — Shows the location of onsite and offsite RI soil borings and monitoring wells, and shows the locations of properties targeted for the SVI investigation.



Remedial Investigation Work Plan

Dunkirk Former
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Dunkirk, New York

- Attachment 2** **Field Sampling Plan (FSP)** — Contains detailed field procedures and protocols that will be followed during the RI.
- Attachment 3** **Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP)** — Presents the analytical methods and procedures that will be used to analyze soil, groundwater, and vapor samples collected during the RI.
- Attachment 4** **Health and Safety Plan (HASP)** — Presents the health and safety procedures, methods, and requirements that will apply to field personnel during implementation of the RI field work.
- Attachment 5** **DNAPL Contingency Plan (DCP)** — Describes procedures to be followed during drilling to limit the potential for remobilizing dense non-aqueous phase liquid (DNAPL), if encountered.
- Attachment 6** **Community Air Monitoring Plan (CAMP)** – Presents air monitoring activities that will be conducted to protect the public from potential vapor or dust emissions generated during subsurface soil disturbance activities.
- Attachment 7** **SVI Standard Operating Procedures (SOPs)** – Presents procedures to be followed during the SVI investigations.



Attachment 1

Table 1: RI Work Plan Table

Table 2: Target Analyte List and
Reporting Limits

Figure 1: Onsite Investigation
Locations

Figure 2: Offsite Investigation
Locations

**TABLE 1
REMEDIAL INVESTIGATION WORK PLAN**

**NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK**

Location/Activity	Action	Rationale
Soil Vapor Intrusion Evaluation (Four Properties) – First RI Activity (2013 Heating Season)		
<p>National Fuel Service Center Building</p> <p>17 Second Street</p> <p>24 Second Street</p> <p>28 Second Street</p>	<p>A soil vapor intrusion (SVI) evaluation will be the first field activity conducted during the Remedial Investigation (RI). The SVI will be conducted at four properties. The first step in the SVI evaluation will be to evaluate the construction and usage of the buildings on each property. Building construction and usage will be used to determine the potential scope of the SVI evaluation for each building.</p> <p>Once the building assessments are completed, National Fuel will transmit an e-mail to the NYSDEC/NYSDOH to confirm the sampling approach for each building. At a minimum, National Fuel anticipates that one indoor air, one sub-slab or soil vapor, and one ambient air sample will be collected during the SVI evaluation at each building; however, the final sampling approach will be determined based on the building assessments.</p> <p>Each SVI evaluation will be conducted in conformance with the New York State Department of Health (NYSDOH) document entitled <u>Guidance for Evaluating Soil Vapor Intrusion in the State of New York, Final, October 2006</u> (Guidance), and the attached Standard Operating Procedures (SOPs).</p> <p>As detailed in the attached SOPs, each soil vapor, indoor air, and ambient outdoor air sample will be collected using a 6-liter SUMMA® canister with an attached, pre-set flow regulator. The laboratory will provide batch-certified-clean canisters with an initial vacuum of approximately 29 inches of mercury (in. of Hg) for sample collection. Flow regulators will be pre-set by the laboratory to provide uniform sample collection over the desired sampling duration. Sampling durations will be as follows:</p> <ul style="list-style-type: none"> • Residential properties – 24-hr sampling duration • Businesses – 8 hr sampling duration <p>A tracer gas (helium) will be used while collecting soil vapor samples to evaluate the integrity of the seals around the soil vapor sampling apparatus. This will provide a means to evaluate whether the samples are diluted by surface air.</p>	<p>The purpose of the SVI evaluation is to</p> <ul style="list-style-type: none"> • Determine the SVI sampling approach for each property. • Determine whether site-related volatile organic compounds (VOCs) are present in sub-slab, soil vapor, and/or indoor air. • If present in indoor air, evaluate if the VOCs are attributable to the site or other potential sources. • If present in indoor air, evaluate if the VOCs levels warrant additional investigation.

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Location/Activity	Action	Rationale
	<p>Samples will be submitted for laboratory analysis to an ELAP certified laboratory in accordance with the United States Environmental Protection Agency (USEPA) Compendium Method TO-15, titled "Determination of VOCs in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)". Samples will be analyzed for the standard TO-15 Target Analyte List, including n-alkanes as presented in Table 1. Laboratory analysis will be performed on a standard turnaround for reporting of analytical results (i.e., three to four weeks following sample collection). Within 48 hours after receiving initial, unvalidated data from the laboratory, a preliminary analytical report and figure will be prepared and transmitted to the New York State Department of Environmental Conservation (NYSDEC) and NYSDOH.</p> <p>National Fuel will prepare brief letter reports of the SVI sampling results for submittal to each property owner. Draft letters will be provided to NYSDEC/NYSDOH for review prior to National Fuel's submittal to property owners. We've assumed each letter will be approximately two pages in length and will attach a table of analytical results with comparison to appropriate criteria.</p>	
Sump Sampling	<p>If, during the building assessments, buildings are determined to have sub-grade foundations with groundwater seeping into the foundations or into sumps, a grab groundwater sample will be collected from basements for Target Compound List (TCL) VOCs analysis using USEPA Method 8260.</p>	<p>The analytical results of potential grab groundwater samples from basements will be evaluated to determine whether dissolved-phase benzene could be present in groundwater entering the basements.</p>

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**NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK**

Location/Activity	Action	Rationale
Source Delineation Near MW-1 (Gas Holder No. 1) – Second RI Activity (Spring 2013)		
Ground Penetrating Radar (GPR)/Electromagnetic (EM) Surveys	GPR and EM-31 will be the first field activity conducted in connection with the Source Delineation program. GPR and EM-31 will be completed in a dense grid over the location of Former Holder No. 1 and former oil tank. GPR and EM-31 surveying will also be used at each drilling location to clear utilities prior to drilling.	GPR and EM-31 will be used to: <ul style="list-style-type: none"> • Fine tune the location of Former Holder No. 1. • Attempt to locate remnants of the former oil tank foundation. • Fine tune the locations of soil borings and monitoring wells to be installed during the RI. • Locate underground utilities at each drilling location.
Vacuum Excavator Utility Clearance and Former Foundation Confirmation	<p>A vacuum excavator will be used to clear each soil boring and monitoring well location to approximately 5 feet below grade.</p> <p>The vacuum excavator will also be used to confirm the location of Former Holder No. 1 foundation and former oil tank foundation. The vacuum excavator confirmation borings will be positioned based on the results of the GPR and EM-31 geophysical survey. Vacuum excavator borings will be completed until the intact foundations are exposed. The soil borings targeted to be inside and outside of the holder ring (below) will be fine-tuned based on the results of the vacuum excavator borings.</p>	<p>The vacuum excavator will enable safe drilling by identifying potential utilities at each drilling location.</p> <p>The vacuum excavator will also allow for visual confirmation of the intact Former Holder No. 1 foundation and potentially the former oil tank foundation. Both of these structures could be a potential source of the dissolved-phase benzene observed in the MW-1 area.</p>
Soil Borings SB-13 through SB-24	<p>Soil borings will be continuously-sampled using hollow stem auger (HSA) and/or direct-push drilling techniques. The drilling rig chosen for the program will have both capabilities. Soil samples will be collected using 2-inch diameter by 2- or 4-foot long macro-core samplers. Soil recovered from each 2- or 4-foot interval will be visually characterized for color, texture, and moisture content. The presence of visible discoloration, NAPL, and obvious odors encountered in the soil will be noted.</p> <p>Each boring will be drilled to the bedrock surface, which is expected to be encountered at a depth of approximately 18 to 20 feet below grade. Drilling will not be performed through any subsurface structures (e.g., concrete or brick slabs) where significant quantities of NAPL are encountered, in an effort to limit the potential downward migration of NAPL. Drilling may continue to greater depths at such</p>	<p>The purpose of drilling these soil borings is to:</p> <ul style="list-style-type: none"> • Collect soil samples to help define the three-dimensional distribution of benzene impacts and potential MGP-related impacts in soil in the MW-1 area. • Better define the source of elevated benzene concentrations. • Evaluate whether Former Holder No. 1 was constructed with a floor. • Assess the potential presence of MGP-related impacts within and/or beneath the floor of Former Holder No. 1 (if a floor is present).

**TABLE 1
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**NATIONAL FUEL
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Location/Activity	Action	Rationale
	<p>locations at an alternate boring located just outside the footprint of the subsurface structure. This will be determined in the field based on field observations.</p> <p>Up to two soil samples will be collected from each boring and submitted to an ELAP certified laboratory for analysis of TCL VOCs, TCL SVOCs, and total cyanide using United States Environmental Protection Agency (USEPA) methods. Samples will be collected from interval(s) based on visual/olfactory observations and photoionization detector (PID) screening results. Priority will be given to intervals containing potential MGP-related impacts. Samples will also be collected from apparently “clean” intervals to provide information to define the “bottom” extent of impacted areas. If no impacts are observed in a soil boring, one soil sample will be collected near the water table and the other will be collected from the bottom of the boring (above the bedrock surface).</p>	<ul style="list-style-type: none"> • Assess whether the potential source of elevated benzene detected in the MW-1 area could be outside/upgradient of Former Holder No. 1 and whether MGP-related impacts are present outside of Former Holder No. 1. • Gather data to support a potential remedial action for the MW-1/Former Holder No. 1 area.
<p>Temporary Wells (at SB-13 through SB-24)</p>	<p>Temporary wells will be installed at each boring using 1-inch diameter PVC with 10-foot long screens. Temporary wells will be installed at each location by lowering the PVC well material to the bottom of the soil boring (assumed to be on the bedrock surface) prior to pulling the augers/direct-push tooling from the boring. Natural soils will be allowed to collapse around the well screen. Groundwater samples will be collected using a new, disposable polyethylene mini bailer to purging approximately one well volume prior to sampling. Groundwater samples will be submitted to an ELAP certified laboratory and analyzed for TCL VOCs using USEPA Method 8260. Borings will be abandoned after sampling by filling the temporary well with a loose grout mixture and allowing the grout to seep into the formation, then topping the temporary well with another slug of grout prior to pulling the PVC.</p>	<p>The overall purpose of the temporary well groundwater sampling is to collect data to help define the distribution of benzene impacts and other potential MGP-related impacts in groundwater in the Former Holder No.1/MW-1 area, and to better define the source of elevated benzene concentrations.</p>

**TABLE 1
REMEDIAL INVESTIGATION WORK PLAN**

**NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK**

Location/Activity	Action	Rationale
Downgradient Plume Delineation (Downgradient from MW-3 and MW-7/MW-8) – Second RI Activity (Spring 2013)		
<p><u>Monitoring Wells</u></p> <p><u>MW-9 through MW-12 (downgradient from MW-7 and MW-8)</u></p> <p><u>MW-13 (downgradient from MW-3)</u></p>	<p>Install and sample groundwater from four monitoring wells located downgradient from MW-7 and MW-8 and one monitoring well downgradient from MW-3. Well borings will be drilled and sampled in the same manner as the soil borings (described above).</p> <p>Monitoring wells will be constructed using two-inch diameter schedule 40 PVC material and 0.010-inch slotted, 10-foot long well screens. The monitoring well downgradient from MW-3 will be constructed similar to the construction of MW-3: a 10-ft screen from approximately 5 to 15 feet below grade. Monitoring wells downgradient from MW-7 and MW-8 will be installed similar to the construction of MW-7/MW-8, with the bottom of each well situated on the bedrock surface (assumed to be approximately 18 feet below grade).</p> <p>Monitoring wells will be developed by surging/purging the saturated portion of the screened interval. An attempt will be made to remove a minimum of 10 well volumes from each well, depending on the yielding capacity of the well.</p> <p>Two rounds of groundwater samples will be collected from the monitoring wells using low-flow sampling techniques and specific-capacity test data will be measured at the new monitoring wells as water is purged during sampling.</p> <p>Both rounds of groundwater samples will be submitted to an ELAP certified laboratory and analyzed for TCL VOCs, TCL SVOCs, and total cyanide using USEPA methods. Field parameters measured during groundwater sampling will include pH, turbidity, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential (ORP).</p>	<p>The overall purpose of monitoring wells MW-9 through MW-13 will be to define the downgradient extent of dissolved-phase site –related impacts and better define the groundwater flow direction. The specific purpose of each well is as follows:</p> <ul style="list-style-type: none"> • MW-9 through MW-12: define the extent of dissolved-phase benzene downgradient from MW-7 and MW-8. • MW-13: define the extent of dissolved-phase BTEX compounds detected in MW-3. <p>Monitoring wells will be developed to promote the hydraulic connection between the well screen and the surrounding geologic formation and to help remove fine sediment from the borehole wall and sand pack.</p> <p>Specific-capacity data will be used to estimate the hydraulic conductivity of the saturated material screened by the monitoring wells.</p>

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Location/Activity	Action	Rationale
Survey		
Survey New Borings, Wells, and Vacuum Excavator Borings	Determine location and elevation of new wells and soil borings using a licensed land surveyor. Information measured will include the horizontal location and vertical locations of the top of the protective casing, the top of the inner casing, and the ground surface adjacent to the wells and soil borings.	Provide the information necessary to determine groundwater elevations, location/elevation of subgrade soil horizons or encountered structures. The survey of the vacuum excavator confirmation borings will be used to update the location of Former Holder No. 1 and possibly the former oil tank onto site mapping.
Field Methods and Quality Assurance for Soil and Groundwater Sampling		
<p>The field and sampling activities will be conducted in general accordance with the appendices included in the NYSDEC-approved <i>Site Characterization Work Plan</i>, dated August 2009. The appendices include the Field Sampling Plan (FSP), Quality Assurance Sampling and Analysis Project Plan (QASAPP), Health and Safety Plan (HASP), and DNAPL Contingency Plan (DCP). Community air monitoring will also be conducted in accordance with the NYSDOH-approved Community Air Monitoring Plan (CAMP), dated March 2012.</p> <p>As described in the QAPP, soil and groundwater samples will be submitted for laboratory analysis using United States Environmental Protection Agency (USEPA) SW-846 Methods as referenced in the most recent edition of the NYSDEC Analytical Services Protocol (ASP), with Category B analytical laboratory reports. Soil and groundwater samples will be analyzed for TCL VOCs, TCL SVOCs, and/or total cyanide. The soil and groundwater sample(s) (including quality assurance/quality control [QA/QC] samples) will be collected, packaged, handled, and shipped in general accordance with the QA/QC protocols and the soil and groundwater sampling protocols presented in the FSP and QASAPP.</p> <p>A Data Usability Summary Report (DUSR) of the laboratory data packages will be prepared and the results of the DUSR will be incorporated into data tables which will be provided in subsequent reports.</p>		

**TABLE 2
TARGET ANALYTE LIST AND REPORTING LIMITS**

**SVI EVALUATION
NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK**

Analyte	CAS Number	Molecular Weight	Reporting Limit	
			(ppbv)	(mg/m ³)
Benzene	71-43-2	78.11	0.20	0.64
Benzyl chloride	100-44-7	140.57	0.40	2.3
Bromodichloromethane	75-27-4	163.83	0.20	1.3
Bromoform	75-25-2	252.75	0.20	2.1
Bromomethane (Methyl bromide)	74-83-9	94.95	0.20	0.78
2-Butanone (Methyl ethyl ketone)	78-93-3	72.11	1.0	2.9
Carbon Tetrachloride	56-23-5	153.84	0.20	1.3
Chlorobenzene	108-90-7	112.56	0.20	0.92
Chloroethane	75-00-3	64.52	0.20	0.53
Chloroform	67-66-3	119.39	0.20	0.98
Chloromethane (Methyl chloride)	74-87-3	50.49	0.50	1.0
Cyclohexane	110-82-7	84.16	0.50	1.7
Dibromochloromethane	124-48-1	208.29	0.20	1.7
1,2-Dibromoethane	106-93-4	187.88	0.20	1.5
1,2-Dichlorobenzene	95-50-1	147.01	0.20	1.2
1,3-Dichlorobenzene	541-73-1	147.01	0.20	1.2
1,4-Dichlorobenzene	106-46-7	147.01	0.20	1.2
Dichlorodifluoromethane (Freon 12)	75-71-8	120.92	0.20	0.99
1,1-Dichloroethane	75-34-3	98.97	0.20	0.81
1,2-Dichloroethane	107-06-2	98.96	0.20	0.81
1,1-Dichloroethene	75-35-4	96.95	0.20	0.79
1,2-Dichloroethene (cis)	156-59-2	96.95	0.20	0.79
1,2-Dichloroethene (trans)	156-60-5	96.95	0.20	0.79
1,2-Dichloropropane	78-87-5	112.99	0.20	0.92
cis-1,3-Dichloropropene	10061-01-5	110.98	0.20	0.91
trans-1,3-Dichloropropene	10061-02-6	110.98	0.20	0.91
1,2-Dichlorotetrafluoroethane (Freon 114)	76-14-2	170.93	0.20	1.4
1,4-Dioxane	123-91-1	88.11	0.50	1.8
Ethanol *	64-17-5	46.07	0.20	0.38
Ethylbenzene	100-41-4	106.16	0.20	0.87
Hexachlorobutadiene	87-68-3	260.76	1.0	10.7
n-Hexane	110-54-3	86.18	0.50	1.8
Methylene Chloride	75-09-2	84.94	0.50	1.7
4-Methyl-2-pentanone (MIBK)	108-10-1	100.16	0.50	2.0
MTBE (Methyl tert-butyl ether)	1634-04-4	88.15	1.0	3.6
Styrene	100-42-5	104.14	0.20	0.85
Tertiary Butyl Alcohol (TBA)	76-65-0	74.12	2.0	6.1
1,1,1,2-Tetrachloroethane	79-34-5	167.86	0.20	1.4
Tetrachloroethene (PCE)	127-18-4	165.85	0.20	1.4
Toluene	108-88-3	92.13	0.20	0.75
1,2,4-Trichlorobenzene	120-82-1	181.46	1.0	7.4
1,1,1-Trichloroethane	71-55-6	133.42	0.20	1.1
1,1,2-Trichloroethane	79-00-5	133.42	0.20	1.1
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	76-13-1	187.38	0.20	1.5
Trichloroethene (TCE)	79-01-6	131.40	0.20	1.1
Trichlorofluoromethane (Freon 11)	75-69-4	137.38	0.20	1.1
1,2,4-Trimethylbenzene	95-63-6	120.19	0.20	0.98
1,3,5-Trimethylbenzene	108-67-8	120.19	0.20	0.98
2,2,4-Trimethylpentane	540-84-1	114.23	0.50	2.3

See Notes on Page 2.

**TABLE 2
TARGET ANALYTE LIST AND REPORTING LIMITS**

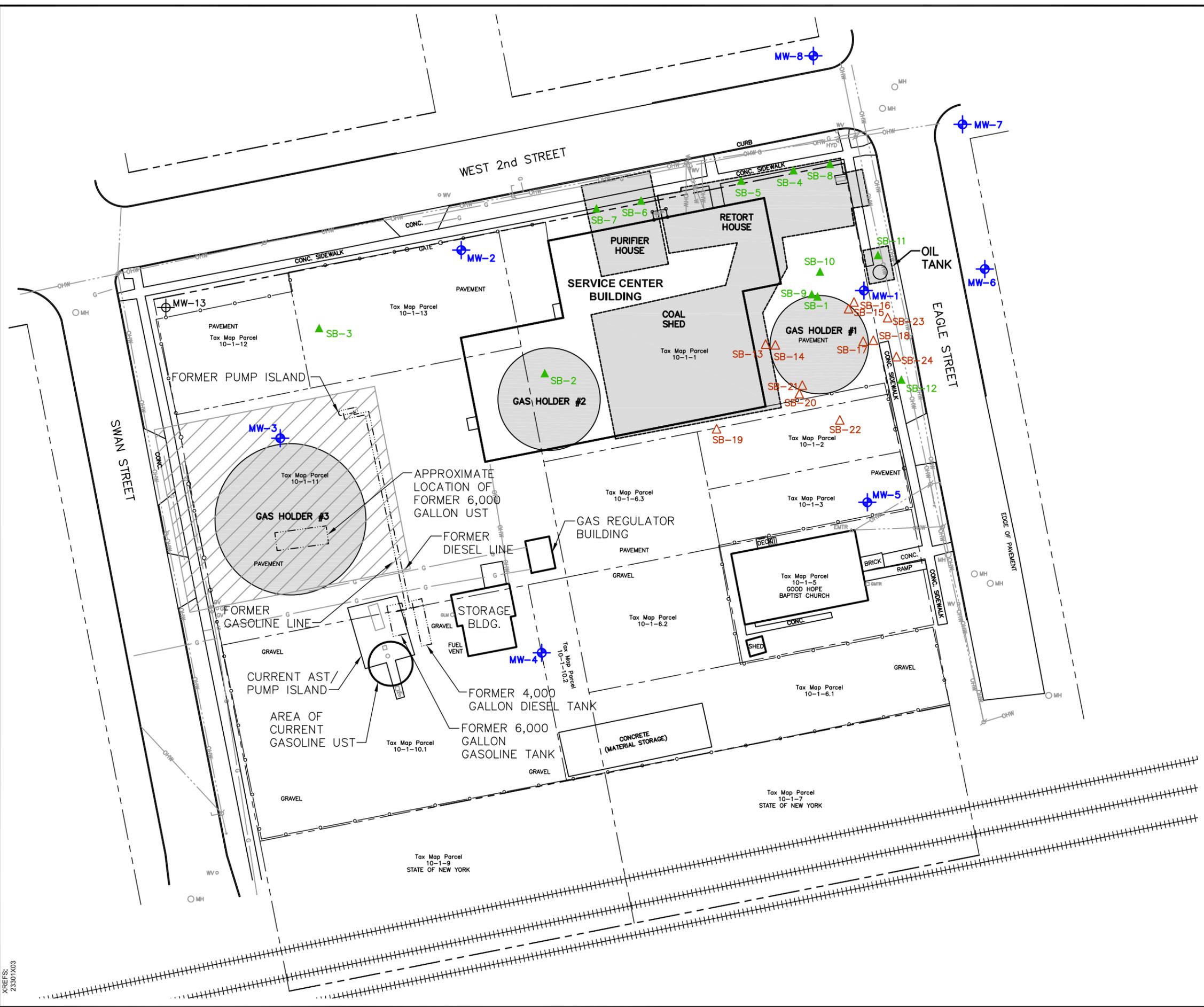
**SVI EVALUATION
NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK**

Analyte	CAS Number	Molecular Weight	Reporting Limit	
			(ppbv)	(mg/m ³)
Vinyl Chloride	75-01-4	62.50	0.20	0.51
Xylenes (m&p)	1330-20-7	106.16	0.20	0.9
Xylenes (o)	95-47-6	106.16	0.20	0.87
Acetone (2-propanone)	67-64-1	58.08	5.0	12
Bromoethene	593-60-2	106.96	0.20	0.87
1,3-Butadiene	106-99-0	54.09	0.40	0.88
Carbon Disulfide	75-15-0	76.14	0.50	1.6
3-Chloropropene (allyl chloride)	107-05-1	76.53	0.20	0.63
2-Chlorotoluene	95-49-8	126.59	0.40	2.1
4-Ethyltoluene (p-ethyltoluene)	622-96-8	120.20	0.40	2.0
n-Heptane	142-82-5	101.20	0.50	2.1
Isopropyl Alcohol	67-63-0	61.09	2.0	5.0
Methyl Butyl Ketone	591-78-6	100.16	0.50	2.0
n-Butane	106-97-8	58.12	0.40	1.0
n-Decane	124-18-5	142.29	1.0	5.8
n-Dodecane	112-40-3	170.34	1.0	7.0
n-Nonane	111-84-2	128.26	0.50	2.6
n-Octane	111-65-9	114.23	0.40	1.9
n-Pentane	109-66-0	72.15	1.0	3.0
n-Undecane	1120-21-4	156.31	1.0	6.4
1,2,3-Trimethylbenzene**	80-62-6	120.19	0.20	1.0
Naphthalene	91-20-3	128.17	0.50	2.6
1-Methylnaphthalene**	90-12-0	142.20	2.50	15
2-Methylnaphthalene**	91-57-6	142.20	2.50	15
Tetramethylbenzene*	25619-60-7	134.21	TBD	TBD
Indene**	95-13-6	116.16	0.40	1.9
Indane**	496-11-7	118.18	0.20	1.0
Thiophene**	110-02-1	84.14	0.20	0.7

Notes:

- Analyses to be performed using United States Environmental Protection Agency (USEPA) Compendium Method TO-15.
- CAS = Chemical Abstract Services.
- Molecular weights are presented in grams per mole.
- ppbv = parts per billion volumetric basis.
- mg/m³ = micrograms per cubic meter.
- TBD = To be determined; reporting limit not available.
- * = Compound to be included in laboratory analysis as a tentatively identified compound (TIC).
- ** = 1-point calibration.

CITY: SYRACUSE, N.Y.; DIV: GROUP 14; IENVCAD: DB: LPOSENAUER, RALLEN, R. BASSETT; LDR: OPT; PIC: OPT; PM: SPOW/LN; TMR: OPT; LVR: OPT; NDR: OFF; REF: G:\ENVCAD\SYRACUSE\ACT\B0023301\10001100002\DWG\R1\23301B01.dwg; LAYOUT: 1; SAVER: 12/29/2013 9:48 AM; ACADVER: 18.13 (LMS TECH); PAGES: 1; PLOTSTYLE: PLT\FULL.CTB; PLOTTED: 12/29/2013 9:48 AM; BY: BASSETT, RICHARD

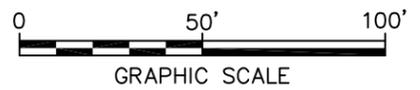


LEGEND:

- PROPOSED MONITORING WELL
- PROPOSED SOIL BORING
- SOIL BORING
- MONITORING WELL
- FORMER MGP STRUCTURE
- FORMER PETROLEUM DISTRIBUTION STRUCTURES
- APPROXIMATE EXTENT OF PETROLEUM REMEDIATION AREA
- APPROXIMATE PROPERTY LINE
- RAILROAD
- EXISTING BUILDING
- CHAIN LINK FENCE
- GAS LINE
- OVERHEAD WIRE
- WATER LINE

NOTES:

1. ALL LOCATIONS APPROXIMATE.
2. BASEMAP FROM NYS GIS CLEARINGHOUSE WEBPAGE FOR ORTHOIMAGERY AND CT MALE SURVEY OBTAINED ON SEPTEMBER 14, 2010.
3. APPROXIMATE EXTENT OF PETROLEUM REMEDIATION AREA BASED ON A HAND SKETCH MAP PROVIDED BY NATIONAL FUEL ON JANUARY 26, 2009. DATE OF REMEDIATION NOT DEFINED ON THAT MAP.
4. LOCATIONS OF GAS HOLDERS 2 AND 3 DIGITIZED FROM A MAY 10, 1956 DRAWING PROVIDED BY NATIONAL FUEL. ALL OTHER MGP STRUCTURES DIGITIZED FROM 1893 AND 1904 SANBORN FIRE INSURANCE MAPS.
5. LOCATIONS OF FORMER USTs, PUMP ISLAND, AND ASSOCIATED DISTRIBUTION LINES FROM MESCH ENGINEERING, P.C. DRAWING ENTITLED "SITE PLAN", ORIGINAL DRAWING DATED 9/17/87.
6. MONITORING WELLS MW-5 AND MW-6, AND SOIL BORINGS SB-9 THROUGH SB-12 FROM SURVEY FILE PROVIDED BY C.T. MALE ASSOCIATES, DATED 10/7/11.



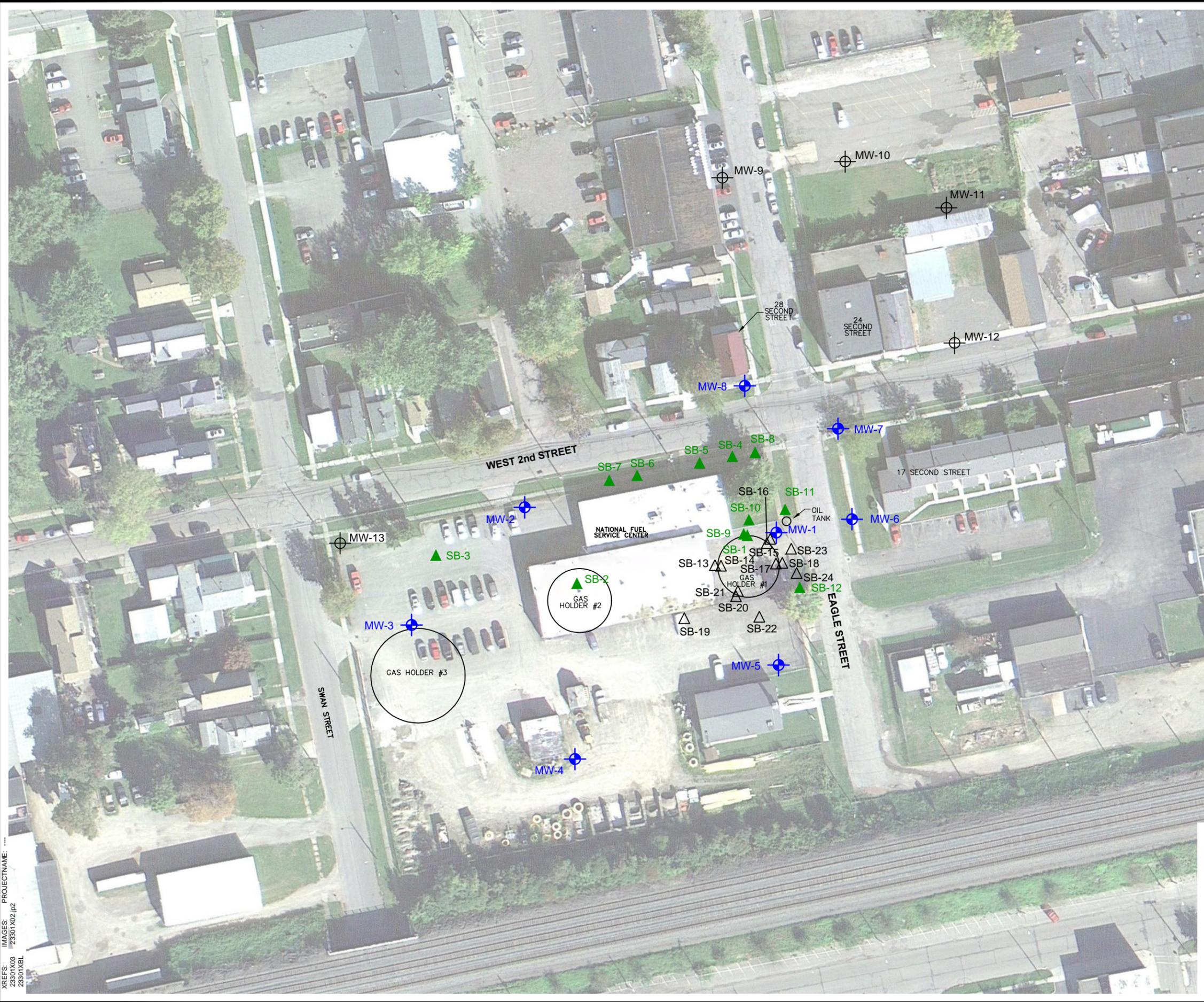
NATIONAL FUEL
DUNKIRK FORMER MGP SITE
DUNKIRK, NEW YORK
SITE CHARACTERIZATION

ONSITE INVESTIGATION LOCATIONS



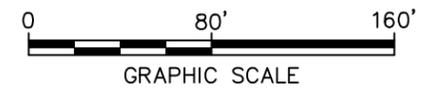
FIGURE
1

CITY: SYRACUSE, N.Y. DIV: GROUP: ENV/IM/DV DE: LIPOSENAUER, R ALLEN, R BASSETT LD:(OP) PIC:(OP) PM: S POWLIN TM:(OP) LXR:(OR)ONE="OFF"="REF"
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 XREFS: 23301X03 23301X02 23301X01 PROJECTNAME: ---



- LEGEND:**
- PROPOSED MONITORING WELL
 - PROPOSED SOIL BORING
 - MONITORING WELL
 - SOIL BORING

- NOTES:**
1. ALL LOCATIONS APPROXIMATE.
 2. LOCATIONS OF GAS HOLDERS 2 AND 3 DIGITIZED FROM A MAY 10, 1956 DRAWING PROVIDED BY NATIONAL FUEL. ALL OTHER MGP STRUCTURES DIGITIZED FROM 1893 AND 1904 SANBORN FIRE INSURANCE MAPS.
 3. MONITORING WELLS MW-5 AND MW-6, AND SOIL BORINGS SB-9 THROUGH SB-12 FROM SURVEY FILE PROVIDED BY C.T. MALE ASSOCIATES, DATED 10/7/11. MONITORING WELLS MW-7 AND MW-8 FROM SURVEY FILE PROVIDED BY C.T. MALE ASSOCIATES, DATED 10/1/12.
 4. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO OBTAINED ON JANUARY 28, 2012 DATED OCTOBER 6, 2011.



NATIONAL FUEL
 DUNKIRK FORMER MGP SITE
 DUNKIRK, NEW YORK
REMEDIAL INVESTIGATION

OFFSITE INVESTIGATION LOCATIONS



FIGURE
2



Attachment 2

Field Sampling Plan

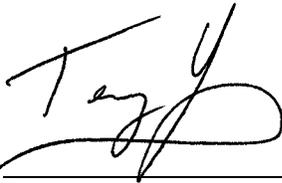
National Fuel Gas Distribution Corporation

Appendix A
Field Sampling Plan

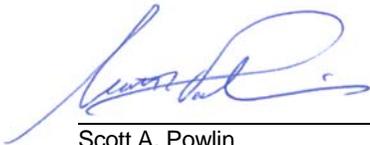
Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

February 2009

ARCADIS



Terry W. Young
Principal-in-Charge



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**Appendix A
Field Sampling Plan**

Dunkirk Former Manufactured
Gas Plant Site
Dunkirk, New York

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Date:
February 2009

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1. Introduction

1.1 General

This Field Sampling Plan (FSP) supports the Site Characterization (SC) Work Plan prepared by ARCADIS for the Dunkirk former Manufactured Gas Plant (MGP) Site (the “site”) located in Dunkirk, New York. The investigation locations described in the SC Work Plan are shown on Figure 1 of the Work Plan. The SC Work Plan and this FSP were prepared on behalf of National Fuel Gas Distribution Corporation (National Fuel).

This FSP contains field procedures and sample collection methods to be used during implementation of the field activities described in the SC Work Plan. The FSP should be used in conjunction with the SC Work Plan, the Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP), and the Health and Safety Plan (HASP). The SC Work Plan presents the site background and defines the field sampling program. The QA/SAPP outlines the procedures that will be used during the SC to ensure that data collected and subsequent reports are of high enough quality to meet project objectives. The HASP presents the procedures and practices to be followed during the SC field work to help ensure the safety of workers, and is designed to prevent occupational injuries and worker exposures to chemical, physical and biological hazards. The QA/SAPP and HASP are provided in Appendix B and Appendix C, respectively, of the SC Work Plan.

1.2 Project Objectives

The overall objectives of the SC are to:

- assess whether MGP-related residual materials are present at the site related to the operation of the former MGP.
- determine whether MGP-related residual materials, if present at the site, have a potential to pose a significant threat to public health or the environment.
- determine whether a Remedial Investigation (RI) of the site is appropriate.

The technical approach to address the above objectives is provided in Table 1 of the SC Work Plan.

1.3 Overview of Investigation Field Activities

To obtain information necessary to meet the investigation objective stated above, the following activities will be conducted:

- Drilling soil borings
- Installing monitoring wells
- Measuring fluid levels
- Collecting soil samples during the advancement of the monitoring wells and soil borings
- Collecting groundwater samples
- Conducting a geophysical survey
- Conducting a site survey

The sampling locations and quantities for each field sampling activity are described in detail in the SC Work Plan, and therefore, are not further described in this FSP.

1.4 Site Description and History

1.4.1 Site Description

The approximately 3 acre site is located at 31 West 2nd Street at the southeastern corner of the intersection of Swan Street and West 2nd Street in Dunkirk, Chautauqua County, New York (see Figure 1 of the SC Work Plan). The site comprises a generally rectangular piece of land that is now located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south (see Figure 2 of the SC Work Plan).

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline. The current site structures are shown on Figure 2 of the SC Work Plan.

The site is generally flat-lying and is largely paved with asphalt. A gravel-covered area used for staging gas distribution supplies is found in the southern approximately $\frac{1}{4}$ of the site. Small strips of grass areas are located in the rights-of-way along the perimeter of the site and in the northeast corner of the site. A grassy area also exists on the southern edge of the site, near the railroad.

1.4.2 Site History

The MGP operated from the late 1800s to approximately 1910. National Fuel currently owns the site (NFG, 2008). Based on a review of available Sanborn Fire Insurance Maps from 1888 to 1964, at its peak, the MGP consisted of three gas holders (which for the purpose of this Work Plan are numbered sequentially from east to west as holder 1 to holder 3), a retort house, a purifier house, a coal shed, and an oil tank. With the exception of holder 3, (the furthest to the west), the plant structures all existed in the northeast corner of the site. The current Service Center Building sits over at least a portion of holder 2, the retort house, the purifier house, and the coal shed. Figure 2 of the SC Work Plan shows the locations of the former MGP structures as they relate to present-day features. Limited information is available regarding gas production at the Dunkirk MGP; however, a review of the publication "Survey of Town Gas and By-Product Production and Locations in the U.S." indicates that approximately 7, 23, and 26 million cubic feet of gas was produced at the MGP in 1890, 1900, and 1910 (Radian Corporation, 1985).

Coal was the primary feedstock for the manufactured gas process at the site (Radian Corporation, 1985). This method of producing gas, known as the coal carbonization method, consisted of heating bituminous coal in a sealed chamber (i.e., retorts), with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned (or purified), and distributed while coke was removed and sold or used. The main byproducts of the coal carbonization method were tars, oils, coke, ammoniacal liquor, ash and clinker, and residuals associated with the gas purification process (purifier wastes). The tars were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from a later gas producing process known as the carbureted water-gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

2. Field Activities

2.1 General Field Guidelines

All underground utilities will be identified prior to any drilling or subsurface sampling. Public and privately owned utilities will be located by contacting Dig Safely New York such that responsible agencies can mark their underground utilities at the site. Site access agreements will be obtained prior to conducting any field work on properties not owned by National Fuel. Other potential on site hazards such as traffic, overhead power lines, and building hazards will be identified during a site reconnaissance visit.

Field log books will be maintained by the Field Manager/ Site Supervisor 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 (COC) records will be written with indelible ink. If an error is made in these documents, the individual entering

the data 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 or made illegible. 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, Packing, 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 COC will be initiated. A sample COC form is included on Figure A-1.

If samples are to be shipped by commercial carrier (e.g., UPS), sample bottles/jars will be packed in coolers containing the following:

- 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 COC in a re-sealable plastic bag, taped in place on the inside cover of the cooler

The cooler will then be sealed with tape. If the cooler contains a drain plug, it must be sealed with duct 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 COC 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-Solv[®]) 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. The back of the drill rig and augers, rods, and 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 National Fuel 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.

Unless sealed in manufacturer's packaging, polyvinyl chloride (PVC) monitoring well casing screens will be decontaminated by the above procedures before installation.

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% “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% “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 Drilling Procedures

The drilling and geological logging methods to be used during the subsurface investigation are as follows:

- Boreholes in the overburden will be drilled using hollow stem auger or direct push techniques. If difficult drilling conditions are encountered in the subsurface soils, alternate drilling methods may be used.
- Boreholes drilled using hollow stem augers will be advanced using a drill rig equipped with 3- or 4-inch hollow stem augers. Soil samples will be collected continuously to the bottom of the borings using 2-foot-long, 2-inch diameter discrete split spoon samplers advanced 2 feet per sampling run. Sampling method ASTM D1586-84 (Standard Method for Penetration Test and Split-Barrel Sampling of Soils) will be followed, unless otherwise authorized by the Field Manager/Site Supervisor.
- Boreholes drilled using direct push techniques will be advanced using either a truck or tractor mounted push/percussion drill rig. Soil samples will be collected continuously to the bottom of the borings using 2- or 4-foot-long, 2-inch diameter Macrocore[®] samplers, equipped with disposable PVC liners, advanced 2 to 4 feet per sampling run.
- For samples that may be submitted for chemical analysis, split spoons will be decontaminated, as specified in Section 2.3.2, between uses. Sample descriptions, photoionization detector (PID) readings, and location will be recorded in the field book.

- Upon completion of each boring, the borehole will be sealed with a bentonite/cement grout tremied in place from the bottom of the borehole up.
- A plywood sheet or tub may be placed around the auger or casing when drilling to contain cuttings.
- Cuttings will be placed in a drum or roll off supplied by National Fuel or the drilling subcontractor. Decontamination water will be placed in drums or plastic tanks supplied by National Fuel or the drilling subcontractor. Soil cuttings and decontamination water will be picked up and containerized at the end of each work day. The roll-offs or open-top drums used to contain the solids will be covered when not in use.

Pertinent notes regarding the drilling work will be recorded in the field book.

2.5 Sample Description

Collected samples will be described by persons who have been trained in ARCADIS soil description procedures and have a degree in geology or a geology-related discipline. The procedure that will be followed for describing soils is contained in Attachment A-1.

2.6 Subsurface Soil Analytical Sampling Procedure

Subsurface soils collected from the unconsolidated fill and soils beneath the site using split spoon or Macrocore[®] sampling methods will be selected for laboratory analysis based on:

- their position in relation to potential source areas.
- the visual presence of source materials.
- the relative levels of volatile organics based on PID field screening measurements.
- the discretion of the field manager.

Samples selected for laboratory analysis will be placed in the appropriate containers provided by the laboratory. Sample containers for volatile organic analyses will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel tray or bowl with a decontaminated stainless steel trowel or disposable scoop. Laboratory-supplied sample containers for other

analytes will then be filled. Duplicate samples will be collected at the frequency detailed in the QA/SAPP (Appendix B) by alternately filling two sets of sample containers.

Where there is sufficient sample volume, representative portions of each soil sample will be placed in a one-pint jar or re-closable plastic bag, labeled, and stored on site. This container will be labeled with the following:

- Site
- Boring number
- Interval sampled
- Date
- Initials of sampling personnel

2.7 Monitoring Well Installation and Development

Monitoring wells will be installed to the depths and at the locations defined in the SC Work Plan. After completion of drilling and well installation, all wells will be developed to establish hydraulic connection between the well and the formation. The following procedures will be used to install, and develop monitoring wells.

2.7.1 Monitoring Well Specifications

Figure A-2 shows details of a typical monitoring well construction for shallow wells installed in unconsolidated soils that do not penetrate a presumed confining layer. The overburden monitoring wells will be installed according to the following specifications:

- PVC 2-inch diameter, threaded, flush-joint casing and 10-foot-long, 0.010-inch or 0.020-inch slot screens will be installed, depending on the grain size of the material being screened.
- A sump, 2 feet in length and grouted in place with cement, may be attached to the bottom of the screen for potential collection of dense non-aqueous phase liquids (DNAPLs), if present.
- The top of the casing will extend approximately 2 feet above ground surface given site-specific considerations; otherwise, flush-mount casings will be used.

- The annulus around the screens will be backfilled with an appropriate size of silica sand to a minimum height of 1 foot above the top of the screen, assuming there is sufficient room to install an appropriate surface seal above the sand.
- An approximately 2-foot-thick (depending on conditions) chipped bentonite seal or slurry (30 gallons water to 25 to 30 pounds bentonite, or relative proportions) will be placed above the sand pack.
- The remainder of the annular space will be filled with a cement/bentonite grout to approximately 2 feet below grade. The grout will be placed with a tremie pipe from the bottom up. The grout will consist of a cement mixture of one 94 pound bag of Portland cement, approximately 5 pounds of granular bentonite, and approximately 7 gallons of water. The grout will be allowed to set for a minimum of 24 hours before wells are developed.
- Each monitoring well will have a vented cap and be protected at the surface with a 4-inch steel casing containing a locking cap. The protective casing will extend approximately 1 to 2 feet below ground surface (bgs) and be set in concrete. In some areas, it may be necessary to provide flush-mounted surface completions.
- A concrete seal or pad, approximately 2 feet in diameter and 1.5 feet deep, will be installed.

The following characteristics of each newly installed well will be recorded in the field log book:

- Date/time of construction
- Drilling method and drilling fluid used
- Approximate well location
- Borehole diameter and well casing diameter
- Well depth
- Drilling and lithologic logs
- Casing materials
- Screen materials and design
- Casing and screen joint type
- Screen slot size/length
- Filter pack material/size
- Filter pack placement method
- Sealant materials

- Sealant placement method
- Well development procedure
- Type of protective well cap
- Detailed drawing of well (including dimensions)

2.7.2 Monitoring Well Development

A minimum of 24 hours after installation, the monitoring wells will be developed by surging/bailing, using a centrifugal pump and dedicated polyethylene tubing, or by Waterra positive displacement pumps and dedicated polyethylene tubing, or other methods at the discretion of the Field Manager/Site Supervisor. The development water will be contained in a tank on site or in drums to be provided by National Fuel or the drilling subcontractor. The wells will be developed until the water removed from the well is reasonably free of visible sediment (50 nephelometric turbidity units [NTUs]), if possible, or until the turbidity levels stabilize, assuming a minimum of 10 well volumes of water have been removed from the monitoring well during development. Following development, wells will be allowed to recover for at least one week before groundwater is purged and sampled. All monitoring well development will be overseen by a field geologist and the duration, method of development, and approximate volume of water removed will be recorded in the field book.

2.8 Fluid-level Measurements

The following procedure will be used to measure fluid-level depths at monitoring wells and surface water gauges:

- Decontaminate the water level probe or oil/water interface probe (for wells expected to contain non-aqueous phase liquids [NAPLs]).
- Measure the static fluid-level, fluid interfaces (i.e., NAPL/water interface), and sound the bottom of the well (if applicable) with reference to the surveyed elevation mark on the top of the PVC casing or surface water gauge. Record all measurements to nearest 0.01 foot and record in the field book.

The measurements will be made in as short a timeframe as practical to minimize temporal fluctuations in hydraulic conditions.

2.9 Low-Flow Groundwater Sampling Procedures for Monitoring Wells

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
- Six-foot rule with gradation in hundredths of a foot
- Conductivity/temperature meter
- pH meter
- Turbidity 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
- COC forms
- Indelible ink pens
- Site map with well locations and groundwater contours maps
- Keys to wells

The following 21 steps detail the monitoring well sampling procedures:

1. Review materials checklist (Part II) to ensure that the appropriate equipment has been acquired.
2. 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).
3. Label all sample containers using an appropriate label.
4. Use safety equipment, as required in the HASP.
5. Place plastic sheeting adjacent to the well to use as a clean work area.
6. Establish the background reading with the PID and record the reading on the field log.
7. Remove lock from the well and if rusted or broken replace with a new brass keyed-alike lock.
8. 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.
9. Set out on plastic sheeting the dedicated or disposable sampling device and meters.
10. 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].
11. 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.

12. 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.
13. 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.
14. 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):

± 0.1 for pH

$\pm 3\%$ for specific conductance (conductivity)

± 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).

15. Fill in the sample label and cover the label with clear packing tape to secure the label onto the container.
16. 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.
17. Secure with packing material and store at 4 degrees Celsius on wet ice in an insulated transport container provided by the laboratory.
18. 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.
19. Record the time sampling procedures were completed on the field logs.
20. 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.
21. Complete the procedures for packaging, shipping, and handling with associated COC forms.

2.10 Geophysical Survey

A geophysical investigation will be performed to assist in the delineation of subsurface structures (e.g., former holder structures, foundation walls, utility locations, etc.) that may be present at the site, and could influence the distribution of MGP-related material. The geophysical investigation will consist of ground penetrating radar (GPR) and electromagnetic (EM) surveys. These surveys will be performed following the general procedures provided below.

2.10.1 EM Survey

The EM survey will be conducted on a 10-foot grid across the accessible areas of the site. This survey is designed to identify anomalies that may be associated with buried former MGP structures and/or areas that have decreased or elevated ground conductivity (as compared to background values), which could represent MGP-related structures or materials.

The EM survey will be performed using a Geonics EM-31 frequency-domain conductivity meter equipped with a digital data recorder. The EM survey data will be collected using vertical dipole orientation with both quadrature (apparent conductivity) and inphase (metal sensitivity) modes. The EM-31 uses a fixed intercoil spacing of 12.1 feet to provide an exploration depth of approximately 16 feet. This exploration depth should be adequate for evaluating subsurface features of interest at the site.

The EM data will be reduced, contoured and evaluated at the site and compared with historic information to determine if any anomalies that are present are associated with past activities. Areas of decrease or elevated EM measurements will be further investigated using GPR. A contour map of the EM measurements will be generated for the geophysical letter report.

2.10.2 Ground Penetrating Radar Survey

The Ground Penetrating Radar (GPR) survey will be performed to further investigate the EM anomalies and any additional locations of interest at the site as identified from historical site information, to characterize subsurface structures. The GPR data will be used to help identify potential locations for confirmatory test pits and/or soil borings.

The GPR survey will be performed using Subsurface Interfacing Radar (SIR) System 3000, manufactured by Geophysical Survey Systems, Inc. (GSSI). The GPR system

transmits high-frequency electromagnetic waves into the ground and detects the energy reflected to the surface. Energy is reflected along boundaries of subsurface interfaces that have different electrical properties. Reflections typically occur at lithologic contacts or at changes in subsurface material having high electrical contrasts, including metal objects, concrete structures, and utility pipes. These reflections are detected by an antenna and processed into an electrical signal that is used to create an image of the subsurface feature. The GPR data will be evaluated in the field to determine the location of subsurface features of interest. Subsurface features considered to be of significant interest will be located and marked in the field for potential investigation using intrusive methods (test pits and/or soil borings).

2.11 Air Monitoring

Air monitoring will be conducted in accordance with the procedures detailed in the HASP (Appendix C). Air monitoring will be conducted with a PID and dust monitor during all intrusive land activities and only a PID during sampling activities. The PID will be used to monitor organic vapors in the breathing zone and borehole, and to screen samples for analysis and the dust monitor will be used to monitor particulate concentration in the breathing zone for particulates less than 10 microns in diameter.

The PID and dust monitor readings will be recorded in the field book during trenching and drilling activities. The instruments will be calibrated at least once each day, and more frequently if needed. A detailed procedure for the PID calibration is included as Attachment A-3.

3. Field Instruments

At a minimum, all field screening equipment will be calibrated immediately prior to each day's use. Additional calibration may be required if measurements appear erroneous. 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 Analyzer

The photoionization analyzer will be a Photovac MicroTip (or equivalent), equipped with a 10.6 eV lamp or 11.7 eV lamp, depending on the requirements of the HASP. The Photovac is capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73% of the TCL VOCs. Calibration will be performed according to the procedures outlined in Attachment A-3.

3.2 Dust Monitor

The dust monitor will be a 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 plan. 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 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 plan. Readings must be within 5% to be acceptable.

3.5 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.

3.6 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.

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**Appendix A
Field Sampling Plan**

FIGURES

Figure A-1

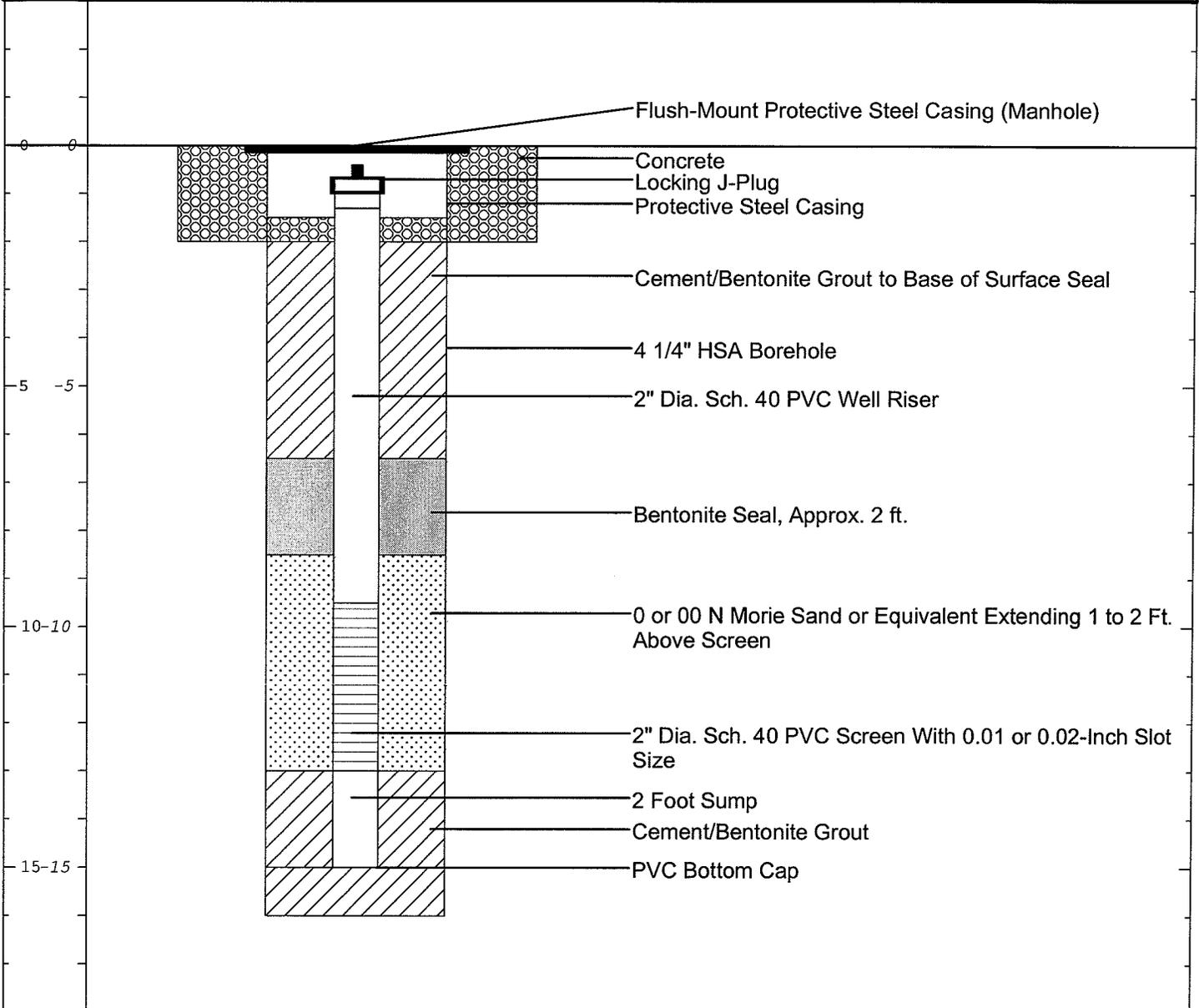
Sample Chain-of-Custody Form

Figure A-2

Monitoring Well Construction
Diagram

Date Start/Finish: Drilling Company: Driller's Name: Drilling Method: Bit Size: Auger Size: Rig Type: Sampling Method:	Northing: NA Easting: NA Casing Elevation: NA Borehole Depth: Surface Elevation: Descriptions By:	Well ID: EXAMPLE WELL 1 Client: Location:
---	--	--

Well Construction Details



 <i>Infrastructure, environment, facilities</i>	Remarks:
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**Appendix A
Field Sampling Plan**

ATTACHMENTS

ARCADIS

Attachment A-1

Soil Description Procedures

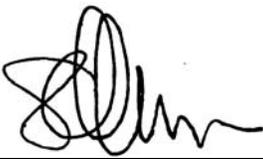
Soil Description

Rev. #: 0

Rev Date: May 20, 2008

Approval Signatures

Prepared by:  _____ Date: 5/22/08

Reviewed by:  _____ Date: 5/22/08
(Technical Expert)

Reviewed by:  _____ Date: 5/22/08
(Technical Expert)

I. Scope and Application

This ARCADIS standard operating procedure (SOP) describes proper soil description procedures. This SOP should be followed for all unconsolidated material unless there is an established client-required specific SOP or regulatory-required specific SOP. In cases where there is a required specific SOP, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-ARCADIS SOP, additional information required by this SOP should be included in field notes with client approval.

This SOP has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;
- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This SOP incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This SOP does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other ARCADIS SOPs, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

II. Personnel Qualifications

Soil descriptions will be completed only by persons who have been trained in ARCADIS soil description procedures. Field personnel will complete training on the ARCADIS soil description SOP in the office and/or in the field under the guidance of an experienced field geologist. For sites where soil descriptions have not previously been well documented, soil descriptions should be performed only by trained persons with a degree in geology or a geology-related discipline.

III. Equipment List

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this SOP for Soil Descriptions and any project-specific SOP (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera.

IV. Cautions

Drilling and drilling-related hazards including subsurface utilities are discussed in other SOPs and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

V. Health and Safety Considerations

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

VI. Procedure

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, Lexan or acetate sleeves for dual-tube direct push, etc.
2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.
3. Examine all of each individual soil sample (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:
 - depth interval;
 - principal component with descriptors, as appropriate;
 - amount and identification of minor component(s) with descriptors as appropriate;
 - moisture;
 - consistency/density;
 - color; and
 - additional description or comments (recorded as notes).

The above is described more fully below.

DEPTH

To measure and record the depth below ground level (bgl) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.

2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).
3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.
4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of 1/2. Due to visual limitations, the finer classifications of Wentworth’s scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the field gauge card that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves s

recommended to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is recommended for determining presence and estimating percentage of clay and silt.

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included)	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be "Pebbles"; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be "Fine to coarse Sand" or for a sample that was 40% silt and 45% clay the principal component would be "Clay and Silt".

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the ARCADIS Soil Description Field Guide.

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

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

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

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

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25 % silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 5) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for the silt and clay. Dilatancy should be provided for silt and silt-sand mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with

modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. ARCADIS prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

- Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes)
- Poorly sorted – a wide range of particle sizes are present

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. For SPT blow counts the N-value is used. The N-value is the blows per foot for the 6” to 18” interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6” to12”, the third interval is 12” to 18”, the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist

samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- **Odor** - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH "Pocket Guide to Chemical Hazards", e.g. "pungent" or "sweet" and should not indicate specific chemicals such as "phenol-like" odor or "BTEX" odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts)
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy
- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance)
- Reaction with HCl (typically used only for special soil conditions)
- Origin, if known (capital letters: LACUSTRINE; FILL; etc.)

EXAMPLE DESCRIPTIONS

51.4 to 54.0' Clay, some silt, medium to high plasticity; trace small to large pebbles, subround to subangular up to 2" diameter; moist; stiff; dark grayish brown (10YR 4/2)
NOTE: Lacustrine; laminated 0.01 to 0.02 feet thick, laminations brownish yellow (10 YR 4/3).



32.5 to 38.0' Sand, medium to Pebbles, coarse; sub-round to sub-angular; trace silt; poorly sorted; wet; grayish brown (10YR5/2). NOTE: sedimentary, igneous and metamorphic particles.

Unlike the first example where a density of cohesive soils could be estimated, this rotosonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose Sand and Pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth

- Principal Components
 - Angularity for very coarse sand and larger particles
 - Plasticity for silt and clay
 - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

VII. Waste Management

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

VIII. Data Recording and Management

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. Two examples of standard boring logs are presented below.

IX. Quality Assurance

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

X. References

ARCADIS Soil Description Field Guide, 2008 (in progress)

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 “Munsell® Color Soil Color Charts

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 “Sand Grain Sizing Folder”

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation.
<http://www.usbr.gov/pmts/geology/fieldmap.htm>

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48

NIOSH Pocket Guide to Chemical Hazards

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63

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Attachment A-2

Field Sampling Log

Site

Event

GROUND-WATER SAMPLING LOG

Sampling Personnel:

Well ID:

Client / Job Number:

Date:

Weather:

Time In:

Time Out:

Well Information

Depth to Water:	(feet)	(from MP)
Total Depth:	(feet)	(from MP)
Length of Water Column:	(feet)	
Volume of Water in Well:	(gall)	
Three Well Volumes:	(gall)	

Well Type:	Flushmount	Stick-Up	
Well Material:	Stainless Steel	PVC	
Well Locked:	Yes	No	
Measuring Point Marked:	Yes	No	
Well Diameter:	1"	2"	Other:

Purging Information

Purging Method:	Bailer	Peristaltic	Grundfos	Other:
Tubing/Bailer Material:	St. Steel	Polyethylene	Teflon	Other:
Sampling Method:	Bailer	Peristaltic	Grundfos	Other:
Duration of Pumping:	(min)			
Average Pumping Rate:	(ml/min)		Water-Quality Meter Type:	
Total Volume Removed:	(gall)		Did well go dry:	Yes No

Conversion Factors				
gal / ft. of water	1" ID	2" ID	4" ID	6" ID
	0.041	0.163	0.653	1.458
1 gal = 3.785 L = 3875 ml = 0.1337 cubic feet				

Unit Stability			
pH	DO	Cond.	ORP
± 0.1	± 10%±	3.0%	± 10 mV

Parameter:	1	2	3	4	5	6	7	8	9
Volume Purged (gal)									
Rate (ml/min)									
Depth to Water (ft.)									
pH									
Temp. (C)									
Conductivity (mS/cm)									
Dissolved Oxygen									
ORP (mV)									
Turbidity (NTU)									
Notes:									

Sampling Information

Analyses	#	Laboratory
Sample ID:		Sample Time:
MS/MSD:	Yes	No
Duplicate:	Yes	No
Duplicate ID		Dup. Time:
Chain of Custody Signed By:		

Problems / Observations

ARCADIS

Attachment A-3

MicroTIP Photoionization Detector
Calibration, Operation, and
Maintenance Procedures

**Attachment A-3. Photovac MicroTIP Photoionization Detector Calibration,
Operation & Maintenance Procedures*****I. Introduction***

The MicroTIP measures relative total concentrations of organic and inorganic vapors in the field and will be calibrated daily prior to use. The MicroTIP does not carry an Intrinsic Safety Rating and will be used in a controlled environment only. The MicroTIP will be used to screen soil samples, the head space of soil/water samples, and to monitor the breathing and work zones as specified in the Health and Safety Plan.

II. Materials

- Photovac MicroTIP (PID)
- Isobutylene calibration gas tank with pressure regulator and up to four other selected span gases
- zero span gas (clean outdoor air or zero grade gas)
- gas sampling bag with plastic tubing to connect PID probe to calibration gas
- flow regulator
- PID calibration and maintenance log

III. Calibration Procedures

1. Turn on the MicroTIP and monitor the ambient air. If there is any doubt of the air quality, then zero grade gas will be obtained.
2. Connect the regulator to the span gas cylinder. Hand-tighten the fittings.
3. Open the valve on the gas bag by turning the valve stem fully counterclockwise.
4. Attach the gas bag to the regulator. Hand-tighten the fittings.
5. Turn the regulator knob counterclockwise half a turn to start the gas flow.

6. Fill the gas bag half full and then close the regulator fully clockwise to turn off the flow of gas.
7. Fill the gas bag, and then turn the valve clockwise.
8. Press "CAL" and expose MicroTIP to zero gas. Press "ENTER", and MicroTIP sets its zero point.
9. MicroTIP then asks for the Span Gas concentration. Enter the known Span Gas concentration and then expose the MicroTIP to the Span Gas.
10. Press "ENTER" and MicroTIP sets its response factor.
11. When MicroTIP's display reverts to normal, the MicroTIP is calibrated and ready to use. Remove the Span Gas from the inlet.
12. After seven hours of use, recharge the battery pack. Record the time the battery pack was charged on the MicroTIP Calibration and Maintenance Log.
13. Record the date, time, your initials, calibration gas, and concentration on the Micro TIP Calibration and Maintenance Log.

IV. Operation Procedures

1. Use the health and safety equipment as required by the Health and Safety Plan.
2. Calibrate the instrument as described in subsection III of this Appendix.
3. Measure and record the background PID reading.
4. If the PID will be used for more than seven hours during optimal weather conditions (50° or greater), or during extreme cold or precipitation, have a fully charged battery available for use.
5. In the event of precipitation, fully cover the instrument, leaving the probe accessible for measurements.
6. Measure and record PID reading.

V. Maintenance Procedures

1. At the end of each day or when the battery is fully discharged, recharge batteries overnight.
2. Store the instrument in the protective case when not in use.
3. Keep records of operation, maintenance, calibration problems, and repairs.
4. A replacement instrument will be available on site or ready for overnight shipment, if necessary.
5. The MicroTIP will be sent back to the manufacturer for service if needed.



Attachment 3

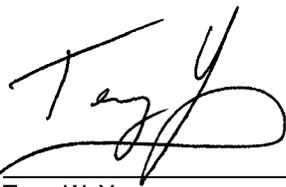
Quality Assurance/Sampling and
Analysis Project Plan

National Fuel Gas Distribution Corporation

Appendix B
Quality Assurance Sampling and
Analysis Project Plan

Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

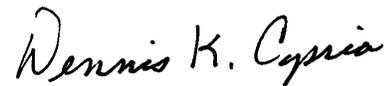
February 2009



Terry W. Young
Principal-in-Charge



Scott A. Powlin
Senior Geologist



Dennis Capria
Quality Assurance Manager

**Appendix B
Quality Assurance Sampling
and Analysis Project Plan**

Dunkirk Former Manufactured
Gas Plant Site
Dunkirk, New York

Prepared for:
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Date:
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Preface

This Quality Assurance Sampling and Analysis Project Plan (QASAPP) presents the sampling and analytical methods and procedures that will be used during implementation of the Site Characterization Work Plan (SC) at the Dunkirk Former Manufactured Gas Plant (MGP) Site in Dunkirk, New York. The QASAPP should be used in conjunction with the SC Work Plan, the Field Sampling Plan (FSP), and the Health and Safety Plan (HASP). The SC Work Plan presents the site background and defines the field sampling program. The FSP contains field procedures and sample collection methods to be used during implementation of the SC Work Plan. The HASP provides a mechanism for establishing safe working conditions at the site. The FSP and HASP are provided in Appendix A and Appendix C, respectively, of the SC Work Plan.

This QASAPP 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 (NEIC) Policies and Procedures Manual (USEPA, 1991).

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

Section	Content
Project Management	
1	Project Organization
2	Project Background
3	Project Description
4	Quality Objectives and Criteria for Measurement Data
5	Specialized Training Requirements/Certification
6	Documentation and Records

Section	Content
Measurement/Data Acquisition	
7	Sampling Process Design
8	Sampling Method Requirements
9	Sample Handling and Custody Requirements
10	Analytical Method Requirements
11	Quality Control Requirements
12	Instrument/Equipment Testing, Inspection, and Maintenance Requirements
13	Instrument Calibration and Frequency
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

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

1. Project Organization and Responsibilities

1.1 Project Organization

The Dunkirk Former Manufactured Gas Plant (MGP) Site in Dunkirk, New York, 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 2.2.

1.1.1 Overall Project Management

ARCADIS, on behalf of National Fuel Gas Distribution Corporation (National Fuel), has overall technical responsibility for the Site Characterization (SC). ARCADIS personnel will perform the tasks and subtasks presented in Section 3 and will be responsible for evaluating resultant investigation data, and preparing the SC deliverables specified in the Work Plan. Project direction and oversight will be provided by National Fuel personnel. A listing of project management personnel and their responsibilities is provided below.

Title	Company/ Organization	Name	Phone Number
Project Manager	National Fuel	Tanya B. Alexander, CHMM, REM	716.857.7410
Principal in Charge	ARCADIS	Terry W. Young	315.446.9120
Project Manager	ARCADIS	Scott A. Powlin	315.446.9120
Field Activities Task Manager	ARCADIS	TBD	NA

1.1.2 Analytical Laboratory Services and Subcontractors

Subcontractors for the analytical and drilling work have not yet been selected; however, laboratory subcontractors will be ELAP-approved, and drilling subcontractor will be licensed in New York State.

Title	Company/ Organization	Name	Phone Number
Laboratory Project Manager	TBD	NA	NA
Driller	TBD	NA	NA



1.1.3 Quality Assurance Staff

The QA aspects of the SC will be conducted by ARCADIS. The following personnel have been assigned to this project component:

Title	Company/ Organization	Name	Phone Number
Quality Assurance Manager	ARCADIS	Dennis Capria	315.446.9120
Quality Assurance Officer	TBD	NA	NA

1.2 Team Member Responsibilities

This section of the QASAPP discusses the responsibilities and duties of the project team members.

1.2.1 National Fuel

Project Manager

1. Overall direction of the SC
2. Review of ARCADIS work products

1.2.2 ARCADIS

Principal in Charge

1. Oversight of the ARCADIS SC work products
2. Provide ARCADIS approval for major project deliverables

Project Manager

1. Management and coordination of all aspects of the project as defined in the SC Work Plan with an emphasis on adhering to the project objectives
2. Reviews SC Report and all documents prepared by ARCADIS

3. Assures corrective actions are taken for deficiencies cited during audits of the SC activities

Field Activities Task Manager

1. Oversight of Soil Investigation
2. Oversight of Groundwater Investigation
3. Oversight of field hydrogeologic efforts
4. Oversight of field screening and collection of soil samples
5. Review of field hydrogeologic records and boring logs
6. Oversight of groundwater sampling
7. Oversight of field analysis and collection of QA samples
8. Reduction of field data calibration and maintenance
9. Review of the field instrumentation, maintenance, and calibration to maintain quality data
10. Preparation of draft reports and other key documents
11. Maintenance of field files of notebooks and logs, and calculations
12. Instruction of field staff
13. Coordination of field and laboratory schedules

Field Personnel

1. Perform field procedures associated with the tasks and subtasks presented in 1.3.1 (above)
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 QA/QC activities with task managers, including audits of SC activities, concentrating on field analytical measurements and practices to meet DQOs
4. Review field reports
5. Review audit reports
6. Prepare QA/QC report which 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 ensure 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

Data Validator

1. Provide independent validation of analytical data

File Custodian

1. Responsible for maintaining project file with original and pertinent documentation

Database Administrator

1. Responsible for maintaining project database

Drilling Subcontractor

1. Performance of groundwater monitoring well installations and test borings in accordance with the SC protocols
2. Decontamination of drilling and sampling equipment

2. Project Background

The following summarizes background information for the site. Additional information can be found in the SC Work Plan.

2.1 Site Description and History

2.1.1 Site Description

The approximately 3 acre site is located at 31 West 2nd Street at the southeastern corner of the intersection of Swan Street and West 2nd Street in Dunkirk, Chautauqua County, New York (see Figure 1 of the SC Work Plan). The site comprises a generally rectangular piece of land that is now located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south (see Figure 2 of the SC Work Plan).

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline. The current site structures are shown on Figure 2 of the SC Work Plan.

The site is generally flat-lying and is largely paved with asphalt. A gravel-covered area used for staging gas distribution supplies is found in the southern approximately $\frac{1}{4}$ of the site. Small strips of grass areas are located in the rights-of-way along the perimeter of the site and in the northeast corner of the site. A grassy area also exists on the southern edge of the site, near the railroad.

2.1.2 Site History

The MGP operated from the late 1800s to approximately 1910. National Fuel currently owns the site (NFG, 2008). Based on a review of available Sanborn Fire Insurance Maps from 1888 to 1964, at its peak, the MGP consisted of three gas holders (which

for the purpose of this Work Plan are numbered sequentially from east to west as holder 1 to holder 3), a retort house, a purifier house, a coal shed, and an oil tank. With the exception of holder 3, (the furthest to the west), the plant structures all existed in the northeast corner of the site. The current Service Center Building sits over at least a portion of holder 2, the retort house, the purifier house, and the coal shed. Figure 2 of the SC Work Plan shows the locations of the former MGP structures as they relate to present-day features. Limited information is available regarding gas production at the Dunkirk MGP; however, a review of the publication "Survey of Town Gas and By-Product Production and Locations in the U.S." indicates that approximately 7, 23, and 26 million cubic feet of gas was produced at the MGP in 1890, 1900, and 1910 (Radian Corporation, 1985).

Coal was the primary feedstock for the manufactured gas process at the site (Radian Corporation, 1985). This method of producing gas, known as the coal carbonization method, consisted of heating bituminous coal in a sealed chamber (i.e., retorts), with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned (or purified), and distributed while coke was removed and sold or used. The main byproducts of the coal carbonization method were tars, oils, coke, ammoniacal liquor, ash and clinker, and residuals associated with the gas purification process (purifier wastes). The tars were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from a later gas producing process known as the carbureted water-gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

2.2 SC Objectives

The overall objectives of the SC are to:

- assess whether MGP-related residual materials are present at the site related to the operation of the former MGP.
- determine whether MGP-related residual materials, if present at the site, have a potential to pose a significant threat to public health or the environment.
- determine whether a Remedial Investigation (RI) of the site is appropriate.

The technical approach to address the above objectives is provided in Table 1 of the SC Work Plan.

3. Project Description

This section presents a description of the investigation activities to be conducted during the SC. Sampling activities associated with the SC will be conducted under the following tasks:

- Soil Investigation
- Groundwater Investigation
- Geophysical Survey

Sampling protocols to be followed during the investigation activities are detailed in the FSP. Samples collected during the investigation will be analyzed in accordance with USEPA's SW-846, Test Methods for Evaluating Solid Waste. Table B-2 presents a list of the constituents that will be analyzed for samples collected as part of the SC. Health and Safety protocols to be followed by field personnel during completion of the investigation activities are discussed in the Health and Safety Plan (HASP).

A brief description of the objectives for each task associated with the SC is presented below. A more detailed description can be found in the associated SC Work Plan.

3.1 Soil Investigation

The objectives of the soil investigation are to:

- assess whether MGP-related residual materials are present in subsurface soil in and around former MGP structures.
- preliminarily assess the depths of holders 1 and 2 and the presence/absence of potential MGP-related residual materials within the holders.
- better characterize the nature and distribution of the upper approximately 20 feet of underlying geologic materials.

3.2 Groundwater Investigation

The objectives of the groundwater investigation are to:

- characterize the general shape of the water table, and develop a preliminary assessment of shallow groundwater flow patterns at the site.

- assess the hydraulic characteristics of the materials screened by the wells.
- determine the presence/absence of MGP-related constituents dissolved in groundwater and if present, whether they are at a concentration in excess of NYSDEC Class GA Standards.

3.3 Geophysical Survey

A geophysical survey will be performed using electromagnetic (EM-31) and Ground Penetrating Radar (GPR) surveys in accessible areas of the site and inside the high-bay garage area of the Service Center. The objectives of the geophysical survey are to:

- locate below-grade remnants of former MGP structures (particularly the former holders).
- assess the location of possible underground utilities.
- evaluate the depth to and configuration of the bedrock surface (if the bedrock surface is less than approximately 15 feet below grade).
- fine-tune the locations of soil borings and monitoring wells to be installed during the SC.

The geophysical survey will be the first field task completed during the SC.

4. Quality Objectives and Criteria for Measurement Data

The DQO process, as described in the USEPA QA/G-5 QASAPP instructions document (USEPA, 2002b), is intended to provide a “logical framework” for planning field investigations. The following section addresses, in turn, each of the seven sequential steps in the USEPA QA/G-5 QASAPP DQO process.

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the quality of the data required to support decisions made during site-related activities and are based on the end uses of the data to be collected. Preliminary DQOs were identified to ensure that the data generated during field investigations will be of adequate quality and sufficient quantity to form a sound basis for decision making relative to the above objectives. Data quality objectives have been specified for each data collection activity or investigation. The DQOs presented herein address investigation efforts only and do not cover health and safety issues, which are addressed in detail in the HASP for this project.

Step 1: State the Problem

The SC will be conducted at the site to evaluate the presence and extent of MGP and/or non-MGP constituents of concern at the site. The sampling and analysis program is intended to generate data to initiate a site database that may potentially support further investigations.

Step 2: Identify the Goal of the Study

The initial use of the data is descriptive (distribution and concentration) and there is no decision point for this descriptive application. Subsequent to review of the descriptive information, an exposure evaluation will be performed based on the findings of the site investigation. The decision in this case is to determine if MGP and/or non-MGP constituents of concern are present at the site and to evaluate potential exposure pathways and concentrations if constituents are discovered.

Step 3: Identify Information Inputs

Decision inputs incorporate both concentration and distribution of constituents of concern in site media. A fundamental basis for decision making is that a sufficient number of data points of acceptable quality are available from the investigation to support the decision. Thus, the necessary inputs for the decision are: 1) the proportion

of non-rejected (usable) data points and 2) the quantity of data needed to evaluate whether there are unacceptable risks to human health and the environment at the site.

The data will be evaluated for completeness, general conformance with requirements of this QASAPP and consistency among data sets, and with historical data, as appropriate.

Step 4: Define the Boundaries of the Study

The boundaries of the study area include the site (property owned by National Fuel) which is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad to the south.

Step 5: Develop the Analytical Approach

The decision on whether data can be used in the pre-qualification and post-excavation confirmation evaluation will be based on the validation results. Following validation, the data will be flagged, as appropriate, and any use restrictions noted. The Sampling and Analysis Plan (SAP) has been devised so that the loss of any single data point will not hinder description of the distribution of constituents of concern or the development of a risk assessment. Given this, a reasonable decision rule would be that 90 percent of the data points not be rejected and deemed unusable for exposure evaluation purposes. Applicable actions would be evaluated, if needed, based on the results of the exposure evaluation.

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 QASAPP 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 this QASAPP and in the appended documents. The representative nature of the sampling design has been determined by discussions among professionals familiar with the site and the appropriate government agencies.

Step 7: Develop the Plan for Obtaining Data

The overall QA objective is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting that will provide results to support the evaluation of site data consistent with National Contingency Plan requirements. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, data reporting, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QASAPP.

The SAP involves a phased approach to both sampling and analysis. This provides the opportunity to evaluate and focus each data collection step to optimize the overall data collection process.

A DQO summary for the sampling investigation efforts is presented in the subsequent section. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

A DQO summary for the sampling investigation efforts is presented below. The summary consists of stated DQOs relative to data uses, data types, data quantity, sampling and analytical methods, and data measurement performance criteria.

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 quality assurance. 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% 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, pH, dissolved oxygen, and oxidation-reduction potential) that will be obtained during groundwater 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 “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 ASP Superfund and Category B reporting.

The analytical methods to be used during the SC will be USEPA SW-846 methods with New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP) Revision 2005, QA/QC requirements and Category B reporting deliverables.

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

- Task 1 – Soil Sampling
- Task 2 – Groundwater Sampling

A description of the DQOs for the SC is presented below.

4.1 DQOs for Task 1 – Soil Sampling

As described in the SC Work Plan, numerous soil borings will be drilled to investigate the MGP structures and the nature of the native and fill materials. Numerous surface and subsurface soil samples will be collected and submitted for laboratory analysis for the following:

- Method 8260 for TCL VOCs
- Method 8270 for TCL SVOCs
- Method 9010 or 9012 for cyanide

The number of soil samples that will be collected, including QA/QC samples, is summarized in Table B-1. Table B-2 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

4.2 DQOs for Task 2 – Groundwater Sampling

This task involves the installation of monitoring wells and collecting one round of groundwater samples from the monitoring wells. The resulting groundwater-quality data will be used to determine the presence and level of potentially MGP-related constituents dissolved in groundwater. The number of samples that will be collected, including QA/QC samples, is summarized in Table B-1. Table B-2 presents the parameters to be analyzed under each of the methods described above with the laboratory quantitation limits.

As described in the SC Work Plan, both hydrogeologic and water quality data are required to meet the objective of this task. Hydrogeologic data will consist of water level information and hydraulic conductivity values that will be used to calculate other hydrogeologic parameters. Groundwater quality data will consist of field parameters, including pH, turbidity, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential, as well as the laboratory parameters described below. The rationale for the selection of these parameters is discussed in Table 1 of the SC Work Plan.

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



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Groundwater samples will be analyzed according to the following methods:

- Method 8260 for TCL VOCs
- Method 8270 for TCL SVOCs
- Method 9010 or 9012 for cyanide

5. Special Training Requirements/Certification

Compliant with the Occupational Safety and Health Administration's (OSHA's) final rule, "Hazardous Waste Operations and Emergency Response," 29 CFR§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.

6. Documentation and Records

6.1 General

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

6.2 Field Documentation

Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis, and sample chain-of-custody. This documentation constitutes of 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 (COC) forms will provide the record of responsibility for sample collection, transport, and submittal to the laboratory. COC 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 COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files. A sample COC form is included in Appendix A.

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.

6.3 Laboratory Documentation

6.3.1 Laboratory Project Files

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

6.3.2 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 quality controls. 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 QASAPP. 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.

6.3.3 Computer Tape and Hard Copy Storage

All electronic files will be maintained on magnetic tape or diskette for 5 years; hard copy data packages will be maintained in files for 5 years.

6.4 Data Reporting Requirements

6.4.1 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 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.

6.4.2 Laboratory Data Reporting

The laboratory is responsible for preparing ASP Category B data packages for all VOC, SVOC, and TAL Inorganic (including cyanide and total organic carbon), reduced data packages, and case narratives for all other analyses.

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 COC forms, air bills, and shipping tags.

Analytical Results: Reported according to analysis type and 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 collected 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 TCL VOC, TCL SVOC, and total cyanide 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.

6.5 Project File

Project documentation will be placed in a single project file at the ARCADIS office in Syracuse, New York. This file will consist of the following components:

1. Agreements (file chronologically)
2. Correspondence (filed chronologically)
3. Memos (file chronologically)
4. Notes and Data (filed by topic)



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Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation when received) and field data will be filed with notes and data. Filed materials may be removed and signed out by authorized personnel on a temporary basis only.



7. Sampling Process Design

Information regarding the sampling design and rationale and associated sampling locations can be found in the SC Work Plan.

8. Sampling Method Requirements

Surface and subsurface soil, groundwater, soil vapor, and sediment samples will be collected as described in the SC Work Plan and the FSP. The FSP also contains the procedures that will be followed to collect split-spoon samples; install monitoring wells; measure water levels; install soil vapor points; conduct sediment probing; perform field measurements; and handle, package, and ship collected samples.

9. Sample Handling and Custody Requirements

9.1 Sample Containers and Preservation

Appropriate sample containers, preservation methods, and laboratory holding times for the samples are shown in Table B-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 (OSWER) Directive 9240.05A requirements. The field personnel will be responsible for properly labeling containers and preserving samples (as appropriate).

9.2 Packing, Handling, and Shipping Requirements

Sample packaging and shipment procedures are designed to insure that the samples will arrive at the laboratory, with the COC, intact.

Samples will be packaged for shipment as outlined below:

- Ensure 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 ensure that they are properly sealed.
- Wrap the sample container cap with clear packing tape to prevent it from becoming loose.
- Complete the COC form with the required sampling information and ensure 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 COC prior to this transfer. The appropriate personnel will sign and date the COC 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 COC 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 the 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 COC 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 COC 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.

9.3 Field Custody Procedures

The objective of field sample custody is to assure 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 the 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 COC forms.

9.3.1 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, along 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, along 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.

9.3.2 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

9.3.3 Field Chain-of-Custody Forms

Completed COC forms will be required for all samples to be analyzed. COC forms will be initiated by the sampling crew in the field. The COC 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 COC form will accompany the samples to the laboratory. Copies of the COC will be made prior to shipment (or multiple copy forms used) for field documentation. The COC forms will remain with the samples at all times. The samples and signed COC forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express) 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 co-located 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 co-located. 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.

9.4 Management of Investigation-Derived Materials and Wastes

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

9.5 Laboratory Procedures

9.5.1 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.

9.5.2 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.

9.5.3 Sample Chain-of-Custody and Documentation

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

9.5.4 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 COC 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 quality control 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 ensure 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.

9.5.5 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.

10. Analytical Procedures

10.1 Field Analytical Procedures

Field analytical procedures will include the measurement of dissolved oxygen, pH, turbidity, temperature, oxidation-reduction potential and conductivity, and groundwater levels. Specific field measurement protocols are provided in the FSP.

10.2 Laboratory Analytical Procedures

Laboratory analytical requirements presented in the sub-sections below include a general summary of requirements, specifics related to each sample medium to be analyzed, and details of the methods to be used for this project. SW-846 methods with NYSDEC, ASP, 2005 Revision, QA/QC and reporting deliverables requirements will be used for all analytes.

10.2.1 General

The following tables summarize general analytical requirements:

Table	Title
Table B-1	Environmental and Quality Control Sample Analyses
Table B-2	Parameters, Methods, and Quantitation Limits
Table B-3	Sample Containers, Preservation Methods, and Holding Times Requirements

10.2.2 SC Sample Matrices

10.2.2.1 Surface/Subsurface Soil and Sediments

Analyses in this category will relate to soil and sediments samples. Analyses will be performed following the methods listed in Table B-1. Results will be reported as dry weight, in units presented in Table B-2. Moisture content will be reported separately.

10.2.2.2 Groundwater

Analyses will be performed following the methods listed in Table B-1. Analytical results for all analyses will be reported in units identified in Table B-2.

10.2.2.3 *Soil Vapor*

Analyses will be performed following the methods listed in Table B-1. Analytical results for all analyses will be reported in units identified in Table B-2.

10.2.3 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 quality control procedures including matrix spike, matrix spike duplicates, matrix spike blanks, and surrogate recoveries is provided in NYSDEC, ASP 2005 Revision, Exhibit E.

11. Quality Control Requirements

11.1 Quality Assurance Indicators

The overall quality assurance objective for this QASAPP is to develop and implement procedures for sampling, chain-of-custody, laboratory analysis, instrument calibration, data reduction and reporting, internal quality control, 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 QASAPP. Specific QC checks are discussed in Section 11.2.

Quality assurance 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 QASAPP, as referenced below.

11.1.1 Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability. The SC has been designed to assess the presence of the constituents at the time of sampling. The Work Plan presents the rationale for sample quantities and location. The FSP and this QASAPP 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.

11.1.2 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 QASAPP, 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.

11.1.3 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 11.6.

11.1.4 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 SC Work Plan. Checks for analytical precision will include the analysis of matrix spike duplicates, 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 Section 11.4.

11.1.5 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, matrix spikes, 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 11.4.

11.2 Field Quality Control Checks

11.2.1 Field Measurements

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

11.2.2 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.

11.2.3 Field Duplicates

Field duplicates will be collected for groundwater and source materials/soil samples to check reproducibility of the sampling methods. Field duplicates will be prepared as discussed in the FSP. In general, source material/soil and groundwater sample field duplicates will be analyzed at a 5 percent frequency (every 20 samples). Table B-1 provides an estimated number of field duplicates for each applicable parameter and matrix.

11.2.4 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 one 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 B-1 provides an estimated number of rinse blanks collected during the SC.

11.2.5 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 volatile organic constituents. 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 volatile organic constituents. Table B-1 provides an estimated number of trip blanks collected for each matrix and parameter during the SC.

11.3 Analytical Laboratory Quality Control Checks

Internal quality control procedures are specified in the analytical methods. These specifications include the types of QC checks required (method blanks, reagent/preparation blanks, matrix spike and matrix spike duplicates (MS/MSD), 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.

11.3.1 Method Blanks

Method blanks will serve as a measure of contamination attributable to a variety of sources including glassware, reagents, and instrumentation. The method blank will be initiated at the beginning of an analytical procedure and is carried through the entire process.

11.3.2 Matrix Spike/Matrix Spike Duplicates

The MS will serve as a measure of method accuracy in a given matrix. The MS and the MSD together will serve as a measure of method precision.

11.3.3 Surrogate Spikes

Surrogate spikes are organic compounds that have similar properties to those being tested. They will serve as indicators of method performance and accuracy in organic analyses.

11.3.4 Laboratory Duplicates

Laboratory duplicates will serve to the measure method precision in inorganic and supplemental analyses.

11.3.5 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 13.

11.3.6 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 QC samples after preparation and prior to analysis. If internal standard areas in one or more samples exceed the specified tolerances, then cause will be investigated, the instrument will be recalibrated if necessary, and all affected samples will be reanalyzed.

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

11.3.7 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.

11.4 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 MSD, laboratory duplicate, and field duplicates as identified in Table B-1.

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 matrix spike duplicate and laboratory duplicate analyses are identified in the NYSDEC ASP Revision 2005.

11.5 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 matrix spikes, surrogate spikes, and internal standards. Where available and appropriate, QA performance standards will be analyzed periodically to assess laboratory accuracy. Accuracy will be calculated as a percent recovery as follows:

$$Accuracy = \frac{A-X}{B} \times 100$$

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 matrix spike recoveries and surrogate recovery objectives are identified in the NYSDEC ASP, 2005 Revision.

11.6 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.

12. 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.

12.1 Field Instruments and Equipment

Prior to any field sampling, each piece of field equipment will be inspected to assure it is operational. If the equipment is not operational, it must be serviced prior to use. All meters which 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, and 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.

12.2 Laboratory Instruments and Equipment

12.2.1 General

Only qualified personnel will service instruments and equipment. Repairs, adjustments, and calibrations are documented in the appropriate logbook or data sheet.

12.2.2 Instrument Maintenance

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

The laboratory will maintain a sufficient supply of spare parts for its instruments to minimize downtime. Whenever possible, backup instrumentation will be retained.

Whenever practical, analytical equipment will be maintained under a service contract. The contract allows for preventative system maintenance and repair on an “as-needed” basis. The laboratory has sufficiently trained staff to allow for the day-to-day maintenance of equipment.

12.2.3 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.

13. Instrument Calibration and Frequency

13.1 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.

13.2 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, Semivolatile Organics, Cyanide (total) and Total Organic Carbon (TOC)

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

Total Organic Carbon

Equipment calibration procedures will follow guidelines presented in Lloyd Kahn Method.

14. Inspection/Acceptance Requirements for Supplies and Consumables

The laboratory shall inspect/test all supplies and consumables prior to use with SC samples. Documentation shall be maintained for all associated testing and analyses.

15. Data Acquisition Requirements for Nondirect Measurements

At this point in time, historical data generated by outside parties is not anticipated to be used directly in completing the SC. However, historical data will be used as guidance in determining sampling locations for the SC.

Prior to their use, historic data sets will be reviewed according to the procedures identified in subsequent sections of this QASAPP to determine the appropriate uses of such data. The extent to which these data can be validated will be determined by the analytical level and QC data available. The evaluation of historic data for SC purposes requires the following:

- Identification of analytical levels
- Evaluation of QC data, when available
- Development of conclusions regarding the acceptability of the data for intended uses

Acceptability of historic data for intended uses will be determined by application of these procedures and professional judgment. If the historic data quality cannot be determined, its use will be limited to general trend evaluations.

16. Data Management

The purpose of the data management is to ensure 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

16.1 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 re-sampling 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.

16.2 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.

16.2.1 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 ensure 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.

Field Logs

The personnel performing the field activities will keep field logs that detail all observations and measurements made during the SC. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To ensure 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 ensures 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

COC forms are used as a means of documenting and tracking sample possession from time of collection to the time of disposal. A COC 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 COC procedure. A more thorough description of the COC forms is located in the FSP.

16.2.2 Data Security

Measures will be taken during the field investigation to ensure 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 cabinet. Access to these files will be limited to the field personnel who utilize them.

16.3 Sample Management and Tracking

A record of all field documentation, as well as analytical and QA/QC results, will be maintained to ensure 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 COC forms, as described in Section 9.3.3. On a daily basis, the completed COC forms associated with samples collected that day will be faxed from the project office to the QAM. Copies of all completed COC 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 COCs 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.

16.4 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.

16.4.1 Computer Hardware

If required, the database will be constructed on Pentium[®]-based personal computer work stations connected through a Novell network server. The Novell network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners, modems, etc. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

16.4.2 Computer Software

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

16.4.3 Surveying Information

In general, each location sampled as part of the SC will be surveyed to ensure accurate documentation of sample locations for mapping and GIS purposes (if

appropriate), to facilitate the re-sampling 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. This information will be digitally stored in a data logger attached to the total station. On a weekly basis, each data logger in use will be transferred to the ARCADIS Syracuse Office, where the information will be downloaded into a personal computer for processing with surveying software. Control monuments will be established using GPS 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. On a weekly basis, a copy of the relevant pages will be forwarded to Syracuse, New York, where the relevant information will be manually keyed into ARCADIS' surveying software package for further processing. The surveying software reduces the field notes and calculates a location's elevation relative to the project datum.

Following computation of a location's state plane coordinates and, at select locations, elevations, the computer information will undergo a QA/QC review by a licensed land surveyor. Following the approval of the computed information, the coordinates and elevations will be transferred to the File Custodian both in a digital and a hard copy format.

16.4.4 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 COC form will be placed in the project files. The data packages will be examined to ensure that the correct analyses were performed for each sample submitted and that all of the

analyses requested on the COC 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, the digital files will be used to populate the appropriate database tables. An example of the format of electronic data deliverable (EDD) format is included in Table B-5. This format specifies one data record for each constituent for each sample analyzed. Specific fields include:

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

The individual EDDs, supplied by the laboratory in either an ASCII comma separated value (CSV) format or in a Microsoft Excel 97 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.

16.4.5 Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of the SC 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 SC 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.

16.5 Document Control and Inventory

ARCADIS maintains project files in its Syracuse, New York office. Each client project is assigned a file/job number. Each file is then broken down into the following subfiles:

- #1- Agreements and Contracts - all agreements and contracts involving the off-site investigations
- #2- Correspondence - all external correspondence, including reports

- #3- Memoranda - all internal and external memoranda
- #4- Notes and Data - notes and data from field, laboratory, and internal calculations
- #5- News Clippings - local newspapers, regulatory publications, and technical publications are sources of articles

Originals, when possible, are placed in the files. These are the central files and will serve as the site-specific files for the investigations.

17. Assessment and Response Actions

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

17.1 Field Audits

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

17.1.1 Performance Audits

The Project 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 Quality Assurance Manager will review all field reports and communicate concerns to the ARCADIS Project Manager, as appropriate. In addition, the ARCADIS Quality Assurance Manager will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures.

17.1.2 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 Project Manager will periodically confirm that work is being performed consistent with the SC Work Plan, the FSP, and the HASP.

17.2 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.

17.3 Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QASAPP, 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 for the SC are described below.

17.3.1 Field Procedures

When conducting the SC 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 ARCADIS Project Manager.

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

1. Protocols as defined by this QASAPP, 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.

17.3.2 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 Project 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.

18. Reports to Management

18.1 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 Quality Assurance Manager 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. If required, this report 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

18.2 SC Reporting

Upon sample transport to the laboratory, a copy of the chain-of-custody will be forwarded to National Fuel. Upon receipt of the ASP - Category B Data Package from the laboratory, the ARCADIS Quality Assurance Manager will determine if the data package has met the required data quality objectives. The analytical data package will also be incorporated into the SC Report.

19. Data Review, Validation, and Verification

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

1. Validation of the data
2. Reduction or manipulation of the data mathematically or otherwise into meaningful and useful forms
3. Organization, interpretation, and reporting of the data

19.1 Field Data Reduction, Validation, and Reporting

19.1.1 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 Project Manager for adherence to the 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.

19.1.1.1 Task 1 – Soil Investigation

The specific data reduction activity that will be performed during Task 1 is:

1. Mapping of areas impacted with MGP-related constituents based on findings of the soil-boring program

19.1.1.2 Task 2 – Groundwater Investigation

Reduction of the field data collected during performance of Task 3 will include:

1. Calculation of water elevations by subtracting the depth-to-water data from the surveyed elevation of the measuring point
2. Production of hydrogeologic contour maps by contouring lines of equal water elevations using known elevation points

19.1.2 Field Data Validation

Field data calculations, transfers, and interpretations will be conducted by the field personnel and reviewed for accuracy by the Project Manager and the Quality Assurance Manager. The Project Manager will recalculate at least five percent of all data reductions. Field documentation and data reduction prepared by field personnel will be reviewed by the Project Manager and Quality Assurance Manager. 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

19.1.3 Field Data Reporting

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

19.2 Laboratory Data Reduction, Review, and Reporting

19.2.1 Laboratory Data Reduction

Laboratory analytical data will be directly transferred from the instrument to the computer or the data reporting form (as applicable). Calculation of sample concentrations will be performed using the appropriate regression analysis program, response factors, and dilution factors (where applicable).

19.2.2 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 17. 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.

20. 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 SC 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 validation will also include a review of completeness and compliance, including the elements provided in Table B-4.

ARCADIS will validate all data generated producing a NYSDEC data usability summary report (DUSR) for each individual SDG using the most recent versions of the USEPA's Function Guidelines (USEPA, 1999; 2002) and USEPA Region II SOPs for data validation available at the time of project initiation, where appropriate. These procedures and criteria may be modified as necessary to address project-specific and method-specific criteria, control limits, and procedures. Data validation will consist of data screening, checking, reviewing, editing, and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QASAPP. Any deviations from the analytical method or any special reporting requirements apart from that specified in this QASAPP will be detailed on COC forms.

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of data package.
- Verify that field COC forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Holding time exceedences, should they occur, will be documented. Data for all samples exceeding holding

time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.

- Verify that parameters were analyzed according to the methods specified.
- Review QA/QC data (i.e., make sure duplicates, blanks, and spikes were analyzed on the required number of samples, as specified in the method; verify that duplicate and MS recoveries are acceptable).
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate.
- If data appears suspect, investigate the specific data of concern. Calculations will be traced back to raw data; if calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics as applicable to each method:

- Assessment of the data package
- Description of any protocol deviations
- Failures to reconcile reported and/or raw data
- Assessment of any compromised data
- Overall appraisal of the analytical data
- Table of site name, sample quantities, matrix, and fractions analyzed

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean producing data without quality control qualifiers. Qualified data can provide useful information.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the ARCADIS QAC at this point.

1. Data validation reports will be kept in the project file at the ARCADIS office in Syracuse, New York.

21. 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/non-critical 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

Acronyms

ASTM	American Society for Testing and Material
ARCADIS	ARCADIS
ASP	Analytical Services Protocol
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CSV	Comma Separated Value
DUP	Duplicate
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable GC Gas Chromatography
FSP	Field Sampling Plan
GC/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
mg/kg	Milligram per kilogram
mg/L	Milligrams per liter
mS/cm	Millisiemens per centimeter
MS	Matrix Spike
MSD	Matrix Spike Duplicate

NEIC	National Enforcement Investigations Center
ng	Nanogram
NIST	National Institute of Science and Technology
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PNP	Paranitrophenol
PPE	Personal Protective Equipment
ppb	Parts per billion
ppm	Parts per million
QAM	Quality Assurance Manager
QASAPP	Quality Assurance Sampling and Analysis Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation Recovery Act
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SC	Site Characterization
SDG	Sample Delivery Group
SOP	Standard Operating Procedures



Appendix B
Quality Assurance
Sampling and
Analysis Project Plan
Dunkirk Former MGP Site
Dunkirk, New York

SU	Standard Units
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency

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**Appendix B
Quality Assurance Sampling
and Analysis Project Plan**

TABLES

Table B-1. Environmental and Quality Control Analyses, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Environmental Sample Matrix/ Laboratory Parameters	Estimated Environmental Sample Quantity	Field QC Analyses							Laboratory QC Analyses ^{1,2}						Estimated Overall Total
		Trip Blank		Field Duplicate		Rinse Blank ³		Est. Matrix Total	MS		MSD		Lab Duplicate		
		Freq	No.	Freq	No.	Freq	No.		Freq	No.	Freq	No.	Freq	No.	
Soils															
Volatile Organics Method 8260	10	1/day	4	1/20	1	1/20	1	16	1/20	1	1/20	1	--	--	18
Semivolatile Organics Method 8270	10	--	--	1/20	1	1/20	1	12	1/20	1	1/20	1	--	--	14
Total Cyanide Method 9012	10	--	--	1/20	1	1/20	1	12	1/20	1	--	--	1/20	1	14
Groundwater															
Volatile Organics Method 8260	4	1/day	1	1/20	1	--	--	6	1/20	1	1/20	1	--	--	8
Semivolatile Organics Method 8270	4	--	--	1/20	1	--	--	5	1/20	1	1/20	1	--	--	7
Cyanide (total) Method 9012	4	--	--	1/20	1	--	--	5	1/20	1	--	--	1/20	1	7

Notes:

¹ The number of laboratory QC analyses is based on the frequencies given for the number of environmental samples estimated, not including field QC analyses (i.e., rinse and trip blanks).

² Laboratory QC analyses are listed only for those parameters that must be performed on site samples. The laboratory is required to analyze QC samples for the remaining parameters at the frequency listed in the associated analytical method.

³ Rinse blank samples will be collected only when non-dedicated sampling devices are used. Rinse blanks will be collected at a frequency of one per day of use or one per 20 samples, whichever is less.

MS = Matrix spike.

MSB = Matrix spike blank.

MSD = Matrix spike duplicate.

Table B-2. Method Reporting Limits and Action Limits, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Analyte	Water (ug/L)		Soil (ug/kg)		
	Laboratory MDL	Laboratory RL	Laboratory MDL	Laboratory Low Level RL	Laboratory Medium RL
Volatile Organic Compounds 8260 ¹					
1,1,1,2-Tetrachloroethane	0.35	1.0	0.31	5	500
1,1,1-Trichloroethane	0.26	1.0	0.36	5	500
1,1,2,2-Tetrachloroethane	0.48	1.0	0.33	5	500
1,1,2-Trichloroethane	0.42	1.0	0.25	5	500
1,1-Dichloroethane	0.27	1.0	0.58	5	500
1,1-Dichloroethene	0.29	1.0	0.61	5	500
1,2-Dichloroethane	0.46	1.0	0.25	5	500
1,2,3-Trichloropropane	0.32	1.0	0.51	5	500
1,2-Dibromo-3-chloropropane (DBCP)	0.47	1.0	0.37	5	500
1,2-Dibromoethane (EDB)	0.42	1.0	0.19	5	500
1,2-Dichlorobenzene	0.4	1.0	0.32	5	500
1,2-Dichloropropane	0.33	1.0	0.26	5	500
1,3-Dichlorobenzene	0.33	1.0	0.3	5	500
1,4-Dichlorobenzene	0.37	1.0	0.23	5	500
2-Butanone (MEK)	1.3	5.0	0.81	25	500
2-Chloroethyl vinyl ether	0.96	1.0	6.25	5	500
2-Hexanone	1.3	5.0	6.3	25	500
4-Methyl-2-pentanone (MIBK)	1.3	5.0	6.3	25	500
Acetone	1.3	5.0	1.1	5	500
Acrylonitrile	1.39	5	25	200	500
Benzene	0.35	1.0	0.55	5	500
Bromochloromethane	0.4	1.0	0.36	5	500
Bromoform	0.26	1.0	0.46	5	500
Bromomethane	0.28	1.0	0.46	5	500
Carbon Disulfide	0.23	1.0	0.43	5	500
Carbon Tetrachloride	0.27	1.0	0.68	5	500
Chlorobenzene	0.32	1.0	0.51	5	500
Chloroethane	0.32	1.0	0.36	5	500
Chloroform	0.34	1.0	0.31	5	500
cis-1,2-Dichloroethene	0.22	1.0	0.25	5	500
cis-1,3-Dichloropropene	0.32	1.0	0.29	5	500
Dibromochloromethane	0.34	1.0	0.28	5	500
Dichlorobromomethane	0.39	1.0	0.26	5	500
Ethylbenzene	0.45	1.0	0.35	5	500
Iodomethane	0.27	1.0	0.61	5	500
Methyl Chloride	0.35	1.0	0.3	5	500
Methylene Chloride	0.44	1.0	2.2	5	500
Styrene	0.31	1.0	0.25	5	500
Tetrachloroethene	0.36	1.0	0.3	5	500
Toluene	0.51	1.0	0.85	5	500
Total Xylenes	0.93	1.0	2.9	15	500
trans-1,2-Dichloroethene	0.33	1.0	0.52	5	500
trans-1,3-Dichloropropene	0.37	1.0	0.64	5	500
trans-1,4-Dichloro-2-butene	2.12	5	0.36	5	500
Trichloroethene	0.32	1.0	0.35	5	500
Trichlorofluoromethane	0.15	1.0	0.55	5	500
Vinyl Acetate	1.29	5	0.36	5	500
Vinyl Chloride	0.24	1.0	0.2	10	500
Semivolatile Organic Compounds 8270 ¹					
1,2,4-Trichlorobenzene	0.11	10	4.83	330	330
1,2-Dichlorobenzene	0.14	10	3.23	330	330
1,3-Dichlorobenzene	0.14	10	3.02	330	330
1,4-Dichlorobenzene	0.16	10	2.22	330	330
2,4,5-Trichlorophenol	0.99	10	37	330	330
2,4,6-Trichlorophenol	0.99	10	11	330	330
2,4-Dichlorophenol	0.79	10	8.8	330	330
2,4-Dimethylphenol	0.96	10	46	330	330
2,4-Dinitrophenol	2.2	10	59	830	800
2,4-Dinitrotoluene	0.45	10	26	330	330
2,6-Dinitrotoluene	0.51	10	41	330	330
2-Chloronaphthalene	0.08	10	11	330	330
2-Chlorophenol	0.51	10	8.6	330	330
2-Methylnaphthalene	0.08	10	2	330	330
2-Methylphenol	0.23	10	5.1	330	330
2-Nitroaniline	0.5	10	54	830	800
2-Nitrophenol	0.6	10	7.7	330	330
3,3'-Dichlorobenzidine	0.37	10	148	330	600

See Notes on Page 2.

Table B-2. Method Reporting Limits and Action Limits, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Analyte	Water (ug/L)		Soil (ug/kg)		
	Laboratory MDL	Laboratory RL	Laboratory MDL	Laboratory Low Level RL	Laboratory Medium RL
Semivolatile Organic Compounds 8270¹ (Cont'd.)					
3-Nitroaniline	1.5	10	39	830	800
4-Bromophenyl-phenylether	0.9	10	54	330	330
4-Chloro-3-Methylphenol	0.6	10	6.9	330	330
4-Chloroaniline	0.33	10	50	330	330
4-Chlorophenyl-phenylether	0.17	10	3.6	330	330
4,6-Dinitro-2-methylphenol	0.23	10	58	830	800
4-Methylphenol	0.35	10	9.4	330	330
4-Nitroaniline	0.46	10	19	830	800
4-Nitrophenol	1.5	10	41	830	800
Acenaphthene	0.11	10	2	330	330
Acenaphthylene	0.05	10	1.4	330	330
Anthracene	0.06	10	4.3	330	330
Benzo(a)anthracene	0.06	10	2.9	330	330
Benzo(b)fluoranthene	0.06	10	3.3	330	330
Benzo(k)fluoranthene	0.07	10	1.9	330	330
Benzo (g,h,i,) Perylene	0.08	10	2	330	330
Benzo(a)pyrene	0.09	10	4.1	330	330
Benzyl alcohol	0.29	10	8.06	330	330
bis(2-Chloroethoxy)methane	0.38	10	9.2	330	330
bis(2-chloroethyl)ether	0.18	10	15	330	330
bis(2-chloroisopropyl)ether	0.42	10	17.6	330	330
bis(2-Ethylhexyl) phthalate	4.8	10	54	330	330
Butyl benzyl phthalate	1.7	10	45	330	330
Chrysene	0.27	10	1.7	330	330
Di-n-butyl phthalate	0.3	10	58	330	330
Di-n-octyl phthalate	0.24	10	3.9	330	330
Dibenzo(a,h)anthracene	0.2	10	2	330	330
Dibenzofuran	0.1	10	1.8	330	330
Diethyl phthalate	0.11	10	5.1	330	330
Dimethylphthalate	0.3	10	4.4	330	330
Fluoranthene	0.1	10	2.4	330	330
Fluorene	0.07	10	2.4	330	330
Hexachlorobenzene	0.44	10	8.4	330	330
Hexachlorobutadiene	2.6	10	8.6	330	330
Hexachlorocyclopentadiene	2.5	10	51	330	330
Hexachloroethane	2.8	10	13	330	330
Indeno(1,2,3-cd)pyrene	0.15	10	4.7	330	330
Isophorone	0.32	10	8.4	330	330
N-Nitrosodimethylamine	1	10	12	330	330
N-Nitroso-di-n-propylamine	0.45	10	13	330	330
N-Nitrosodiphenylamine	0.26	10	9.2	330	330
Naphthalene	0.12	10	2.8	330	330
Nitrobenzene	0.54	10	7.5	330	330
Pentachlorophenol	5.1	10	58	830	800
Phenanthrene	0.11	10	3.5	330	330
Phenol	0.45	10	18	330	330
Pyrene	0.07	10	1.1	330	330
Inorganics - 9010B/9012A¹					
Cyanide	5	10	870	1000	1000

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. The reporting limits listed are the Maximum Concentration of Contaminants for the Toxicity Characteristic (Fed. Reg.).

Table B-3. Sample Containers, Preservation, and Holding Time Requirements, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Parameter	Container	Preservation	Maximum Holding Time from VTSR
Groundwater Samples			
Volatile Organics	(2) 40-ml Teflon-lined septa (glass)	Cool 4°C HCl to pH <2	5 days (unpreserved) 12 days (preserved)
Semivolatile Organics	(2) 1-liter containers (glass)	Cool 4°C	5 days extraction; 40 days analysis
Cyanide	(1) 500-ml container (plastic)	Cool 4°C NaOH to pH >12	12 days
Soil Samples			
Volatile Organics	(1) 4-oz container (glass)	Cool 4°C	12 days
Semivolatile Organics	(1) 4-oz container (glass)	Cool 4°C	5 days extraction; 40 days analysis
Cyanide	(1) 4-oz container (glass)	Cool 4°C	12 days

Notes:

VTSR = Verifiable time of sample receipt. Samples must be delivered to laboratory within 48 hours from day of collection.

Table B-4. Data Validation Checklist - Laboratory Analytical Data, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

REVIEW FOR COMPLETENESS
1. Chain-of-custody forms included.
2. Sample preparation and analysis summary tables included.
3. QA/QC summaries of analytical data included.
4. Relevant calibration data included with analytical data.
5. Instrument and method performance data included.
6. Method detection limits documented.
7. Data report forms of examples for calculations of concentrations.
8. Raw data used in identification and quantification of the analysis required.
REVIEW OF COMPLIANCE
1. Data package completed.
2. QAPP requirements for data met.
3. QA/QC criteria met.
4. Instrument type and calibration procedures met.
5. Initial and continuing calibration met.
6. Data reporting forms completed.
7. Problems and corrective actions documented.

Table B-5. Electronic Data Deliverable (EDD) Format, Site Characterization, Dunkirk Former MGP Site, Dunkirk, New York

Field Name	Maximum Length	Data Type	Comments
FIELD SAMPLE ID	50	TEXT	From the chain of custody. Add "RE" or "DL" to differentiate reanalyses and dilutions.
SDG	50	TEXT	
LAB SAMPLE ID	50	TEXT	
MATRIX	10	TEXT	SOIL, WATER, etc.
SAMPLE TYPE	10	TEXT	FB, RB, TB, FD, FS for Field Blank, Rinse Blank, Trip Blank, Field Duplicate and Field Sample, respectively. DEFAULT TO FS
DATE COLLECTED	--	DATE/TIME	MM/DD/YY
TIME COLLECTED*	--	DATE/TIME	Military time
DEPTH START	--	NUMBER	
DEPTH END	--	NUMBER	
DEPTH UNITS	25	TEXT	FEET, INCHES, METERS, etc.
ANALYTICAL METHOD	50	TEXT	
CAS NUMBER	25	TEXT	
ANALYTE	100	TEXT	
RESULT VALUE	--	NUMBER	For non-detected results, enter Reporting Limit ("U" must be present in Lab Qualifier field).
LAB QUALIFIER	10	TEXT	"U" for non-detected, others as defined by laboratory.
REPORTING LIMIT	--	NUMBER	
RESULT UNIT	25	TEXT	
DILUTION FACTOR	--	NUMBER	
REPORTABLE RESULT	--	YES/NO	DEFAULT TO YES
FILTERED?	--	YES/NO	
DATE ANALYZED	--	DATE/TIME	MM/DD/YY
TIME ANALYZED*	--	DATE/TIME	Military time
DATE EXTRACTED*	--	DATE/TIME	MM/DD/YY
LABORATORY NAME*	50	TEXT	

Notes:

1. This definition is for an "Excel-type" spreadsheet. Fields flagged with an "*" are optional and may be left blank if not available electronically from the laboratory.
2. Depth-related fields may be left blank for samples and matrices for which they are not applicable.



Attachment 4

Health and Safety Plan

National Fuel Gas Distribution Corporation

Appendix C
Health and Safety Plan

Dunkirk Former Manufactured Gas Plant Site
(Site No. 9-07-035)
Dunkirk, New York

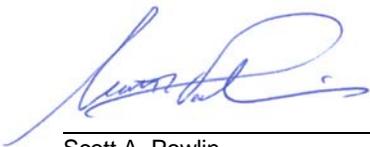
February 2009



Terry W. Young, P.E.
Principal-In-Charge

**Appendix C
Health and Safety Plan**

Dunkirk Former Manufactured
Gas Plant Site
Dunkirk, New York



Scott A. Powlin
Project Manager

Prepared for:
National Fuel Gas Distribution Corporation



Charles Webster
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Our Ref.:
B0023301.0000.00001

Date:
February 2009

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Attachments

- A Material Safety Data Sheets
- B Incident/Near Miss Investigation Form
- C Loss Prevention Observation Form
- D Health and Safety Inspection Form
- E Safety Meeting Log
- F Air Monitoring Log
- G Underground/Overhead Utilities Checklist

Approvals and Acknowledgments

Approvals

I have read and approved this Health and Safety Plan (HASP) with respect to project hazards, regulatory requirements, and ARCADIS procedures.

Project Name: National Fuel Gas Distribution Corporation, Dunkirk Former
Manufactured Gas Plant Site – Dunkirk, New York

Project Number: B0023301.0000.00001

Project Manager/Date

Health and Safety Officer/Date

Health and Safety Supervisor/Date

Acknowledgments

The final approved version of this HASP has been provided to the Site Supervisor. I acknowledge my responsibility to provide the Site Supervisor with the equipment, materials and qualified personnel to implement fully all safety requirements in this HASP. I will formally review this plan with the Health and Safety Staff every six months until project completion.

Project Manager/Date

I acknowledge receipt of this HASP from the Project Manager, and that it is my responsibility to explain its contents to all site personnel and cause these requirements to be fully implemented. Any change in conditions, scope of work, or other change that might affect worker safety requires me to notify the Project Manager and/or the Health and Safety Officer.

Site Supervisor/Date

1. Introduction

1.1 Objective

The objective of site activities is to conduct a Site Characterization (SC) at the Dunkirk Former Manufactured Gas Plant (MGP) Site (the site), in Dunkirk, New York in accordance with the approach outlined in the SC Work Plan. Field activities are expected to include the following general tasks:

- Mobilization
- Soil boring installations
- Monitoring well installations
- Collection of soil samples during the advancement of the monitoring wells and soil borings
- Collection of groundwater samples
- Measurement of fluid levels
- Geophysical Survey
- Survey
- Decontamination
- Demobilization

The objective of this Health and Safety Plan (HASP) is to provide a mechanism for establishing safe working conditions at the site. The safety organization, procedures, and protective equipment have been established based on an analysis of potential physical, chemical, and biological hazards. Specific hazard control methodologies have been evaluated and selected to minimize the potential of injury, illness, or other hazardous incident.

The HASP should be used in conjunction with the SC Work Plan, the Field Sampling Plan (FSP), and the Quality Assurance/Sampling and Analysis Project Plan (QA/SAPP). The SC Work Plan presents the site background and defines the field sampling program. The FSP contains field procedures and sample collection methods to be used during implementation of the SC Work Plan. The QA/SAPP presents the quality assurance/quality control (QA/QC) procedures to be used during implementation of the SC Work Plan, as well as a description of the general field and laboratory procedures. The FSP and QA/SAPP are provided in Appendix A and Appendix B, respectively, of the SC Work Plan.

1.2 Site Description and History

1.2.1 Site Description

The approximately 3 acre site is located at 31 West 2nd Street at the southeastern corner of the intersection of Swan Street and West 2nd Street in Dunkirk, Chautauqua County, New York (see Figure 1 of the SC Work Plan). The site comprises a generally rectangular piece of land that is now located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2nd Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south (see Figure 2 of the SC Work Plan).

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline. The current site structures are shown on Figure 2 of the SC Work Plan.

The site is generally flat-lying and is largely paved with asphalt. A gravel-covered area used for staging gas distribution supplies is found in the southern approximately $\frac{1}{4}$ of the site. Small strips of grass areas are located in the rights-of-way along the perimeter of the site and in the northeast corner of the site. A grassy area also exists on the southern edge of the site, near the railroad.

1.2.2 Site History

The MGP operated from the late 1800s to approximately 1910. National Fuel currently owns the site (NFG, 2008). Based on a review of available Sanborn Fire Insurance Maps from 1888 to 1964, at its peak, the MGP consisted of three gas holders (which for the purpose of this Work Plan are numbered sequentially from east to west as holder 1 to holder 3), a retort house, a purifier house, a coal shed, and an oil tank. With the exception of holder 3, (the furthest to the west), the plant structures all existed in the northeast corner of the site. The current Service Center Building sits over at least a portion of holder 2, the retort house, the purifier house, and the coal shed. Figure 2 of the SC Work Plan shows the locations of the former MGP structures as they relate to

present-day features. Limited information is available regarding gas production at the Dunkirk MGP; however, a review of the publication "Survey of Town Gas and By-Product Production and Locations in the U.S." indicates that approximately 7, 23, and 26 million cubic feet of gas was produced at the MGP in 1890, 1900, and 1910 (Radian Corporation, 1985).

Coal was the primary feedstock for the manufactured gas process at the site (Radian Corporation, 1985). This method of producing gas, known as the coal carbonization method, consisted of heating bituminous coal in a sealed chamber (i.e., retorts), with destructive distillation of gas from the coal and the formation of coke. The gases were collected, cleaned (or purified), and distributed while coke was removed and sold or used. The main byproducts of the coal carbonization method were tars, oils, coke, ammoniacal liquor, ash and clinker, and residuals associated with the gas purification process (purifier wastes). The tars were generally viscous and contained higher concentrations of phenols and base nitrogen organics when compared to the tars generated from a later gas producing process known as the carbureted water-gas process. Coal carbonization also produced cyanide in the gas, which was removed during gas purification and often appears in wastes such as lime and wood chips.

1.3 Policy Statement

The policy of ARCADIS is to provide a safe and healthful work environment. No aspect of operations is of greater importance than injury and illness prevention. A fundamental principle of safety management is that all injuries, illnesses, and incidents are preventable. ARCADIS will take every reasonable step to eliminate or control hazards in order to minimize the possibility of injury, illness, or incident.

This HASP prescribes the procedures that must be followed during activities at the site. Operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and the Health and Safety Officer (HSO) or his designee. This document will be reviewed periodically to ensure that it is current and technically correct. Any changes in site conditions and/or the scope of work will require a review and modification to this HASP. Such changes will be completed in the form of an addendum or a revision to the plan.

The provisions of this plan are mandatory for all ARCADIS personnel and ARCADIS subcontractors assigned to the project. Subcontractors may prepare their own site-specific HASPs that must meet the basic requirements of this HASP. All visitors to ARCADIS work areas at the site must abide by the requirements of this plan.

1.4 References

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, United States Environmental Protection Agency (USEPA) regulations, and ARCADIS health and safety policies and procedures. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guides*, USEPA (Publication 9285.1-03, June 1992).
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, National Institute for Occupational Safety and Health (NIOSH), OSHA, United States Coast Guard (USCG), USEPA (86116, October 1985).
- *Title 29 of the Code of Federal Regulations (CFR)*, Part 1910.
- *Title 29 of the CFR*, Part 1926.
- *Pocket Guide to Chemical Hazards*, Department of Health and Human Services (DHHS), Public Health Service (PHS), Center for Disease Control and Prevention (CDC), NIOSH (2005).
- *Threshold Limit Values*, American Conference of Governmental Industrial Hygienists (ACGIH) (2007).
- *Guide to Occupational Exposure Values*, ACGIH (2007).
- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 2nd Ed. (1993).
- *Health and Safety Manual*, ARCADIS.

1.5 Definitions

The following definitions (listed alphabetically) are applicable to this HASP:

- *Contamination Reduction Zone (CRZ)* - Area between the exclusion zone and support zone that provides a transition between contaminated and clean areas. Decontamination stations are located in this zone.

- *Exclusion Zone (EZ)* - Any portions of the site where hazardous substances are, or are reasonably suspected to be present, and pose an exposure hazard to onsite personnel.
- *Incident* - All losses, including first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions.
- *Near Miss* - An incident in which no injury, illness, motor vehicle accident, equipment or property damage, etc., occurred, but under slightly different circumstances, could have occurred.
- *Onsite Personnel* - All ARCADIS and subcontractor personnel involved with the project.
- *Project* - All onsite work performed under the scope of work.
- *Site* - The area described in Section 1.2, Site and Facility Description, where the work is to be performed by ARCADIS personnel and subcontractors.
- *Subcontractor* - Includes contractor personnel hired by ARCADIS.
- *Support Zone (SZ)* - All areas of the site, except the EZ and CRZ; the SZ surrounds the CRZ and EZ. Support equipment and break areas are located in this zone.
- *Visitor* - All other personnel, except the onsite personnel.
- *Work Area* - The portion of the site where work activities are actively being performed. This area may change daily as work progresses and includes the SZ, CRZ, and EZ. If the work area is located in an area on the site that is not contaminated, or suspected of being contaminated, the entire work area may be a SZ.

1.6 Acronyms

The following acronyms (listed alphabetically) are applicable to this HASP:

- *ACGIH* – American Conference of Governmental Industrial Hygienists
- *ANSI* – American National Standards Institute
- *BTEX* – Benzene, Toluene, Ethylbenzene, Xylene

- *CPR* – Cardiopulmonary Resuscitation
- *COC* – Constituent(s) of Concern
- *CRZ* – Contamination Reduction Zone
- *EMS* – Emergency Management System
- *EZ* – Exclusion Zone
- *GFCI* – Ground Fault Circuit Interrupter
- *HASP* – Health and Safety Plan
- *HSM* – Health and Safety Manager
- *HSO* – Health and Safety Officer
- *HSS* – Health and Safety Supervisor
- *II* – Incident Investigation
- *JSA* – Job Safety Analysis
- *LEL* – Lower Explosive Limit
- *LPS* – Loss Prevention System
- *LPO* – Loss Prevention Observation
- *MGP* – Manufactured Gas Plant
- *MSDS* – Material Safety Data Sheet
- *NIOSH* – National Institute for Occupational Safety and Health
- *NRR* – Noise Reduction Rating
- *NYSDEC* – New York State Department of Environmental Conservation
- *NYSDOH* – New York State Department of Health
- *OSHA* – Occupational Safety and Health Administration
- *PAH* – Polycyclic Aromatic Hydrocarbons
- *PEL* – Permissible Exposure Limit
- *PFD* – Personal Floatation Device
- *PIC* – Principal in Charge
- *PID* – Photoionization Detector
- *PM* – Project Manager
- *PO* – Project Officer
- *PPE* – Personal Protective Equipment
- *SPSA* – Safe Performance Self-Assessment
- *SC* – Site Characterization
- *SS* – Site Supervisor
- *SZ* – Support Zone
- *TLV* – Threshold Limit Value
- *USCG* – United States Coast Guard
- *USEPA* – United States Environmental Protection Agency
- *VOC* – Volatile Organic Compound

2. Roles and Responsibilities

2.1 All Personnel

All ARCADIS and subcontractor personnel must adhere to the procedures outlined in this HASP during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner that conflicts with these procedures. After due warnings, the PM will dismiss from the site any person or subcontractor who violates safety procedures.

All ARCADIS and subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all personnel will attend an initial hazard briefing prior to beginning work at the site.

The roles of ARCADIS personnel and subcontractors are outlined in the following sections. Key project personnel and contacts are summarized in Table 2-1.

2.2 ARCADIS Personnel

2.2.1 Project Officer (PO)/Principal in Charge (PIC)

The PO or PIC is responsible for providing resources to assure project activities are completed in accordance with this HASP, and for meeting all regulatory and contractual requirements.

2.2.2 Health and Safety Officer

The HSO or his designee (the Health and Safety Manager (HSM)) has overall responsibility for the technical health and safety aspects of the project, including review and approval of this HASP. Inquiries regarding ARCADIS health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSO or his designee must approve changes or addenda to this HASP.

2.2.3 Project Manager

The PM is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The PM is responsible for confirming that the Site Supervisor (SS) has the equipment, materials, and qualified personnel to fully

implement the safety requirements of this HASP, and/or that subcontractors assigned to this project meet the requirements established by ARCADIS. It is also the responsibility of the PM to:

- Consult with the HSO/ HSM on site health and safety issues.
- Verify that subcontractors meet health and safety requirements prior to commencing work.
- Review Loss Prevention Observation (LPO) forms.
- Verify that all incidents are thoroughly investigated.
- Approve, in writing, addenda or modifications of this HASP.
- Suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.2.4 Health and Safety Supervisor (HSS)

The HSS is responsible for field health and safety issues, including the execution of this HASP. Questions in the field regarding health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSS will advise the PM on health and safety issues, and will establish and coordinate the project air monitoring program if one is deemed necessary (see Section 6.1, Air Monitoring). The HSS is the primary site contact on health and safety matters. It is the responsibility of the HSS to:

- Provide onsite technical assistance, if necessary.
- Participate in all incident investigations (IIs) and ensure that they are reported to the HSM/HSO, PIC, National Fuel Gas Distribution Corporation (National Fuel) and PM within 24 hours.
- Coordinate site and personal air monitoring as required, including equipment maintenance and calibration.
- Conduct site safety orientation training and safety meetings.
- Verify that ARCADIS personnel and subcontractors have received the required physical examinations and medical certifications.

- Review site activities with respect to compliance with this HASP.
- Maintain required health and safety documents and records.
- Assist the SS in instructing field personnel on project hazards and protective procedures.
- Review LPO forms.

2.2.5 Site Supervisor

The SS is responsible for implementing this HASP, including communicating requirements to onsite personnel and subcontractors. The SS will be responsible for informing the PM of changes in the work plan, procedures, or site conditions so that those changes may be addressed in this HASP. Other responsibilities are to:

- Consult with the HSS on site health and safety issues.
- Conduct LPOs at the site, and complete the LPO forms.
- Stop work, as necessary, for personal safety, protection of property, and regulatory compliance.
- Obtain a site map and determine and post routes to medical facilities and emergency telephone numbers.
- Notify local public emergency representatives (as appropriate) of the nature of the site operations, and post their telephone numbers (i.e., local fire department personnel who would respond for a confined space rescue).
- Observe onsite project personnel for signs of ill health effects.
- Investigate and report any incidents to the HSS.
- Verify that all onsite personnel have had applicable training.
- Verify that onsite personnel are informed of the physical, chemical, and biological hazards associated with the site activities, and the procedures and protective equipment necessary to control the hazards.
- Issue/obtain any required work permits (hot work, confined space, etc.).

For this SC project, the HSS and SS duties may be performed by the same person for some of the work activities and tasks (e.g. soil boring and monitoring well installations where subcontractors are working onsite).

2.3 Subcontractors

Subcontractors and their personnel must understand and comply with applicable regulations and site requirements established in this HASP. Subcontractors may prepare their own site-specific HASP that must be consistent with the requirements of this HASP.

All subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. All subcontractor personnel will attend an initial hazard briefing prior to beginning work at the site. Additionally, onsite subcontractor personnel must attend and participate in the daily site safety meetings.

Subcontractors must designate individuals to function as the PM, HSO, HSS, and SS. In some firms, it is not uncommon for the duties of the HSO to be carried out by the PM. This is acceptable provided the PM has the required knowledge, training, and experience to properly address all hazards associated with the work, and to prepare, approve, and oversee the execution of the site-specific HASP. A subcontractor may designate the same person to perform the duties of both the HSS and the SS. However, depending on the level of complexity of a contractor's scope of work, it may be infeasible for one person to perform both functions satisfactorily.

2.4 All Onsite Personnel

All onsite personnel (including subcontractors) must read and acknowledge their understanding of this HASP before commencing work, and abide by the requirements of the plan. All onsite personnel shall sign the HASP Acknowledgement Form following their review of this HASP.

All ARCADIS and subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all onsite personnel will attend an initial hazard briefing prior to beginning work at the site and the daily safety meetings.

All onsite personnel must perform a Safe Performance Self-Assessment (SPSA) prior to beginning each work activity. The SPSA process is presented in Section 4.2.1. This

process must be performed prior to beginning each activity, and must be performed after any near miss or other incident in order to determine if it is safe to proceed. Onsite personnel will immediately report the following to the SS or HSS:

- Personal injuries and illnesses no matter how minor
- Unexpected or uncontrolled release of chemical substances
- Symptoms of chemical exposure
- Unsafe or hazardous situations
- Unsafe or malfunctioning equipment
- Changes in site conditions that may affect the health and safety of project personnel
- Damage to equipment or property
- Situations or activities for which they are not properly trained
- Near misses

2.5 Visitors

All visitors to ARCADIS work areas must check in with the SS. Visitors will be cautioned to avoid skin contact with surfaces, soils, groundwater, or other materials that may impacted or be suspected to be impacted by constituents of concern (COC).

Visitors requesting to observe work at the site must don appropriate personal protective equipment (PPE) prior to entry to the work area and must have the appropriate training and medical clearances to do so. If respiratory protective devices are necessary, visitors who wish to enter the work area must have been respirator-trained and fit tested for a respirator within the past 12 months.

Table 2-1. Key Personnel

ARCADIS Personnel		
Role	Name	Address/Telephone No.
Principal in Charge	Terry W. Young	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 315.446.9120
Project Manager	Scott A. Powlin, P.G.	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 315.446.9120
Health and Safety Officer	Jay D. Keough, CIH	8 South River Road Cranbury, NJ 08512 609.860.0590
Health and Safety Manager	Charles Webster	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 315.446.9120

ARCADIS Personnel		
Role	Name	Address/Telephone No.
Site Supervisor	TBD	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 315.446.9120
Health and Safety Supervisor	TBD	6723 Towpath Rd., P.O. Box 66 Syracuse, NY 13214-0066 315.446.9120
Subcontractors		
Company/Role	Name	Address/Telephone No.
TBD - Driller	TBD	TBD
Central Hudson Gas & Electric Personnel		
Role	Name	Address/Telephone No.
National Fuel Project Manager	Tanya B. Alexander, CHMM, REM	6363 Main Street Williamsville, NY 14221 716.857-7410
Agency Personnel		
Agency/Role	Name	Address/Telephone No.
New York State Department of Environmental Conservation (NYSDEC) Project Manager	William S. Ottaway	Division of Environmental Remediation NYSDEC 625 Broadway Albany, NY 12233 (518) 402-9686

2.6 Stop Work Authority

Every ARCADIS employee and ARCADIS subcontractor has the authority and the responsibility to stop the work of another co-worker if the working conditions or behaviors are considered unsafe, and is expected to do so.

2.7 Short-Service Employee (SSE) Program

Recognizing that inexperienced employees are at a greater risk for incidents, the following guidelines are established to identify those employees and ease their transition.

- ARCADIS employees new to the industry and new to ARCADIS will be identified in the field by wearing an orange hardhat/ballcap for 6 months.
- ARCADIS employees experienced in the industry, but new to ARCADIS will wear the orange hardhat/ballcap for 3 months.

The following guidelines apply:

- A crew of two to three may have one SSE onsite.
- A crew of five may have two SSEs onsite.
- A crew of ten may have no more than four SSEs onsite.

2.8 Near-Miss Reporting Hotline

To streamline near-miss reporting, especially for employees conducting field work who do not have real-time access to the web, ARCADIS has established a toll-free Near-Miss Reporting Hotline. The hotline will be checked daily and data will be entered into the ARCADIS LPS Database, with the caller listed as the primary contact for the event. All entries will be saved as initial and can be accessed by the caller when they return to their computers. Entry into the database does not relieve the caller from the responsibility of following through with the near-miss investigation, or of notifying other employees in the office or project team of the occurrence.

THE NEAR-MISS REPORTING NUMBER IS 1-866-242-4304.

Callers will be prompted to provide the following information:

- Name and phone number
- Date of near miss
- Location
- Project number (if applicable)
- Brief description of what happened
- Name of division or office Vice President
- What you think could have happened if this situation had resulted in an injury or damage
- Any other information you think may be important

The intent of this service is to enable employees to phone in near misses immediately and have the events entered into the ARCADIS LPS Database. As we all know, the expectation is that immediately after having a near miss, an SPSA will be conducted to provide that it is safe to continue whatever the employee was doing.

Remember, reporting and acting on a near-miss today can save your fellow employees from an injury in the future. Please do your part to help us reach our goal of zero injuries at ARCADIS!

3. Project Hazards and Control Measures

3.1 Scope of Work

Field activities are expected to include the following general tasks:

- Mobilization
- Soil boring installations
- Monitoring well installations
- Collection of soil samples during the advancement of the monitoring wells and soil borings
- Collection of groundwater samples
- Measurement of fluid levels
- Geophysical Survey
- Survey
- Decontamination
- Demobilization

3.2 Field Activities, Hazards, and Control Procedures

The following job safety analyses (JSAs) identify potential health, safety, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the site to identify hazards that may affect onsite personnel, the community, or the environment. The SS must be aware of these changing conditions and discuss them with the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The SS will keep onsite personnel informed of the changing conditions, and the PM will write and/or approve addenda or revisions to this HASP as necessary.

3.2.1 Mobilization

Site mobilization will include establishing drilling and excavation locations, determining the location of utilities and other installations, and establishing work areas. A break area will be set up outside of regulated work areas. Mobilization may involve clearing areas for the SZ and CRZ. During this initial phase, project personnel will walk the site to confirm the existence of anticipated hazards, and identify safety and health issues that may have arisen since the writing of this plan.

The hazards of this phase of activity are associated with, manual materials handling and manual site preparation.

Manual materials handling and manual site preparation may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. 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.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.2.2 Installation of Soil Borings and Groundwater Monitoring Wells

This task includes the installation of groundwater monitoring wells, soil vapor points, and soil borings at specified locations. The hazards associated with the potential contact with impacted soils and groundwater during these installations are discussed in Sampling Sections 3.2.3, 3.2.4 and 3.2.5.

In general, the installation of soil borings and monitoring wells will involve the use of conventional drilling rigs and equipment. The collection of soil samples may also involve the use of direct push type boring equipment. The equipment poses a hazard if it is not properly operated. The equipment is hydraulically powered, and uses static force and dynamic percussion force to advance small-diameter sampling tools. The presence of overhead utilities and underground obstacles poses a hazard if boring equipment contacts them. As the hazards are similar to those encountered when using a conventional drill rig, the required control procedures are also the same as a conventional rig and are included in the following sections.

3.2.2.1 *Drilling Hazards*

The primary physical hazards for this activity are associated with the use of drilling equipment. Rig accidents can occur as a result of improperly placing the rig on uneven or unstable terrain, or failing to adequately secure the rig prior to the start of operations. Underground and overhead utility lines can create hazardous conditions if contacted by drilling equipment. Tools and equipment, such as elevators, cat lines, and wire rope, have the potential for striking, pinning, or cutting personnel.

Wire Rope - Worn or frayed wire rope presents a laceration hazard if loose wires protrude from the main bundle.

Cat Lines - Cat lines are used on drilling rigs to hoist material. Accidents that occur during cat line operations may injure the employee doing the rigging, as well as injure the operator. Minimal hoisting control causes sudden and erratic load movements, which may result in hand and foot injuries.

Working Surfaces - Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls.

Materials Handling - The most common type of accident that occurs in material handling operations is the "caught between" situation when a load is being handled and a finger or toe gets caught between two objects. Rolling stock can shift and/or fall from a pipe rack or truck bed.

3.2.2.2 *Drilling Safety Procedures*

Drill Crews - All drillers must possess required state or local licenses to perform such work. All members of the drill crew shall receive site-specific training prior to beginning work.

The driller is responsible for the safe operation of the drill rig, as well as the crew's adherence to the requirements of this HASP. The driller must ensure that all safety equipment is in proper condition and is properly used. The members of the crew must follow all instructions of the driller, wear all PPE, and be aware of all hazards and control procedures. The drill crews must participate in the Daily Safety Meetings and be aware of all emergency procedures.

Rig Inspection - Each day, prior to the start of work, the drill rig and associated equipment must be inspected by the driller and/or drill crew. Inspections will be documented. The following items must be inspected:

- Vehicle condition
- Proper storage of equipment
- Condition of all wire rope and hydraulic lines
- Condition of all drill rods and threads
- Fire extinguisher
- First aid kit

Drill Rig Set Up - The drill rig must be properly blocked and leveled prior to raising the derrick. The wheels that remain on the ground must be chocked. The leveling jacks shall not be raised until the derrick is lowered. The rig shall be moved only after the derrick has been lowered.

Site Drilling Rules - Before drilling 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. ARCADIS's SS will meet with electrical and natural gas locators onsite prior to marking out the underground utilities. During this meeting, ARCADIS's SS will provide the electric and natural gas locators with a site figure that shows the locations where drilling activities will be completed. ARCADIS's SS will conduct a site walkover with the electrical and natural gas locators to visually identify each location where drilling activities are to be completed during site operations. The Underground/Overhead Utility Checklist (see Attachment G) shall be used to document that nearby utilities have been marked on the ground, and that the drilling 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.

Overhead Electrical Clearances - If drilling is conducted in the vicinity of overhead power lines, the power to the lines must be shut off or the equipment must be positioned and blocked such that no part, including cables, 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

When the drill rig is in transit, with the boom lowered and no load, the equipment clearance must be at least 4 feet for voltages less than 50kV, 10 feet for voltages of 50kV to 345kV, and 16 feet for voltages above 345kV.

Rig Set Up - All well sites will be inspected by the driller prior to the location of the rig to verify a stable surface exists. This is especially important in areas where soft, unstable terrain is common.

All rigs will be properly blocked and leveled prior to raising the derrick. Blocking provides a more stable drilling structure by evenly distributing the weight of the rig. Proper blocking ensures that differential settling of the rig does not occur.

When the ground surface is soft or otherwise unstable, wooden blocks, at least 24 inches by 24 inches and 4 inches to 8 inches thick, shall be placed between the jack swivels and the ground. The emergency brake shall be engaged, and the wheels that are on the ground shall be chocked.

Hoisting Operations - Drillers should never engage the rotary clutch without watching the rotary table, and ensuring it is clear of personnel and equipment.

Unless the drawworks is equipped with an automatic feed control, the brake should not be left unattended without first being tied down.

Auger strings or casing should be picked up slowly.

During instances of unusual loading of the derrick or mast, such as when making an unusually hard pull, only the driller should be on the rig floor; no one else should be on the rig or derrick.

The brakes on the drawworks of the drill rig should be tested by the driller each day. The brakes should be thoroughly inspected by a competent individual each week.

A hoisting line with a load imposed should not be permitted to be in direct contact with any derrick member or stationary equipment, unless it has been specifically designed for line contact.

Workers should never stand near the borehole whenever any wire line device is being run.

Hoisting control stations should be kept clean and controls labeled as to their functions.

Cat Line Operations - Only experienced workers will be allowed to operate the cathead controls. The kill switch must be clearly labeled and operational prior to operation of the cat line. The cathead area must be kept free of obstructions and entanglements.

The operator should not use more wraps than necessary to pick up the load. More than one layer of wrapping is not permitted.

Personnel should not stand near, step over, or go under a cable or cat line that is under tension.

Under no circumstances will personnel be permitted to ride the traveling block or elevators, nor will the cat line be used as a personnel carrier.

Employees rigging loads on cat lines shall:

- keep out from under the load.
- keep fingers and feet where they will not be crushed.
- be sure to signal clearly when the load is being picked up.
- use standard visual signals only and not depend on shouting to co-workers.
- make sure the load is properly rigged, since a sudden jerk in the cat line will shift or drop the load.

Wire Rope - When two wires are broken or rust or corrosion is found adjacent to a socket or end fitting, the wire rope shall be removed from service or resocketed. Special attention shall be given to the inspection of end fittings on boom support, pendants, and guy ropes.

Wire rope removed from service due to defects shall be cut up or plainly marked as being unfit for further use as rigging.

Wire rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope; the clip nuts shall be re-tightened immediately after initial load carrying use and at frequent intervals thereafter.

When a wedge socket fastening is used, the dead or short end of the wire rope shall have a clip attached to it or looped back and secured to itself by a clip; the clip shall not be attached directly to the live end.

Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

Except for eye splices in the ends of wires and for endless wire rope slings, wire rope used in hoisting, lowering, or pulling loads, shall consist of one continuous piece without knot or splice.

An eye splice made in any wire rope shall have not less than five full tucks.

Wire rope shall not be secured by knots. Wire rope clips shall not be used to splice rope.

Eyes in wire rope bridles, slings, or bull wires shall not be formed by wire clips or knots.

Auger Handling - Auger sections shall be transported by cart or carried by two persons. Individuals should not carry auger sections without assistance.

Workers should not be permitted on top of the load during loading, unloading, or transferring of rolling stock.

When equipment is being hoisted, personnel should not stand where the bottom end of the equipment could whip and strike them.

Augers stored in racks, catwalks, or on flatbed trucks should be secured to prevent rolling.

3.2.3 Groundwater Sampling and Monitoring

Groundwater sampling and water level monitoring will involve uncapping, purging (pumping water out of the well), and sampling and monitoring new and 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.

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. A description of each level of personal protection is included in Section 5, Personal Protective Equipment. Control procedures for environmental and general hazards are discussed in Section 4, General Site Safety Procedures.

3.2.4 Subsurface Soil Sampling

This task consists of collecting subsurface soil samples for subsequent analysis and evaluation of potential impact by COC. The physical hazards of these operations are primarily associated with the sample collection methods and procedures utilized. In addition, personnel may be exposed to hazards associated with working in or near excavations.

Hazards - Inhalation and absorption (contact) of COC are the primary routes of entry associated with soil 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 soil sampling methodologies may be utilized based on equipment accessibility and the types of materials to be sampled. These sampling methods may include the use of hand-auger/sampling probes, sampling spoons, or trowels. 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 soil sampling procedures are generally limited to strains/sprains and potential eye hazards. Exposure to soil and water containing COC is also possible. In addition to the safety hazards specific to sampling operations, hazards associated with the operation of vehicles, especially large vehicles with limited operator visibility, is a concern. Of particular concern will be the backing up of trucks, excavation equipment, and other support vehicles.

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 soil sampling activities, a minimum of Modified Level D protection will be worn. In addition, air monitoring will be conducted during soil sampling activities to assess the potential for exposure to airborne COC. Subsurface soil samples will be collected and screened for volatile organic compounds (VOCs) using a PID. 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. A description of each level of personal protection is included in Section 5, Personal Protective Equipment. Control procedures for environmental and general hazards are discussed in Section 4, General Safety Practices.

The following sections discuss hazards and control procedures for excavations.

3.3 Decontamination

All equipment will be decontaminated before leaving the site using visual inspection to verify that COCs have been removed. In addition, all operations that have the potential to generate or release hazardous material will be conducted in a controlled area using the appropriate engineering controls. Specific decontamination techniques will be established based on site conditions. Decontamination procedures will be reviewed with all personnel onsite. It is anticipated that a decontamination pad will be constructed on a suitable surface with polyethylene sheeting or other appropriate containment system. Pressure washing or manual scrub brushing will be used as needed to decontaminate equipment. COC-impacted equipment will be determined "clean" by using visual inspection of all equipment.

Personnel involved in decontamination activities may be exposed to skin contact with contaminated materials and chemicals brought to the site as part of the project work. All personnel will review the operating procedures and PPE prior to decontamination. The equipment used for decontamination and the decontamination containment facility will be inspected daily prior to use. Personnel involved in decontamination activities must wear PPE that is one level below the level worn by personnel working in the EZ.

3.3.1 Pressure Washing

Equipment will be decontaminated before leaving the site. Personnel involved in decontamination activities may be exposed to skin contact with residuals containing site constituents, volatile emissions from heavily soiled equipment, high pressure water spray, and noise.

Hydro blasting is the process of using a stream of water at high pressure to clean or prepare surfaces by removing foreign matter and contaminants. The hazards of high pressure water cleaning are related to the high pressure of the water, which may exceed 10,000 pounds per square inch (psi) at the nozzle. Contact with the water spray may cause severe lacerations, which may then be contaminated with hazardous material. Because of the high pressure involved, the opportunity for slicing or injecting the water stream through soft tissues of the body exists. Hydro blasters will also cut through bone at high enough pressures. A second hazard is repetitive motion, or cumulative trauma disorder. These serious disorders are related to repeatedly squeezing the trigger or constantly fighting the pressure of the spray gun with the forearm or wrist. When pressure washing, steaming, or hydro blasting, the health and safety precautions for hydro blasting outlined below must be observed.

Pressure washing presents a splash hazard. Protection against splash to face and skin is mandatory. The pressure washer is not to be pointed at a person at any time. Steam cleaning presents a thermal burn hazard in addition to the hazards presented by pressure washing. Adequate protection from the hot surfaces must be provided. Only persons trained in use and maintenance of a hydro blaster may use such equipment. Hydro blasting operations will be conducted only by qualified subcontractor personnel.

The following general requirements are provided for high-pressure water cleaning activities:

- The gun, pressure piping, pressure hose ends, and couplings will have a burst pressure of at least four times the operating pressure.
- No equipment or component of such equipment will be operated beyond the manufacturer's specifications or beyond the rated working pressure.
- The maximum operating pressure will be permanently displayed on the pumping unit.
- Wear safety glasses, face-shield, hearing protection, and safety shoes.

- Alternate hands frequently during long periods of use.
- Rotate personnel periodically.
- Use a washer with a gun which supplies water to the wand in a straight line as opposed to supplying water through the grip. This eliminates the gun's twisting motion.
- Keep the equipment in good condition.
- Check to see that releasing the trigger stops the flow of water. Do not wire back the trigger.
- A hose safety shroud will be placed on hoses whenever operating pressure exceeds 2,000 psi.
- The pressure control will be a "deadman" type to safely reduce the nozzle discharge pressure when control is released.
- The pressure discharge gauge indicating pump pressure will be clearly visible for monitoring pump pressure.
- A pressure relief device set to relieve at 110% of the maximum working pressure of the unit or its components, whichever is lower, will be installed on the pump. The relief will be clearly marked and displayed on the device.
- A strainer or filter should be installed on the water supply system to prevent debris from entering the water blasting units and clogging the gun, control, or other device.

Pay close attention to the water line. It is under pressure, and may whip about if broken. If a water line breaks, relieve the pressure before trying to grab the line.

3.4 Demobilization

Demobilization involves the removal of all tools, equipment, supplies, and vehicles brought to the site. The hazards of this phase of activity are associated with heavy equipment operation and manual materials handling.

Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Heavy equipment

operation presents noise and vibration hazards, and hot surfaces, to operators. Personnel in the vicinity of heavy equipment operation may be exposed to physical hazards resulting in fractures, contusions, and lacerations and may be exposed to high noise levels. 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.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.5 Chemical Hazards

The chemical hazards associated with site operations are related to inhalation, ingestion, and skin exposure to site COCs. Concentrations of airborne COCs during site tasks may be measurable, and may require air monitoring during certain operations. Air monitoring requirements for site tasks are outlined in Section 6.1.

Site COCs may include: benzene, toluene, ethylbenzene, and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs) and cyanide.

The potential for inhalation of site COCs is low. The potential for dermal contact with soils and groundwater containing site COCs during excavation, drilling, and sampling operations is moderate. Table 3-2 lists the chemical, physical, and toxicological properties of site COCs. Material Safety Data Sheets (MSDS) for the COCs is included in Attachment A.

4. General Safety Practices

4.1 General Safety Rules

General safety rules for site activities include, but are not limited to, the following:

- At least one copy of this HASP must be in a location at the site that is readily available to personnel, and all project personnel shall review the plan prior to starting work.
- Consume or use food, beverages, chewing gum, and tobacco products only in the SZ or other designated area outside the EZ and CRZ. Cosmetics shall not be applied in the EZ or CRZ.
- Wash hands before eating, drinking, smoking, or using toilet facilities.
- Wear all PPE as required, and stop work and replace damaged PPE immediately.
- Secure disposable coveralls, boots, and gloves at the wrists and legs and ensure closure of the suit around the neck.
- Upon skin contact with materials that may be impacted by COC, remove contaminated clothing and wash the affected area immediately. Contaminated clothing must be changed. Any skin contact with materials potentially impacted by COC must be reported to the SS or HSS immediately. If needed, medical attention should be sought.
- Practice contamination avoidance. Avoid contact with surfaces either suspected or known to be impacted by COC, such as standing water, mud, or discolored soil. Equipment must be stored on elevated or protected surfaces to reduce the potential for incidental contamination.
- Remove PPE as required in the CRZ to limit the spread of COC-containing materials.
- At the end of each shift or as required, dispose of all single-use coveralls, soiled gloves, and respirator cartridges in designated receptacles designated for this purpose.

- Removing soil containing site COC from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited.
- Inspect all non-disposable PPE for contamination in the CRZ. Any PPE found to be contaminated must be decontaminated or disposed of appropriately.
- Recognize emergency signals used for evacuation, injury, fire, etc.
- Report all injuries, illnesses, near misses, and unsafe conditions or work practices to the SS or HSS.
- Use the “buddy system” during all operations requiring Level C PPE, and when appropriate, during Modified Level D operations.
- Obey all warning signs, tags, and barriers. Do not remove any warnings unless authorized to do so.
- Use, adjust, alter, and repair equipment only if trained and authorized to do so, and in accordance with the manufacturer’s directions.
- Personnel are to perform only tasks for which they have been properly trained and will advise their supervisor if they have been assigned a task for which they are not trained.
- The presence or consumption of alcoholic beverages or illicit drugs during the workday (including breaks) is strictly prohibited. Notify your supervisor if you must take prescription or over-the-counter drugs that indicate they may cause drowsiness or, that heavy equipment should not be operated while taking the medication.
- Remain upwind during site activities whenever possible.

4.2 Loss Prevention System (LPS)

LPS is a behavior based safety system meant to prevent or reduce the occurrence of injury, illness, or other incident. This program seeks the prevention or reduction of losses by:

- emphasizing proactive activities.
- capitalizing on the on-the-job expertise of field employees.

- maximizing the use of positive reinforcement.
- integrating with daily field operations.
- solving problems from the bottom up while providing direction from the top down.

4.2.1 Safe Performance Self-Assessment

All onsite personnel are required to perform a SPSA prior to beginning any activity. This three-step process requires each individual to:

- Assess the risk of the task to be performed. Ask the following questions:
 - What could go wrong?
 - What is the worst thing that could happen if something does go wrong?
- Analyze the ways the risk can be reduced. Ask the following questions:
 - Do I have all the necessary training and knowledge to do this task safely?
 - Do I have all the proper tools and PPE?
- Act to control the risk and perform the task safely.
 - Take the necessary action to perform the job safely.
 - Follow written procedures, and ask for assistance if necessary.

This process must be performed prior to beginning any activity, and must be performed after any near miss or other incident in order to determine if it is safe to proceed.

4.2.2 Incident Investigation

An incident is any of the following events: first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions. All incidents shall be investigated within 24 hours and reported to the PM and the HSO.

The purpose of an II is to prevent the recurrence of a similar hazardous event. II investigates all incidents in the same manner. Using the information gathered during an II, appropriate measures will be taken to protect personnel from the hazard in question. The II form is included in Attachment B.

4.2.3 Loss Prevention Observation

The SS or the HSS will perform the LPO (see Attachment C for the LPO form). The purpose of the LPO is to identify and correct potential hazards, and to positively reinforce behaviors and practices that are correct. The SS or HSS must identify potential deviations from safe work practices that could possibly result in an incident, and take prompt corrective action. The LPO process steps are:

- Identify tasks that have the greatest potential for hazardous incidents.
- Review the standard procedure for completing the task.
- Discuss with the observed employee the task and the SS/HSS role in observing the task.
- Observe the employee completing the task.
- Reference the LPO form for criteria. Complete the form, documenting positive, as well as areas in need of improvement.
- Discuss the results of the LPO with the employee. Discuss corrective action necessary.
- Implement corrective action.
- Communicate the results of the LPO and corrective action to the PM and the HSO.

4.2.4 Job Safety Analysis

A JSA is a tool used of identifying potential hazards and developing corrective or protective systems to eliminate the hazard. A JSA lists all the potential hazards associated with an activity. Hazards may be physical, such as lifting hazards or eye hazards, or environmental, such as weather or biological (stinging insects, snakes, etc.). Following the identification of the hazards associated with an activity, control measures are evaluated and protective measures or procedures are then instituted. JSAs are reviewed periodically to ensure that the procedures and protective equipment specified for each activity are current and technically correct. Any changes in site conditions and/or the scope of work may require a review and modification to the JSA in question. During this review process, comments on the JSA and its procedures should be obtained from personnel associated with the activity being analyzed. JSAs will be developed and reviewed during SC implementation.

4.3 Buddy System

Onsite personnel must use the buddy system as required by operations. Use of the “buddy system” is required during all operations requiring Level C to Level A PPE, and when appropriate, during Level D operations. Crewmembers must observe each other for signs of chemical exposure, and heat or cold stress. Indications of adverse effects include, but are not limited to:

- changes in complexion and skin coloration.
- changes in coordination.
- changes in demeanor.
- excessive salivation and pupillary response.
- changes in speech pattern.

Crewmembers must also be aware of the potential exposure to possible safety hazards, unsafe acts, or non-compliance with safety procedures.

Field personnel must inform their partners or fellow crewmembers of non-visible effects of exposure to toxic materials that they may be experiencing. The symptoms of such exposure may include, but are not limited to:

- headaches.
- dizziness.
- nausea.
- blurred vision.
- cramps.
- irritation of eyes, skin, or respiratory tract.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

4.4 Heat Stress

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Since heat stress is one of the most common illnesses associated with heavy outdoor work conducted with direct solar load and, in particular, because wearing PPE can increase the risk of developing heat stress, workers must be capable of recognizing the signs and symptoms of heat-related illnesses. Personnel must be aware of the types and causes of heat-related illnesses and be able to

recognize the signs and symptoms of these illnesses in both themselves and their co-workers.

Heat rashes are one of the most common problems in hot work environments. Commonly known as prickly heat, a heat rash is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by too much or too little salt.

Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat exhaustion occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; headache, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment.

Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment, be given fluid replacement, and be encouraged to get adequate rest.

Heat stroke is the most serious form of heat stress. Heat stroke occurs when the body's system of temperature regulation fails and the body's temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict.

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of workload and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protestations, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Heat Stress Safety Precautions

Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. A minimum work rest regimen and procedures for calculating ambient adjusted temperature are described in Table 4-1.

Table 4-1. Work/Rest Schedule

Adjusted Temperature ^b	Work/Rest Regimen Normal Work Ensemble ^c	Work/Rest Regimen Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5°F (28.1° - 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° - 82.5°F (25.3° - 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° - 77.5°F (30.8° - 32.2°C)	After each 150 minutes of work	After each 120 minutes of work

Notes:

- a. For work levels of 250 kilocalories/hour (Light-Moderate Type of Work).
- b. Calculate the adjusted air temperature (ta adj) by using this equation: $ta\ adj\ ^\circ F = ta\ ^\circ F + (13 \times \% \text{ sunshine})$. Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)
- c. A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.
- d. The information presented above was generated using the information provided in the ACGIH Threshold Limit Values (TLV) Handbook.

In order to determine if the work rest cycles are adequate for the personnel and specific site conditions, additional monitoring of individual heart rates will be conducted during the rest cycle. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

Additionally, one or more of the following control measures can be used to help control heat stress and are mandatory if any site worker has a heart rate (measure immediately prior to rest period) exceeding 115 beats per minute:

- Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day.
- Onsite drinking water will be kept cool (50 to 60°F).
- A work regimen that will provide adequate rest periods for cooling down will be established, as required.
- All personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- Cooling devices, such as vortex tubes or cooling vests, should be used when personnel must wear impermeable clothing in conditions of extreme heat.

- Employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary.
- A shaded rest area must be provided. All breaks should take place in the shaded rest area.
- Employees must not be assigned to other tasks during breaks.
- Employees must remove impermeable garments during rest periods. This includes white Tyvek®-type garments.

All employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

4.5 Cold Stress

Cold stress normally occurs in temperatures at or below freezing, or under certain circumstances, in temperatures of 40°F. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death. Areas of the body that have high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. Two factors influence the development of a cold weather injury: ambient temperature and the velocity of the wind. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at 18°F. An equivalent chill temperature chart relating the actual dry bulb temperature and wind velocity is presented in Table 4-2.

Table 4-2. Chill Temperature Chart

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
Equivalent Chill Temperature (°F)												
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.				GREAT DANGER Flesh may freeze within 30 seconds.			
	Trench foot and immersion foot may occur at any point on this chart.											

[This chart was developed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA (Source: ACGIH Threshold Limit Values for Chemical Substances and Physical Agents)].

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of tissue damage associated with frostbite. Frostbite of the extremities can be categorized into:

- *Frost Nip or Incipient Frostbite* - characterized by sudden blanching or whitening of skin.
- *Superficial Frostbite* - skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- *Deep Frostbite* - tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. It can be fatal. Its symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and 5) death. Trauma sustained in freezing or sub-zero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment. To avoid cold stress, site personnel must wear protective clothing appropriate for the level of cold and physical activity. In addition to protective clothing, preventive safe work practices, additional training, and warming regimens may be utilized to prevent cold stress.

Safety Precautions for Cold Stress Prevention

For air temperature of 0°F or less, mittens should be used to protect the hands. For exposed skin, continuous exposure should not be permitted when air speed and temperature results in a wind chill temperature of -25°F.

At air temperatures of 36°F or less, field personnel who become immersed in water or whose clothing becomes wet must be immediately provided with a change of clothing and be treated for hypothermia.

If work is done at normal temperature or in a hot environment before entering the cold, the field personnel must ensure that their clothing is not wet as a consequence of sweating. If wet, field personnel must change into dry clothes prior to entering the cold area.

If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work must be modified or suspended until adequate clothing is made available or until weather conditions improve.

Field personnel handling evaporative liquid (e.g., gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F must take special precaution to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling.

Safe Work Practices

Direct contact between bare skin and cold surfaces (< 20°F) should be avoided. Metal tool handles and/or equipment controls should be covered by thermal insulating material.

For work performed in a wind chill temperature at or below 10°F, workers should be under constant protective observation (buddy system). The work rate should be established to prevent heavy sweating that will result in wet clothing. For heavy work, rest periods must be taken in heated shelters and workers should be provided with an opportunity to change into dry clothing if needed.

Field personnel should be provided the opportunity to become accustomed to cold-weather working conditions and required protective clothing.

Work should be arranged in such a way that sitting or standing still for long periods is minimized.

During the warming regimen (rest period), field personnel should be encouraged to remove outer clothing to permit sweat evaporation or to change into dry work clothing. Dehydration, or loss of body fluids, occurs insidiously in the cold environment and may increase susceptibility to cold injury due to a significant change in blood flow to the extremities. Fluid replacement with warm, sweet drinks and soups is recommended. The intake of coffee should be limited because of diuretic and circulatory effects.

4.6 Biological Hazards

Biological hazards may include poison ivy, snakes, thorny bushes and trees, ticks, mosquitoes, and other pests.

4.6.1 Tick Borne Diseases

Lyme Disease - The disease commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

Erlchiosis - The disease also commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

These diseases are transmitted primarily by the deer tick, which is smaller and redder than the common wood tick. The disease may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull's eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, and swelling and pain in the joints, and eventually, arthritis. Symptoms of erlichiosis include muscle and joint aches, flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever (RMSF) - This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (*Rickettsia rickettsii*) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for two to three weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death, if untreated, but if identified and treated promptly, death is uncommon.

Control - Tick repellent containing diethyltoluamide (DEET) should be used when working in tick-infested areas, and pant legs should be tucked into boots. In addition, workers should search the entire body every three or four hours for attached ticks, before going home and again when showering at night. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

4.6.2 Poisonous Plants

Poisonous plants may be present in the work area. Personnel should be alerted to their presence and instructed on methods to prevent exposure. Poison sumac grows as a shrub or small tree with large alternate, compound leaves having 7-13 leaflets without teeth. All plant parts are poisonous. The lack of 1) leaflet glands, 2) "wings" between the leaflets, and 3) teeth on the leaves, in addition to this species' red stems supporting the leaflets and leaves, help to distinguish this plant from similar-looking nonpoisonous species such as other sumacs and tree-of-heaven. Flowers are shades of green, white and yellow and appear in late spring. Fruits are small white berries that mature in late summer and may last through winter.

Poison ivy is a woody shrub or vine with hairy looking aerial roots. It grows to 10 feet or more, climbing high on trees, walls and fences or trails along the ground. All parts of poison ivy, including the roots, are poisonous at all times of the year.



Poison Sumac



Poison Ivy

The main control for both poison ivy and poison sumac is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance.

Poison ivy and sumac are very easy to treat if you identified your contact with the irritating plant within a few hours of the incident. The urushiol oil present in both plants chemically bonds with the proteins in your skin about 30 minutes after contact. Seventy-five percent (%) of the population is affected by contact with urushiol, although immunity to urushiol today does not assure immunity tomorrow, and vice versa. Rash symptoms can appear within a few hours but can take two to five days to appear. The

rash starts as a red, annoyingly itchy area that starts to swell. The area then gets inflamed and will get covered in clusters of tiny pimples, the pimple eventually merge and turn into blisters. The fluid in the blisters turns yellow, dries up, and becomes crusty. Left completely untreated, this cycle can last as short as five days and in severe cases as long as five to six weeks.

If you come in contact with poison ivy, oak or sumac, or a animal exposed to any of these, or tools, gear, or clothing exposed to any of these, you should wash off with hot water (not so hot that it burns) and strong soap as soon as possible. If you can get washed up in the first six hours, before the first symptoms appear, you have a good chance of avoiding an out break, and an even better chance of minimizing the effects if you do have one.

4.6.3 Snakes

The possibility of encountering snakes exists, specifically for personnel working in wooded/vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snakebites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control - To minimize the threat of snakebites, all personnel walking through vegetated areas must be aware of the potential for encountering snakes and the need to avoid actions potentiating encounters, such as turning over logs. If a snake bite occurs, an attempt should be made to identify the snake via size and markings. The victim must be transported to the nearest hospital within 30 minutes. First aid consists of applying a constriction band and washing the area around the wound to remove any unabsorbed venom.

4.6.4 Spiders

Personnel may encounter spiders during work activities.

Two spiders are of concern, the black widow and the brown recluse. Both prefer dark sheltered areas such as basements, equipment sheds and enclosures, and around woodpiles or other scattered debris. The black widow is shiny black, approximately one inch long, and found throughout the United States. There is a distinctive red hourglass

marking on the underside of the black widows body. The bite of a black widow is seldom fatal to healthy adults, but effects include respiratory distress, nausea, vomiting, and muscle spasms. The brown recluse is smaller than the black widow and gets its name from its brown coloring and behavior. The brown recluse is more prevalent in the southern United States. The brown recluse has a distinctive violin shape on the top of its body. The bite of the brown recluse is painful and the bite site ulcerates and takes many weeks to heal completely.

Control - To minimize the threat of spider bites, all personnel walking through vegetated areas must be aware of the potential for encountering these arachnids. Personnel need to avoid actions that may result in encounters, such as turning over logs, and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures. If a spider bite occurs, the victim must be transported to the nearest hospital as soon as possible; first aid consists of applying ice packs and washing the area around the wound to remove any unabsorbed venom.

4.7 Noise

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents onsite.

Control - All personnel must wear hearing protection, with a Noise Reduction Rating (NRR) of at least 20, when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Section 6.2, Noise Monitoring.

Whenever possible, equipment that does not generate excessive noise levels will be selected for this project. If the use of noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, if feasible.

4.8 Spill Control

All personnel must take every precaution to minimize the potential for spills during site operations. All onsite personnel shall immediately report any discharge, no matter how small, to the SS.

Spill control equipment and materials will be located on the site at locations that present the potential for discharge. All sorbent materials used for the cleanup of spills will be containerized and labeled appropriately. In the event of a spill, the SS will follow the provisions in Section 9, Emergency Procedures, to contain and control released materials and to prevent their spread to offsite areas.

4.9 Sanitation

Site sanitation will be maintained according to OSHA requirements.

4.9.1 Break Area

Breaks must be taken in the SZ, away from the active work area after site personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in any area other than the SZ.

4.9.2 Potable Water

The following rules apply to all field operations:

- An adequate supply of potable water will be provided at each project site. Potable water must be kept away from hazardous materials or media, and contaminated clothing or equipment.
- Portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be consumed directly from the container (drinking from the tap is prohibited) nor may it be removed from the container by dipping.
- Containers used for drinking water must be clearly marked and shall not be used for any other purpose.
- Disposable drinking cups must be provided. A sanitary container for dispensing cups and a receptacle for disposing of used cups is required.

4.9.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking, or alternate methods such as waterless hand-cleaner and paper towels will be provided.

4.9.4 Lavatory

If permanent toilet facilities are not available, an appropriate number of portable chemical toilets will be provided.

This requirement does not apply to mobile crews or to normally unattended site locations so long as employees at these locations have transportation immediately available to nearby toilet facilities.

4.10 Emergency Equipment

Adequate emergency equipment for the activities being conducted onsite and as required by applicable sections of 29 CFR 1910 and 29 CFR 1926 will be onsite prior to the commencement of project activities. Personnel will be provided with access to emergency equipment, including, but not limited to, the following:

- Fire extinguishers of adequate size, class, number, and location as required by applicable sections of 29 CFR 1910 and 1926
- Industrial first aid kits of adequate size for the number of personnel onsite
- Emergency eyewash and/or shower if required by operations being conducted onsite

4.11 Lockout/Tagout Procedures

Only fully qualified and trained personnel will perform maintenance procedures. Before maintenance begins, lockout/tagout procedures per OSHA 29 CFR 1910.147 will be followed.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy or material-isolating device such that the equipment cannot be operated until the lockout device is removed. If a device cannot be locked out, a tagout system shall be used. Tagout is the placement of a warning tag on an energy or material isolating device indicating that the equipment controls may not be operated until the tag is removed by the personnel who attached the tag.

4.12 Electrical Safety

Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. If wiring or other electrical work is needed, a qualified electrician must perform it.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations.
- Portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle.
- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double insulated tools must be distinctly marked and listed by UL or FM.
- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them.
- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.
- All circuits must be protected from overload.
- Temporary power lines, switchboxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage.
- Plugs and receptacles must be kept out of water unless of an approved submersible construction.
- All extension cord outlets must be equipped with ground fault circuit interrupters (GFCI).

- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment.
- Extension cords or cables must be inspected prior to each use, and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire.
- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

4.13 Lifting Safety

Using proper lifting techniques may prevent back strain or injury. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone.
- The hands and the object should be free of dirt or grease that could prevent a firm grip.
- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces.
- Fingers must be kept away from points that could crush or pinch them, especially when putting an object down.
- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.
- The load should be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- A worker should not carry a load that he or she cannot see around or over.
- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

4.14 Ladder Safety

When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet (0.9 m) above the upper landing surface to which the ladder is used to gain access; or, when such an extension is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder deflection under a load would, by itself, cause the ladder to slip off its support.

- Ladders shall be maintained free of oil, grease, and other slipping hazards.
- Ladders shall not be loaded beyond the maximum intended load for which they were built, or beyond their manufacturer's rated capacity.
- Ladders shall be used only for the purpose for which they were designed.
- Non-self-supporting ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder (the distance along the ladder between the foot and the top support).
- Wood job-made ladders with spliced side rails shall be used at an angle such that the horizontal distance is one-eighth the working length of the ladder.
- Fixed ladders shall be used at a pitch no greater than 90 degrees from the horizontal, as measured to the back side of the ladder.
- Ladders shall be used only on stable and level surfaces unless secured to prevent accidental displacement.
- Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces, including, but not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery.
- Ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, shall be secured to

prevent accidental displacement, or a barricade shall be used to keep the activities or traffic away from the ladder.

- The area around the top and bottom of ladders shall be kept clear.
- The top of a non-self-supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment.
- Ladders shall not be moved, shifted, or extended while occupied.
- Ladders shall have non-conductive siderails if they are used where the employee or the ladder could contact exposed energized electrical equipment.
- The top, top step, or the step labeled that it or any step above it should not be used as a step.
- Cross-bracing on the rear section of stepladders shall not be used for climbing unless the ladders are designed and provided with steps for climbing on both front and rear sections.
- Ladders shall be inspected by the HSS for visible defects on a daily basis and after any occurrence that could affect their safe use.
- Portable ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; corroded components; or other faulty or defective components shall either be immediately marked in a manner that readily identifies them as defective, or be tagged with "Do Not Use" or similar language, and shall be withdrawn from service.
- Fixed ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; or corroded components; shall be withdrawn from service.
- Ladder repairs shall restore the ladder to a condition meeting its original design criteria, before the ladder is returned to use.
- Single-rail ladders shall not be used.
- When ascending or descending a ladder, the user shall face the ladder.

- Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder.
- An employee shall not carry any object or load that could cause the employee to lose balance and fall.

4.15 Traffic Safety

The project site may be located adjacent to a public roadway where exposure to vehicular traffic is likely. Traffic may also be encountered as vehicles enter and exit the area. To minimize the likelihood of project personnel and activities being affected by traffic, the following procedures will be implemented.

Cones must be placed along the shoulder of the roadway starting 100 feet from the work area to alert passing motorists to the presence of personnel and equipment. A “Slow” or “Men Working” sign must be placed at the first cone. Barricades with flashing lights should be placed between the roadway and the work area.

During activities along a roadway, equipment will be aligned parallel to the roadway to the extent feasible, facing into the oncoming traffic so as to place a barrier between the work crew and the oncoming traffic. All crewmembers must remain behind the equipment and the traffic barrier.

All site personnel who are potentially exposed to vehicular traffic must wear an outer layer of orange warning garments, such as vests, jackets, or shirts. If work is performed in hours of dusk or darkness, workers will be outfitted with reflective garments, either orange, white (including silver-coated reflective coatings or elements that reflect white light), yellow, fluorescent red-orange, or fluorescent yellow-orange.

The flow of traffic into and out of the adjacent business must be assessed, and precautions taken to warn motorists of the presence of workers and equipment. Where possible, vehicles should be aligned to provide physical protection of people and equipment.

5. Personal Protective Equipment

5.1 Levels of Protection

PPE is required to safeguard site personnel from various hazards. Varying levels of protection may be required depending on the levels of COC and the degree of physical hazard. This section presents the various levels of protection and defines the conditions of use for each level. A summary of the levels is presented in Table 5-1 in this section.

5.1.1 Level D Protection

The minimum level of protection that is required of ARCADIS personnel and subcontractors at the site is Level D, which is worn when activities do not involve potential dermal contact with contaminants and air monitoring indicates that no inhalation hazard exists. Level D protection includes the following equipment:

- Work clothing as prescribed by weather
- Steel-toe work boots, meeting ANSI Z41
- Safety glasses with side shields or goggles, meeting ANSI Z87
- Hard hat, meeting ANSI Z89, when falling object hazards are present
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used)
- PFD if working on or near the water

5.1.2 Modified Level D Protection

Modified Level D will be used when airborne contaminants are not present at levels of concern, but site activities present the potential for skin contact with contaminated materials. Modified Level D consists of the following equipment:

- Nitrile outer gloves worn over nitrile surgical gloves
- Latex or PVC overboots when contact with COC-impacted media is anticipated
- Steel-toe work boots, meeting ANSI Z41
- Safety glasses with side shields or goggles, meeting ANSI Z87
- Face shield in addition to safety glasses or goggles when projectiles or splash hazards exist
- Tyvek[®] or KleenGuard[®] coveralls when skin contact with COC-impacted media is anticipated
- Hard hat, meeting ANSI Z89, when falling object hazards are present

- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used)
- PFD if working on or near the water

5.1.3 Level C Protection

Level C protection will be required when the airborne concentration of COCs reaches one-half of the OSHA Permissible Exposure Limit (PEL) or ACGIH TLV. The following equipment will be used for Level C protection:

- Full-face, NIOSH-approved, air-purifying respirator with combination organic vapor cartridges
- Polyethylene-coated Tyvek[®] suit with ankles and cuffs taped to boots and gloves
- Nitrile outer gloves worn over nitrile surgical gloves
- Steel-toe work boots, meeting ANSI Z41
- Chemical-resistant boots with steel toes, or latex or polyvinyl chloride (PVC) overboots over steel-toe boots
- Hard hat, meeting ANSI Z89
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used)
- PFD if working on or near the water

5.2 Selection of PPE

Equipment for personal protection will be selected based on the potential for contact, site conditions, ambient air quality, and the judgment of supervising site personnel and health and safety professionals. The PPE used will be chosen to be effective against the COC present on the site.

5.3 Site Respiratory Protection Program

Respiratory protection is an integral part of employee health and safety at the site due to potentially hazardous concentrations of airborne COC. The site respiratory protection program will consist of the following (as a minimum):

- All onsite personnel who may use respiratory protection will have an assigned respirator.
- All onsite personnel who may use respiratory protection will have been fit tested and trained in the use of a full-face air-purifying respirator within the past 12 months.

- All onsite personnel who may use respiratory protection must within the past year have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSS, prior to commencement of site work.
- Only cleaned, maintained, NIOSH-approved respirators will be used.
- If respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs.
- Contact lenses are not to be worn when a respirator is worn.
- All onsite personnel who may use respiratory protection must be clean-shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator.
- Respirators will be inspected, and a negative pressure test performed prior to each use.
- After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the face piece.

5.4 Using PPE

Depending upon the level of protection selected, specific donning and doffing procedures may be required. The procedures presented in this section are mandatory if Modified Level D or Level C PPE is used. All personnel entering the EZ must put on the required PPE in accordance with the requirements of this HASP. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of COC.

5.4.1 Donning Procedures

These procedures are mandatory only if Modified Level D or Level C PPE is used on the site:

- Remove bulky outerwear. Remove street clothes and store in clean location.
- Put on work clothes or coveralls.
- Put on the required chemical protective coveralls.

- Put on the required chemical protective boots or boot covers.
- Tape the legs of the coveralls to the boots with duct tape.
- Put on the required chemical protective gloves.
- Tape the wrists of the protective coveralls to the gloves.
- Don the required respirator and perform appropriate fit check (Level C).
- Put hood or head covering over head and respirator straps and tape hood to facepiece (Level C).
- Don remaining PPE, such as safety glasses or goggles and hard hat.

When these procedures are instituted, one person must remain outside the work area to ensure that each person entering has the proper protective equipment.

5.4.2 Doffing Procedures

The following procedures are only mandatory if Modified Level D or Level C PPE is required for the site. Whenever a person leaves the work area, the following decontamination sequence will be followed:

- Upon entering the CRZ, rinse contaminated materials from the boots or remove contaminated boot covers.
- Clean reusable protective equipment.
- Remove protective garments, equipment, and respirator (Level C). All disposable clothing should be placed in plastic bags, which are labeled with contaminated waste labels.
- Wash hands, face, and neck (or shower if necessary).
- Proceed to clean area and dress in clean clothing.
- Clean and disinfect respirator for next use.

All disposable equipment, garments, and PPE must be bagged in plastic bags, labeled for disposal. See Section 7, Decontamination, for detailed information on decontamination stations.

5.5 Selection Matrix

The level of personal protection selected will be based on air monitoring of the work environment and an assessment by the SS and HSS of the potential for skin contact

with COC. The PPE selection matrix is presented in Table 5-1. This matrix is based on information available at the time this plan was written. The Airborne Constituent Action Levels in Table 6-1 should be used to verify that the PPE prescribed in these matrices is appropriate.

Table 5-1. PPE Selection Matrix

Task	Anticipated Level of Protection
Mobilization	Level D
Installation of Groundwater Monitoring Wells and Soil Borings	Level D/Modified Level D
Groundwater Sampling and Monitoring	Level D/Modified Level D
Subsurface Soil Sampling	Level D/Modified Level D
Decontamination	Level D/Modified Level D
Demobilization	Level D

6. Air 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 1part per million (ppm), and are sustained for 15 minutes in the breathing zone.

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 Attachment F).

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

Table 6-1 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 well, soil vapor point, and soil boring installations. 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 Table 6-1 are exceeded, work will stop, the HSO/HSM will be contacted, and perimeter monitoring will be performed. Additional monitoring (and appropriate response activities) to be implemented if the total organic vapor and particulate levels in the worker breathing zone exceed action levels as discussed below.

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 National Fuel, the NYSDEC, the New York State Department of Health (NYSDOH), and ARCADIS] listed in Section 11.5 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 ($\mu\text{g}/\text{m}^3$) 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 $150 \mu\text{g}/\text{m}^3$ or greater, then work activities will cease and dust suppression techniques must be employed to maintain particulate levels below $150 \mu\text{g}/\text{m}^3$. In addition, the work area will be enlarged if necessary to keep the public from being exposed to particulate levels greater than $150 \mu\text{g}/\text{m}^3$.

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 National Fuel and ARCADIS PM) will evaluate an alternative course of action.

Table 6-1. Airborne Constituent Action Levels

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 10 ppm	Upgrade to Level C PPE
	>10 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
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

Parameter	Reading in Breathing Zone (BZ)	Action
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, as detailed in Section 6.5 of this HASP.

ppm= parts per million.

mg/m³= milligrams per cubic meter.

LEL= Lower explosive limit.

7. Work Zones and Decontamination

7.1 Work Zones

7.1.1 Authorization to Enter

Only personnel with the appropriate training and medical certifications (if respirators are required) will be allowed to work at the project site. The SS will maintain a list of authorized persons; only personnel on the authorized persons list will be allowed to enter the site work areas.

7.1.2 Site Orientation and Hazard Briefing

No person will be allowed in the work area during site operations without first being given a site orientation and hazard briefing. This orientation will be presented by the SS or HSS, and will consist of a review of this HASP. This review must cover the chemical, physical, and biological hazards, protective equipment, safe work procedures, and emergency procedures for the project. Following this initial meeting, daily safety meetings will be held each day before work begins.

All people entering the site work areas, including visitors, must document their attendance at this briefing, as well as the daily safety meetings on the forms included with this plan.

7.1.3 Certification Documents

A training and medical file may be established for the project and kept onsite during all site operations. Specialty training, such as first aid/cardiopulmonary resuscitation (CPR) certificates, as well as current medical clearances for all project field personnel required to wear respirators, will be maintained within that file. All ARCADIS and subcontractor personnel must provide their training and medical documentation to the HSS prior to starting work.

7.1.4 Entry Log

A log-in/log-out sheet will be maintained at the site by the SS. Personnel must sign in and out on a log sheet as they enter and leave the work area, and the SS may document entry and exit in the field notebook.

7.1.5 Entry Requirements

In addition to the authorization, hazard briefing, and certification requirements listed above, no person will be allowed in any ARCADIS work area unless they are wearing the minimum PPE as described in Section 5, Personal Protective Equipment.

7.1.6 Emergency Entry and Exit

People who must enter the work area on an emergency basis will be briefed of the hazards by the SS. All activities will cease in the event of an emergency. People exiting the work area because of an emergency will gather in a safe area for a head count. The SS is responsible for ensuring that all people who entered the work area have exited in the event of an emergency.

7.1.7 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas.

7.1.7.1 Exclusion Zone

An EZ may consist of a specific work area, or may be the entire area of potential contamination. All employees entering an EZ must use the required PPE, and must have the appropriate training and medical clearance for hazardous waste work. The EZ is the defined area where there is a possible respiratory and/or contact health hazard. Cones, caution tape, or a site diagram will identify the location of each EZ.

7.1.7.2 Contamination Reduction Zone

The CRZ or transition area will be established, if necessary, to perform decontamination of personnel and equipment. All personnel entering or leaving the EZ will pass through this area to prevent any cross-contamination. Tools, equipment, and machinery will be decontaminated in a specific location. The decontamination of all personnel will be performed onsite adjacent to the EZ. Personal protective outer garments and respiratory protection will be removed in the CRZ and prepared for cleaning or disposal. This zone is the only appropriate corridor between the EZ and the SZ.

7.1.7.3 Support Zone

The SZ is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the support area only after proper decontamination. Smoking may be permitted in the SZ, subject to site requirements.

7.1.8 Posting

Work areas will be prominently marked on the ground and delineated using cones, caution tape. Work areas may also be shown on a site diagram.

7.1.9 Site Inspections

The SS will conduct a daily inspection of site activities, equipment, and procedures to verify that the required elements are in place. The Safety Inspection Form in Attachment D may be used as a guide for daily inspections. A monthly LPO must also be completed and forwarded to the PM for review.

7.2 Decontamination

7.2.1 Personnel Decontamination

All personnel wearing Modified Level D or Level C protective equipment in the EZ must undergo personal decontamination prior to entering the SZ. The personnel decontamination area will consist of the following stations at a minimum:

- *Station 1:* Personnel leaving the contaminated zone will remove the gross contamination from their outer clothing and boots.
- *Station 2:* Personnel will remove their outer garment and gloves and dispose of it in properly labeled containers. Personnel will then decontaminate their hard hats, and boots with an aqueous solution of detergent or other appropriate cleaning solution. These items are then hand carried to the next station.
- *Station 3:* Personnel will thoroughly wash their hands and face before leaving the CRZ. Respirators will be sanitized and then placed in a clean plastic bag.

7.2.2 Equipment Decontamination

All vehicles that have entered the EZ will be decontaminated at the decontamination pad prior to leaving the zone. If the level of vehicle contamination is low, decontamination may be limited to rinsing of tires and wheel wells with water. If the vehicle is significantly contaminated, steam cleaning or pressure washing of vehicles and equipment may be required.

7.2.3 Personal Protective Equipment Decontamination

Where and whenever possible, single-use, external protective clothing must be used for work within the EZ or CRZ. This protective clothing must be disposed of in properly labeled containers. Reusable protective clothing will be rinsed at the site with detergent and water. The rinsate will be collected for disposal.

When removed from the CRZ, the respirator will be thoroughly cleaned with soap and water. The respirator face piece, straps, valves, and covers must be thoroughly cleaned at the end of each work shift, and ready for use prior to the next shift. Respirator parts may be disinfected with a solution of bleach and water, or by using a spray disinfectant.

8. Training and Medical Surveillance

8.1 Training

8.1.1 General

All onsite project personnel who work in areas where they may be exposed to site contaminants must be trained as required by OSHA Regulation 29 CFR 1910.120 (HAZWOPER). Field employees exposed or potentially exposed over the PEL receive 40 hours of initial training and three days of actual field experience under the direct supervision of a trained, experienced supervisor. Field employees onsite for a specific limited task such as groundwater monitoring/sampling, surveying, etc. and who are unlikely to be exposed over the PEL receive 24 hours of initial training and one day of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their initial training more than 12 months prior to the start of the project must have completed an eight-hour refresher course within the past 12 months. The SS must have completed an additional eight hours of supervisory training, and must have a current first-aid/CPR certificate.

8.1.2 Basic 40-Hour Course

The following is a list of the topics typically covered in a 40-hour HAZWOPER training course:

- General safety procedures
- Physical hazards (fall protection, noise, heat stress, cold stress)
- Names and job descriptions of key personnel responsible for site health and safety
- Safety, health, and other hazards typically present at hazardous waste sites
- Use, application, and limitations of PPE
- Work practices by which employees can minimize risks from hazards
- Safe use of engineering controls and equipment onsite
- Medical surveillance requirements
- Recognition of symptoms and signs which might indicate overexposure to hazards
- Worker right-to-know (Hazard Communication OSHA 1910.1200)
- Routes of exposure to contaminants
- Engineering controls and safe work practices
- Components of a health and safety program and a site-specific HASP
- Decontamination practices for personnel and equipment
- Confined-space entry procedures
- General emergency response procedures

8.1.3 Supervisor Course

Management and supervisors must receive an additional eight hours of training, which typically includes:

- general site safety and health procedures.
- PPE programs.
- air monitoring techniques.

8.1.4 Site-Specific Training

Site-specific training will be accomplished by onsite personnel reading this HASP, or through a thorough site briefing by the PM, SS, or HSS on the contents of this HASP before work begins. The review must include a discussion of the chemical, physical, and biological hazards; the protective equipment and safety procedures; and emergency procedures.

8.1.5 Daily Safety Meetings

Twice daily safety meetings will be held to cover the work to be accomplished, the hazards anticipated, the PPE and procedures required to minimize site hazards, and emergency procedures. The SS or HSS should present these meetings prior to beginning the day's fieldwork and again after lunch. No work will be performed in an EZ before a safety meeting has been held. A safety meeting must also be held prior to new tasks, and repeated if new hazards are encountered. The Daily Safety Meeting Log is included in Attachment E.

8.1.6 First Aid and CPR

At least one employee current in first aid/CPR will be assigned to the work crew and will be on the site during operations. Refresher training in first aid (triennially) and CPR (annually) is required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

8.2 Medical Surveillance

8.2.1 Medical Examination

All personnel who are potentially exposed to site contaminants must participate in a medical surveillance program as defined by OSHA at 29 CFR 1910.120 (f).

8.2.2 Pre-Placement Medical Examination

All potentially exposed personnel must have completed a comprehensive medical examination prior to assignment, and periodically thereafter as defined by applicable regulations. The pre-placement and periodic medical examinations typically include the following elements:

- Medical and occupational history questionnaire
- Physical examination
- Complete blood count, with differential
- Liver enzyme profile
- Chest X-ray, at a frequency determined by the physician
- Pulmonary function test
- Audiogram
- Electrocardiogram for persons older than 45 years of age, or if indicated during the physical examination
- Drug and alcohol screening, as required by job assignment
- Visual acuity
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director

The examining physician provides the employee with a letter summarizing his findings and recommendations, confirming the worker's fitness for work and ability to wear a respirator. Documentation of medical clearance will be available for each employee during all project site work.

Subcontractors will certify that all their employees have successfully completed a physical examination by a qualified physician. The physical examinations must meet the requirements of 29 CFR 1910.120 and 29 CFR 1910.134. Subcontractors will supply copies of the medical examination certificate for each onsite employee.

8.2.3 Other Medical Examinations

In addition to pre-employment, annual, and exit physicals, personnel may be examined:

- At employee request after known or suspected exposure to toxic or hazardous materials.
- At the discretion of the HSS, HSO, or occupational physician in anticipation of, or after known or suspected exposure to toxic or hazardous materials.

8.2.4 Periodic Exam

Following the placement examination, all employees must undergo a periodic examination, similar in scope to the placement examination. For employees potentially exposed over 30 days per year, the frequency of periodic examinations will be annual. For employees potentially exposed less than 30 days per year, the frequency for periodic examinations will be 24 months.

8.2.5 Medical Restriction

When the examining physician identifies a need to restrict work activity, the employee's supervisor must communicate the restriction to the employee and the HSS. The terms of the restriction will be discussed with the employee and the supervisor.