Supplemental Remedial Investigation Work Plan

Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203292 (South)

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7020

Submitted by:
GEI Consultants, Inc., P. C.
110 Walt Whitman Road, Suite 204
Huntington Station, NY 11746
631.760.9300

September 2017
Project 1700655

Thomas Johansen
Project Geologist

Nicholas J. Recchia, P.G.
Environmental Practice Leader
Hydrogeologist

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Certification

I, Thomas H. Johansen, certify that I am currently a Qualified Environmental Professional as defined in 6 NYCRR Part 375 and that this Supplemental Report Investigation Work Plan (SRIWP) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

______________________	September 26, 2017
Signature	Date

1. Background and Site Description

1.1 Introduction

GEI Consultants, Inc., P. C. (GEI) has prepared this Supplemental Remedial Investigation Work Plan (SRIWP) for the property known as Concourse Village West Apartments. The non-contiguous property is located in the Bronx and occupies three (3) New York City Tax Lots (Block 2485; Lots 35, 13, and 49) with the following addresses: 180 East 156th Street, 702 Grand Concourse, and 729 Concourse Village West located in the Bronx, New York. The Lots will be developed separately and will be known in this report as:

- Concourse Village West Apartments-North (Lot 35/ **BCP #C203291**) and;
- Concourse Village West Apartments-South (Lots 49 & 13/ **BCP #C203092**)

For purposes of reporting the two developments, they will be combined into one report; however, two distinct Brownfield Cleanup Program (BCP) applications were filed with the New York State Department of Environmental Conservation (NYSDEC) and the site maintains two BCP numbers. **Figure 1** defines the North and South site boundaries, as well as shows the proposed/existing sampling locations.

1.2 Objective and Scope of the SRIWP

The objective of this Supplemental Remedial Investigation Work Plan is as follows:

1. Define the Qualitative Exposure Assessment (QEA) as discussed in GEI's Remedial Investigation Report (RIR) for Concourse Village West Apartments-North (Lot 35/ **BCP #C203291**) by collecting an up-gradient and down-gradient groundwater sample from two existing off-site monitoring wells located on the sidewalks of East 156th Street and Concourse Village West;
2. Obtain groundwater quality information from an on-site monitoring well (GW-7) located on Concourse Village West Apartments-North (Lot 35/ **BCP #C203291**) to define localized groundwater conditions;
3. Obtain groundwater quality information from an on-site monitoring well (GW-4) located on Concourse Village West Apartments-North (Lot 35/ **BCP #C203292**) to define localized groundwater conditions;
4. Install three (3) 2-inch monitoring wells on Lot 13; Concourse Village West Apartments-South (Lots 49 & 13/ **BCP #C203092**);
5. Collect/analyze groundwater samples from the new wells installed on Lot 13.

1.3 Historical Background

Lot 35:

This Site was occupied by two small wood frame buildings in 1891. The use in these buildings is not indicated on the 1891 Sanborn map. The property was an undeveloped lot from at least 1908 to 1950, at which time the existing building was constructed at the site. Identified former uses of the site since 1950 include a gasoline filling station (from 1951 to the late 1960s), auto repair and auto body shops (1950 to the 1990s), automobile parking, office uses, a retail store and a retail coin-operated laundromat.

Lot 13:

Research into the history of the property indicates that the site was undeveloped land in 1891, as indicated by the Sanborn map for that year. By 1908, the site contained a 2-story residential dwelling. This structure was demolished sometime prior to 1935. From 1935 to 2005, the identified former occupants and uses of the site include a gasoline filling station, auto repair garages, the U-Haul Corporation, Meineke Discount Mufflers, Meineke Car Care Center, and A.G. Concourse Auto Service and Reliable Parking Service, Inc. Sanborn maps show a filling station until 2007; however, the property has been occupied by an attended parking lot since that time. The 1935, 1944, and 1946 Sanborn maps show four (4) 550-gallon buried gasoline tanks on the eastern portion of the site. No evidence of the closure or removal of the underground storage tanks from the site was found in the information reviewed for this report therefore, it is possible that the underground tanks may exist at the site. According to information in the NYSDEC Petroleum Bulk Storage Database, there was formerly a 275-gallon, aboveground waste/used oil tank registered at the site (Facility ID: 2-609472). The registration is in the name A.G. Concourse Auto Service. The Petroleum Bulk Storage (PBS) registration for this tank expired on 2/26/09. According to information in the NYSDEC Spill Logs database, Spill Number 0607307 was assigned to the site on 9/26/06 from a spill of an unspecified quantity of petroleum due to sloppy housekeeping. This spill incident was closed by the NYSDEC on 11/2/06.

Lot 49:

Research into the history of the property indicates that the site has been used as an automobile parking lot since the 1950s. Prior to the 1950s, the site was an undeveloped lot, except for a produce garden on the site in 1908. The identified former uses of the project site are not types of operations which typically involve the storage or use of hazardous materials or petroleum products. According to Sanborn historical maps, the two-story industrial building located to the south of the site was formerly occupied by the Morgan Steam Laundry Company from the 1930s to the 1950s.

1.4 Description of Local Hydrogeological Conditions

The information below was derived from a Phase II Environmental Site Investigation (ESI) and Geotechnical Reports conducted at the project site.

Site Soil/Stratigraphy

The encountered subsurface conditions consist of: fill soils; glacial outwash sand deposits; varved glacial lake deposits consisting predominately of silt and low plasticity clay; and bedrock. The fill typically consists of sand with varying amounts of ash, cinders and glass. Silts, clays and underlying clays consisted of predominantly fine grained varved glacial lake deposits below the fill layer. Based upon regional topographic and geologic maps, bedrock is estimated be approximately 70-80 feet below grade surface (ft bgs).

No evidence of perched water was observed during the Remedial Investigation (RI). Saturated soil indicative of the regional groundwater table was observed at approximately 30-35 ft bgs. Based upon regional topography, groundwater is anticipated to flow in a south/southeasterly direction. Groundwater was acquired and measured through already existing monitoring wells located on-site.

The Harlem River is located approximately 0.4-miles west of the project site. Otherwise, no surface water bodies are located within 1/2-mile of the Site according to the United State Geologic Survey (USGS) 7 1/2-minute map. Please see Soil Boring Logs in **Appendix A** for a detailed description of each boring location.

No evidence of perched water was observed during the RI. Saturated soil indicative of the regional groundwater table was observed at approximately 30-35 ft bgs.

1.5 Phase II Groundwater Analytical Results

The groundwater samples collected during the Phase II investigation were compared to the New York State 6-New York Codes, Rules and Regulations (6-NYCRR) Part 703.5 Class GA AWQS.

Groundwater Lot 35 (Concourse Village West Apartments-NORTH C203291)

- The following volatile organic compounds (VOCs) were detected on Lot 35 at levels above their respective NYSDEC Technical & Operational Guidance Series (TOGS) Standards: 1,2,3-Trimethylbenzene (maximum 180 microgram per liter [µg/L]); 1,3,5-Trimethylbenze (maximum 35 µg/L); Ethylbenzene (maximum 130 µg/L); Isopropylbenzene (maximum 32 µg/L); n-Butylbenzene (maximum 15 µg/L); n-Propylbenzene (maximum 36 µg/L); o-Xylene (maximum 14 µg/L); p & m- Xylenes (maximum 200 µg/L); and P-Isopropyltoluene (maximum 6.4 µg/L).

Groundwater on Lots 13 and 49 (Concourse Village West Apartments-SOUTH C203092)

- The following VOCs were detected on Lot 49 at levels above their respective NYSDEC TOGS Standards (note: no groundwater samples were acquired from Lot 13 due to drill rig limitations and refusal): 1,2,3-Trimethylbenzene (maximum 240 µg/L); 1,3,5-Trimethylbenze (maximum 45 µg/L); Ethyl Benzene (maximum 150 µg/L); Isopropylbenzene (maximum 36 µg/L); n-Butylbenzene (maximum 22 µg/L); n-Propylbenzene (maximum 48 µg/L); o-Xylene (maximum 12 µg/L); p & m- Xylenes (maximum 230 µg/L); and sec-Butylbenzene (maximum 6.3 µg/L).

Figures 2 and 3 show the location and posts the values for groundwater that exceed the New York State 6- NYCRR Part 703.5 Class GA groundwater standards.

2. Scope of Work

The scope of work listed below was developed to determine the extent of contamination at Concourse Village West Apartments-North (Lot 35/ **BCP #C203291**) and Concourse Village West Apartments-South (Lots 49 & 13/ **BCP #C203092**). The results of the scope below will be incorporated into each site's remedy plan.

2.1 Scope of Work Concourse Village West Apartments-North (Lot 35/ BCP #C203291)

1. Collect two groundwater samples from previously installed off-site monitoring wells located along East 156th Street (up-gradient) and Concourse Village West (down-gradient). The 2-inch monitoring wells were installed by EnviroTrac in 2007 and are associated with an off-site NYSDEC Spill **(#05-51708**). The wells will be given a designation associated with the Concourse Village West Apartments Project (*GW-XX*). See **Figure 1** for proposed sampling locations.
   - The two groundwater samples collected from the off-site monitoring wells will be analyzed for VOCs using EPA Methodology 8260

2. Collect groundwater parameters from an existing on-site monitoring well that is designated GW-7.
   - Groundwater Parameters include: PH, Conductivity, Turbidity, Dissolved Oxygen, Temperature, Salinity, and ORP

2.2 Scope of Work Concourse Village West Apartments-South (Lots 49 & 13/ BCP #C203092)

1. Collect groundwater parameters from an existing on-site monitoring well that is designated GW-3.
   - Groundwater Parameters include: PH, Conductivity, Turbidity, Dissolved Oxygen, Temperature, Salinity, and ORP

2. Install three (3) 2-inch PVC monitoring wells to 55 ft bgs. Monitoring wells will be set with 10-foot sections of 0.020-inch slotted-screen.
   - Groundwater samples will be analyzed for VOCs, semi-volatile organic compounds (SVOCs), Target Analyte List (TAL) Metals, Pesticides/ Polychlorinated biphenyls (PCBs) using United States Department of Environmental Protection Agency (USEPA) Methodologies 8260; 8270; 6010; 8081/8082.

All field work will be performed in accordance with GEI Standard Operating Procedures methods included in **Appendix B**. A Community Air Monitoring Plan (CAMP) will be implemented during field activities and is included in **Appendix C**. The Construction Health and Safety Plan (CHASP) is included in **Appendix D**. Analytical sampling will be performed in accordance with the Quality Assurance Project Plan (QAPP) included in **Appendix E**. The locations of all proposed sampling points for the SRIWP samples are depicted in **Figure 1**. Quality Assurance/Quality Control (QA/QC) samples will be collected according to the QAPP.

2.3 Execution of the SRIWP

Site work will commence at 0700 Monday through Friday with no heavy truck traffic until 0800. All work must be completed and the work area closed for the evening at 1700 unless otherwise authorized by the property owner. During working hours, the drilling subcontractor will make every effort to minimize potential community impacts. These include, but are not limited to, noise and traffic concerns associated with the execution of the SRIWP. Site work will not be conducted on weekends or holidays without prior approval by the property owner.

2.4 Mobilization and Site Access

All on-site personnel performing intrusive activities that have the potential to come in contact with impacted materials will have the requisite 1910.120 OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) Training as well as site-specific training prior to intrusive activities. All personnel performing work associated with this RIWP will be required to have both general and site-specific training. The general training includes all applicable OSHA and state required training, such as 40-hour HAZWOPER and the 8-hour Refresher Training. Supervisory personnel will also have supervisory training. All personnel will be in a medical surveillance program. Also, site-specific training will be given to all personnel performing fieldwork at the site daily. This site-specific training will include a review of potential site hazards, required personal protective equipment (PPE), and site warning and evacuation procedures.

The drilling subcontractor will apply for and obtain all necessary federal, state, and local permits associated with the SRIWP. These permits may include, but are not limited to, traffic routing, road opening, construction/zoning, etc. Conditions of these permits will be complied with during the construction.

The property owner will provide access to the site. This access will be for all SRIWP activities.

The drilling subcontractor will be responsible for contacting the New York City – Long Island One Call Center to request that all utilities on the site be located and marked. The Contractor is responsible for resolving all potential conflicts. Underground utility protection will be the responsibility of the selected Contractor. When all utilities have been verified/confirmed/ protected, then intrusive activities may be initiated.

The selected drilling subcontractor will mobilize all necessary labor, equipment, supplies, and materials to complete the SRIWP. Lay down areas for equipment, supplies and materials, the appropriate exclusion zone(s), and support area(s) will be identified to conduct the planned activities safely and effectively. All equipment will be inspected prior to utilization for the SRIWP and checked periodically for performance and corrective repair. All equipment will be cleaned prior to arrival on the project site.

2.5 Site Preparation

The site will be prepared for the SRIWP. Site preparation activities necessary to provide support for the work include the establishment of work zones, support facilities, decontamination facilities, and installation of temporary security measures around work areas. The work area may change daily based on the locations of the sampling points. Modifying the work area daily should help to reduce the need for erosion control, security and overnight safety measures, and minimize disruption to normal community operations.

All work will be conducted to minimize impacts to existing utilities.

2.6 Odor and Fugitive Dust Control

In accordance with NYSDEC and New York State Department of Health (NYSDOH) requirements, a CAMP will be implemented at the site during ground intrusive activities. The objective of the CAMP is to provide a measure of protection for the downwind community (i.e., offsite receptors, including residences and businesses and onsite workers not involved with site SRIWP activities) from potential airborne contaminant releases as a direct result of intrusive SRIWP activities. Air monitoring stations will be placed up-wind and downwind of each intrusive work area (i.e., soil boring, soil vapor probe and monitoring well locations). VOCs and respirable particulates (PM-10) will be monitored at the up-wind and downwind stations on a continuous basis. In addition, to the fixed stations, VOCs and particulates will be monitored in the work zone using hand held equipment. VOCs and particulates will also be monitored around the perimeter of the work zone on a regular basis (hourly) by GEI air monitoring personnel.

2.7 Site Restoration

The drilling subcontractor will restore all areas disturbed by the SRIWP activities to pre-existing conditions based on the applicable access agreements. Restoration actions shall include, but may not be limited to:

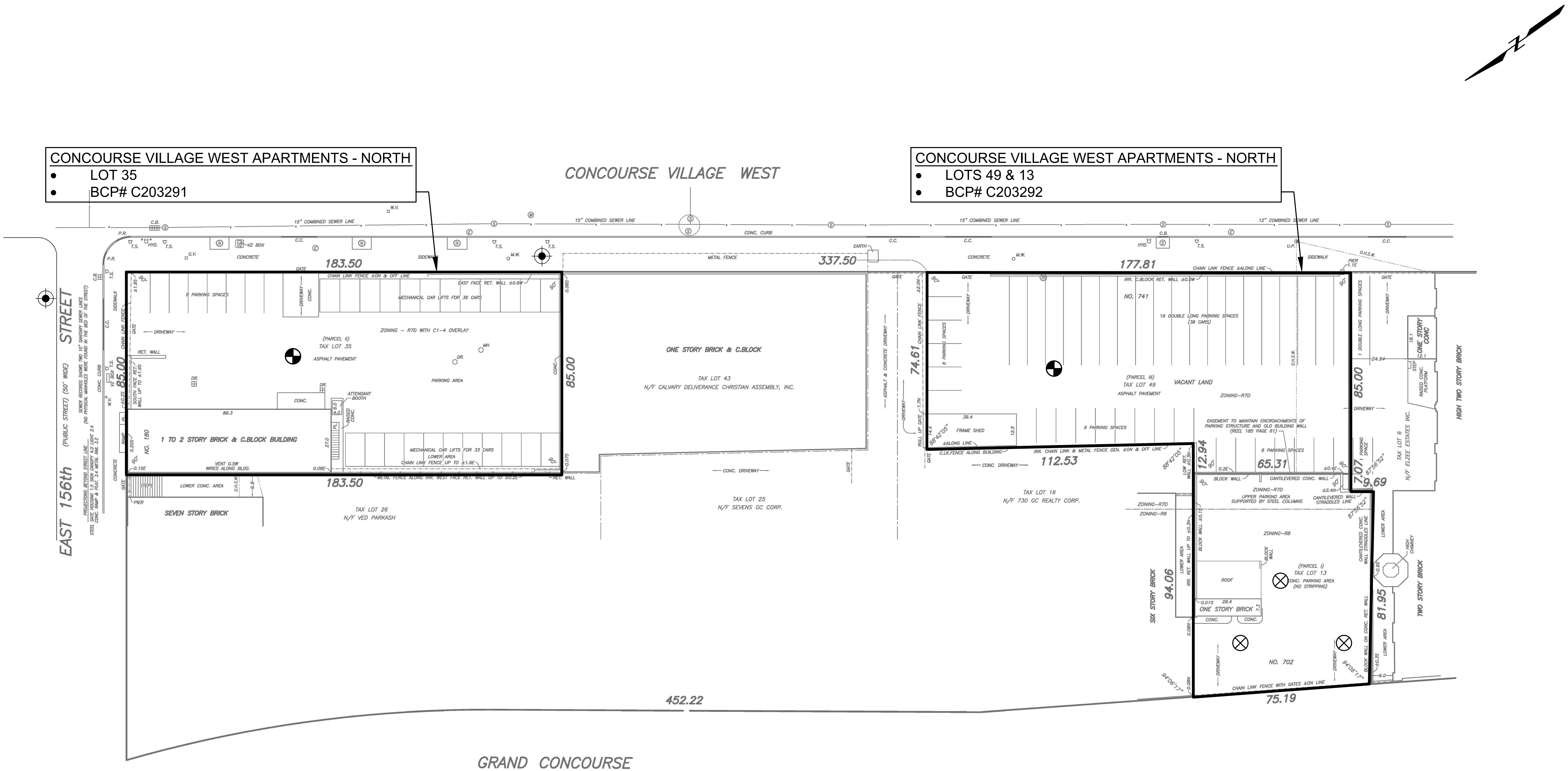
- Removal of all temporary facilities, including decontamination areas, and unused materials; and
- Replacement or repair of all asphalt and concrete surfaces removed or damaged during the SRIWP, as appropriate.

3. Supplemental Remedial Investigation Report

The sample results will be compared to New York State Ambient Water Quality Standards and Guidance Values for Class GA Groundwater.

The results, along with supporting documentation, will be provided to the NYSDEC in the form of a Supplemental Remedial Investigation Report (SRIR).

Figures



LEGEND

EXISTING ON-SITE MONITORING WELL

EXISTING OFF-SITE MONITORING WELL

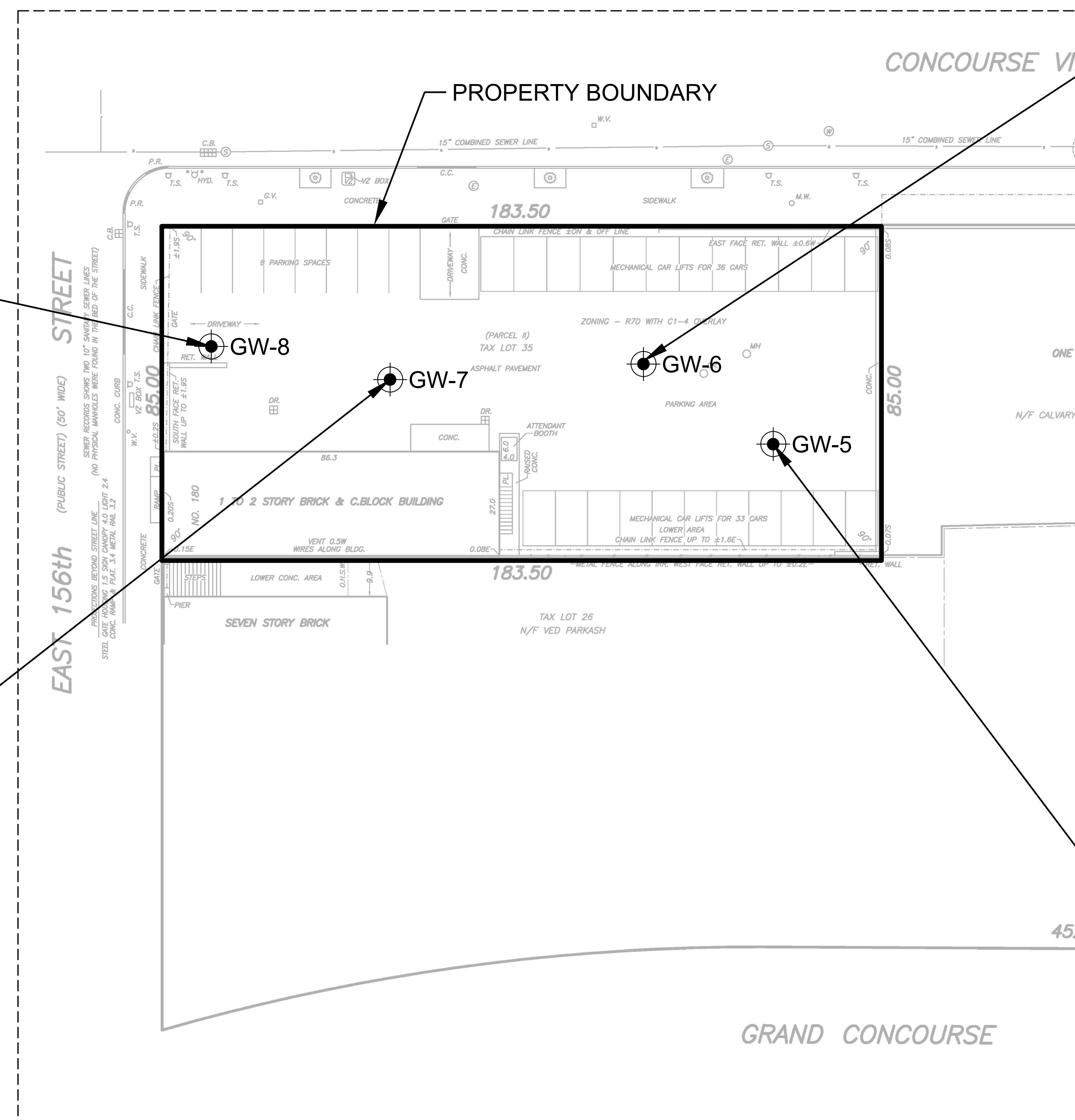
PROPOSED MONITORING WELL LOCATIONS

702 GRAND CONCOURSE 741 CONCOURSE VILLAGE WEST 180 EAST 156TH STREET BRONX, NEW YORK	GEI Consultants	PROPOSED SAMPLE LOCATIONS
CONCOURSE VILLAGE WEST APARTMENTS SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN	Project 1700655	SEPTEMBER 2017 Fig. 1

\\gdc1v-fs01\ I:\Tech\Environmental Projects\Azimuth Development Group\Concourse Village West Bronx, NY\CAD\Figures\Supplemental RAWP\1700655 - FIG 1.dwg - 9/25/2017

Sample ID Sampling Date Client Matrix	NYSDEC TOGS Standards and Guidance Values	GW-8 42774.0 Water	
Compound	GA	Result	Q
Volatile Organics, 8260 - Comprehensive	ug/L	ug/L	
1,2,4-Trimethylbenzene	5	**8.4**	
1,3,5-Trimethylbenzene	5	**5.6**	
Ethyl Benzene	5	**7.0**	
p- & m- Xylenes	5	**8.0**	
Xylenes, Total	5	**10.0**	
Semi-Volatiles, 8270 Base/Neutrals	ug/L	ug/L	
Dilution Factor		10.0	
Pyrene	50	**199.0**	JD
Metals, Target Analyte, ICP	ug/L	ug/L	
Dilution Factor		1.0	
Lead	25	**91.2**	
Manganese	300	**3,910.0**	
Selenium	10	**20.2**	
Sodium	20000	**78,700.0**	
Metals, Target Analyte, ICP Dissolved	ug/L	ug/L	
Dilution Factor		1.0	
Magnesium	35000	27,000.0	
Manganese	300	**5,270.0**	
Sodium	20000	**113,000.0**	

Sample ID Sampling Date Client Matrix	NYSDEC TOGS Standards and Guidance Values	GW-7 42774.0 Water	
Compound	GA	Result	Q
Volatile Organics, 8260 - Comprehensive	ug/L	ug/L	
1,2,4-Trimethylbenzene	5	**180.0**	D
1,3,5-Trimethylbenzene	5	**35.0**	
Ethyl Benzene	5	**130.0**	D
Isopropylbenzene	5	**32.0**	
n-Butylbenzene	5	**15.0**	
n-Propylbenzene	5	**36.0**	D
o-Xylene	5	**14.0**	
p- & m- Xylenes	5	**200.0**	D
p-Isopropyltoluene	5	**6.4**	
Xylenes, Total	5	**210.0**	D
Semi-Volatiles, 8270 Base/Neutrals	ug/L	ug/L	
Dilution Factor		1.0	
Benzo(a)anthracene	0.002	**0.1**	
Benzo(a)pyrene	0.002	**0.2**	
Benzo(b)fluoranthene	0.002	**0.2**	
Benzo(k)fluoranthene	0.002	**0.2**	
Chrysene	0.002	**0.1**	
Indeno(1,2,3-cd)pyrene	0.002	**0.1**	
Naphthalene	10	**19.4**	
Metals, Target Analyte, ICP	ug/L	ug/L	
Dilution Factor		1.0	
Lead	25	**74.8**	
Manganese	300	**1,390.0**	
Selenium	10	**27.8**	
Sodium	20000	**130,000.0**	
Metals, Target Analyte, ICP Dissolved	ug/L	ug/L	
Dilution Factor		1.0	
Magnesium	35000	10,100.0	
Manganese	300	**1,950.0**	
Sodium	20000	**200,000.0**	



Sample ID Sampling Date Client Matrix	NYSDEC TOGS Standards and Guidance Values	GW-6 42774.0 Water	
Compound	GA	Result	Q
Semi-Volatiles, 8270 Base/Neutrals	ug/L	ug/L	
Dilution Factor		1.0	
Benzo(a)pyrene	0.002	**0.1**	
Benzo(b)fluoranthene	0.002	**0.2**	
Benzo(k)fluoranthene	0.002	**0.1**	
Chrysene	0.002	**0.1**	
Indeno(1,2,3-cd)pyrene	0.002	**0.1**	
Pyrene	50	0.1	J
Metals, Target Analyte, ICP	ug/L	ug/L	
Dilution Factor		1.0	
Lead	25	18.4	
Manganese	300	**3,440.0**	
Selenium	10	**18.1**	
Sodium	20000	**437,000.0**	
Metals, Target Analyte, ICP Dissolved	ug/L	ug/L	
Dilution Factor		1.0	
Magnesium	35000	**44,900.0**	
Manganese	300	**1,390.0**	
Selenium	10	**17.4**	

Sample ID Sampling Date Client Matrix	NYSDEC TOGS Standards and Guidance Values	GW-5 42774.0 Water	
Compound	GA	Result	Q
Metals, Target Analyte, ICP	ug/L	ug/L	
Dilution Factor		1.0	
Lead	25	**30.0**	
Manganese	300	**6,320.0**	
Selenium	10	**25.6**	
Sodium	20000	**82,700.0**	
Metals, Target Analyte, ICP Dissolved	ug/L	ug/L	
Dilution Factor		1.0	
Magnesium	35000	15,100.0	
Manganese	300	5.6	U
Selenium	10	**30.0**	
Sodium	20000	**117,000.0**	

NOTES:
Any Regulatory Exceedences are color coded by Regulation

Q is the Qualifier Column with definitions as follows:
D=result is from an analysis that required a dilution
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
U=analyte not detected at or above the level indicated
B=analyte found in the analysis batch blank
E=result is estimated and cannot be accurately reported due to levels encountered or interferences
P=this flag is used for pesticide and PCB (Aroclor) target compounds when there is a % difference for detected concentrations that exceed method dictated limits between the two GC columns used for analysis
NT=this indicates the analyte was not a target for this sample
~=this indicates that no regulatory limit has been established for this analyte

LEGEND
GROUNDWATER

180 EAST 156TH STREET
BRONX, NEW YORK

CONCOURSE VILLAGE WEST APARTMENTS
SUPPLEMENTAL REMEDIAL INVESTIGATION
WORK PLAN

GEI Consultants

GROUNDWATER CHEMISTRY MAP
[BCP# 203291]

Project 1700655 | SEPTEMBER 2017 | Fig. 2

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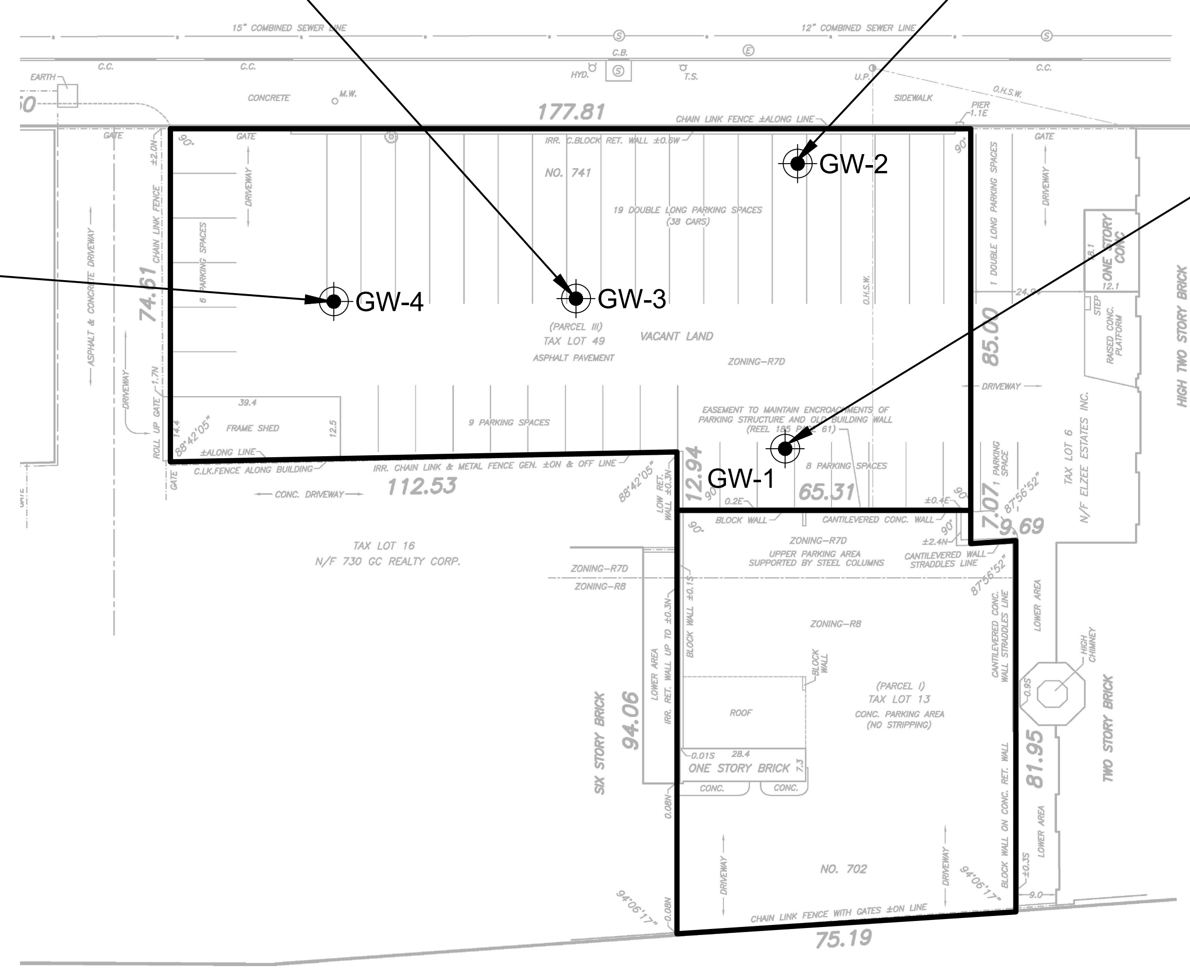
Sample ID Sampling Date Client Matrix	GW-3 2/8/2017 Water	
Compound	**Result**	**Q**
Volatile Organics, 8260 - Comprehensive	ug/L	
Dilution Factor	20	
1,2,4-Trimethylbenzene	**240**	D
1,3,5-Trimethylbenzene	**45**	D
Ethyl Benzene	**150**	D
Isopropylbenzene	**36**	
n-Butylbenzene	**22**	
n-Propylbenzene	**48**	D
o-Xylene	**12**	
p- & m- Xylenes	**230**	D
sec-Butylbenzene	**6.300**	
Xylenes, Total	**240**	D
Semi-Volatiles, 8270 Base/Neutrals	ug/L	
Dilution Factor	1	
Benzo(a)anthracene	**0.116**	
Benzo(a)pyrene	**0.232**	
Benzo(b)fluoranthene	**0.200**	
Benzo(k)fluoranthene	**0.200**	
Chrysene	**0.147**	
Indeno(1,2,3-cd)pyrene	**0.105**	
Naphthalene	**24**	
Metals, Target Analyte, ICP Dissolved	ug/L	
Dilution Factor	1	
Manganese	**1,940**	
Sodium	**198,000**	

Sample ID Sampling Date Client Matrix	GW-2 2/8/2017 Water	
Compound	**Result**	**Q**
Metals, Target Analyte, ICP Dissolved	ug/L	
Dilution Factor	1	
Magnesium	**45,900**	
Manganese	**1,470**	
Selenium	**29.400**	

Sample ID Sampling Date Client Matrix	GW-1 2/8/2017 Water	
Compound	**Result**	**Q**
Metals, Target Analyte, ICP Dissolved	ug/L	
Dilution Factor	1	
Selenium	**48**	
Sodium	**147,000**	

Sample ID Sampling Date Client Matrix	GW-4 2/8/2017 Water	
Compound	**Result**	**Q**
Volatile Organics, 8260 - Comprehensive	ug/L	
Dilution Factor	1	
1,2,4-Trimethylbenzene	**7.400**	
Ethyl Benzene	**6.800**	
p- & m- Xylenes	**7.400**	
Xylenes, Total	**9.300**	
Metals, Target Analyte, ICP Dissolved	ug/L	
Dilution Factor	1	
Manganese	**5,230**	
Sodium	**116,000**	

Sample ID Sampling Date Client Matrix	NYSDEC TOGS Standards and Guidance Values
Compound	**GA**
Volatile Organics, 8260 - Comprehensive	ug/L
Dilution Factor	
1,2,4-Trimethylbenzene	5
1,3,5-Trimethylbenzene	5
Ethyl Benzene	5
Isopropylbenzene	5
n-Butylbenzene	5
n-Propylbenzene	5
o-Xylene	5
p- & m- Xylenes	5
p-Isopropyltoluene	5
sec-Butylbenzene	5
Xylenes, Total	5
Semi-Volatiles, 8270 Base/Neutrals	ug/L
Dilution Factor	
Benzo(a)anthracene	0.002
Benzo(a)pyrene	0.002
Benzo(b)fluoranthene	0.002
Benzo(k)fluoranthene	0.002
Chrysene	0.002
Indeno(1,2,3-cd)pyrene	0.002
Naphthalene	10
Pyrene	50
Metals, Target Analyte, ICP Dissolved	ug/L
Dilution Factor	
Magnesium	35000
Manganese	300
Selenium	10
Sodium	20000



NOTES:
ug/L = micrograms per liter
Any Regulatory Exceedences are bold and shaded

Q is the Qualifier Column with definitions as follows:
J=analyte detected at or above the MDL (method detection limit) but below the RL (Reporting Limit) - data is estimated
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NT=this indicates the analyte was not a target for this sample
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LEGEND
GROUNDWATER

702 GRAND CONCOURSE
741 CONCOURSE VILLAGE WEST
BRONX, NEW YORK

CONCOURSE VILLAGE WEST APARTMENTS
SUPPLEMENTAL REMEDIAL INVESTIGATION
WORK PLAN

GEI Consultants

Project 1700655

GROUNDWATER CHEMISTRY MAP
[BCP# 203292]

SEPTEMBER 2017

Fig. 3

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Appendix A

Soil Boring Logs, Monitoring Well Installation Logs, and Geotechnical Boring Logs

GEI Consultants

EXPLORATION LOG

SOIL BORING (B1)

Boring/Well ID:	B-1	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt 4"
1								Black/brown fine to coarse sand & gravel, stone, red brick (fill)
								Brown fine sand 100%
2								
3								
4	S-2	4-8					0.0	Brown fine sand 100% (SP)
5								
6								
7								
8	S-3	8-12					0.0	Brown fine sand 100% (SP)
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100% (SP)
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B2)

Boring/Well ID:	B-2	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt 4"
1								Black/brown fine to coarse gravel & sand, concrete, red brick & stone fill
								Brown fine sand 100%
2								
3								
4	S-2	4-8					0.0	Brown fine sand 100%
5								
6								
7								
8	S-3	8-12					0.0	Brown fine sand 100%
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B3)

Boring/Well ID:	B-3	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel, stone (fill)
1								
2								
3								
4	S-2	4-8					0.0	Brown fine sand 100% (SP)
5								
6								
7								
8	S-3	8-12					0.0	Brown fine sand 100%
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B4)

Boring/Well ID:	B-4	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand, concrete, gravel, stone
1								red brick fill (urban fill)
2								
3								
4	S-2	4-8					0.0	Brown fine sand 100% (SP)
5								
6								
7								
8	S-3	8-12					0.0	Brown fine sand 100%
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B5)

Boring/Well ID:	B-5	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel, stone, concrete, red brick (fill)
1								
2								
3								
4	S-2	4-8					0.0	Brown fine sand 100%
5								
6								
7								
8	S-3	8-12					0.0	Brown fine sand 100%
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B6)

Boring/Well ID:	B-6	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Brown/black fine to coarse sand & gravel stone, red brick, concrete urban fill
1								
2								
3								
4	S-2	4-8					0.0	
5								Brown fine sand 100%
6								
7								
8	S-3	8-12					0.0	Brown fine sand 100%
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

EXPLORATION LOG

SOIL BORING (B7)

Boring/Well ID:	B-7	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
1								
2								
3								
4	S-2	4-8					0.0	
5								
6								Brown fine sand 100%
7								
8	S-3	8-12					0.0	Brown fine sand 100%
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B8)

Boring/Well ID:	B-8	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/7/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel
1								coal ash/cinders/slag
								red brick, stone, & concrete
2								(urban fill)
3								
4	S-2	4-8					0.0	
5								
6								
7								
8	S-3	8-12					0.0	
9								
10								
11								
12	S-4	12-16					0.0	Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B9)

Boring/Well ID:	B-9	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
1								
2								
3								
4	S-2	4-8					0.0	Very little recovery Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
5								
6								
7								Brown fine sand 100%
8	S-3	8-12					0.0	
9								
10								
11								
12	S-4	12-16						Brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B10)

Boring/Well ID:	B-10	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
1								
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
9								
10								Dark brown fine sand 100%
11								
12	S-3	12-16						Dark brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B11)

Boring/Well ID:	B-11	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):		**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
1								
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand & gravel coal slag/cinders, red brick stone, concrete (urban fill)
9								
10								Dark brown fine sand 100%
11								
12	S-4	12-16						Dark brown fine sand 100%
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B12)

Boring/Well ID:	B-12	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt
1								Black fine to coarse sand, gravel, stone, red brick
								coal cinders & ash/slag
2								glass & debris (urban fill)
3								
4	S-2	4-8					0.0	
5								
6								
7								
8	S-3	8-12					0.0	Brown/tan fine to coarse sand 80%
								fine gravel 20%
9								crushed stone
10								
11								
12	S-4	12-16					0.0	Brown/tan fine to coarse sand 80%
								fine gravel 20%
13								crushed stone
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

EXPLORATION LOG

SOIL BORING (B13)

Boring/Well ID:	B-13	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017?	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt
1								Black fine to coarse sand, coal cinders ash, slag, red brick
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand, coal cinders ash, slag, red brick
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand, coal cinders ash, slag, red brick
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand, coal cinders ash, slag, red brick
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B14)

Boring/Well ID:	B-14	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt
1								Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinder fill red bricks, concrete & stone
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinder fill red bricks, concrete & stone
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinder fill red bricks, concrete & stone
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinder fill red bricks, concrete & stone
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B15)

Boring/Well ID:	B-15	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
0	S-1	0-4					0.0	Asphalt Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders glass, red bricks
1								
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders glass, red bricks
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders glass, red bricks
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders glass, red bricks
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B16)

Boring/Well ID:	B-16	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt
1								Black fine to coarse sand 60% fine to coarse gravel 40% black coal/ash/slag glass, red bricks (urban fill)
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal/ash/slag glass, red bricks (urban fill)
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal/ash/slag glass, red bricks (urban fill)
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal/ash/slag glass, red bricks (urban fill)
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B17)

Boring/Well ID:	B-17	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt
1								Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders red brick (urban fill)
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders red brick (urban fill)
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders red brick (urban fill)
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand 70% fine to coarse gravel 30% coal ash/slag/cinders red brick (urban fill)
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B18)

Boring/Well ID:	B-18	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/cinders/slag red brick, glass (urban fill)
1								
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/cinders/slag red brick, glass (urban fill)
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/cinders/slag red brick, glass (urban fill)
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/cinders/slag red brick, glass (urban fill)
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B19)

Boring/Well ID:	B-19	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	N. Recchia/S. Nyczak	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/8/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	16.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Asphalt
1								Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/slag/cinders
2								
3								
4	S-2	4-8					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/slag/cinders
5								
6								
7								
8	S-3	8-12					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/slag/cinders
9								
10								
11								
12	S-4	12-16					0.0	Black fine to coarse sand 60% fine to coarse gravel 40% black coal ash/slag/cinders
13								
14								
15								
16								EOB @ 16ft
17								
18								
19								
20								
21								
22								
23								
24								
25								

EXPLORATION LOG

SOIL BORING (B20)

Boring/Well ID:	B-20	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	2.0	**Driller:**	
		Drilling Method:	Hand Auger
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	brown sand with rock & ash
1								brown fine sand
								black coal ash/slag/cinders
2								
3								
4								EOB @ 2 ft
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

GEI Consultants

EXPLORATION LOG

SOIL BORING (B21)

Boring/Well ID:	B-21	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	2.0	**Driller:**	
		Drilling Method:	Hand Auger
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	brown sand with rock & ash
1								brown fine sand
								black coal ash/slag/cinders
2								
3								
								Collected by Hand Auger. EOB @ 2ft.
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

GEI Consultants

EXPLORATION LOG

SOIL BORING (B22)

Boring/Well ID:	B-22	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):		**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Concrete/black coal ash
1								brown sand with rock & ash
								brown fine sand
2								black coal ash/slag/cinders
3								
4	S-2	4-8					0.0	
								Very little recovery
5								brown fine to coarse sand with rock
6								
7								
8	S-3	8-12					0.0	Brown well graded sands
								black rock
9								
10								
11								
12	S-4	12-16					0.0	Brown well graded sands
13								EOB @ 13ft (refusal)
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

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EXPLORATION LOG

SOIL BORING (B23)

Boring/Well ID:	B-23	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	4.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Fill/cobbles/rock (fill)
1								
2								
3								
4								EOB @ 4 ft Refusal @ 4 ft
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

GEI Consultants

EXPLORATION LOG

SOIL BORING (B24)

Boring/Well ID:	B-24	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):		**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Tan rocky sand with red sand and brick material (Fill)
1								
2								
3								
4	S-2	4-8					0.0	Brown sand with rock 20%, fine 20%, medium 60%
5								
6								EOB @ 7ft
7								Refusal @ 7ft
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

GEI Consultants

EXPLORATION LOG

SOIL BORING (B25)

Boring/Well ID:	B-25	**Client:**	Azimuth Development Group
Project Number:	1700655	**Project Name:**	Phase II Subsurface Investigation
Logged By:	T. Johansen	**Site Address:**	741 Concourse Village, Bronx, New York
Date:	2/13/2017	**Contractor:**	Tri-State Drilling Technologies, Inc.
Total Depth (feet):	3.0	**Driller:**	
		Drilling Method:	Geoprobe LT 5400
Elevation (Ground):		**Vertical Datum:**	

Depth (feet)	Sample Identification	Sample Interval (feet)	Blows per 6 inches	Penetration (inches)	Recovery (inches)	Stratographic Unit	PID Jar HS / Remarks	Sample Description
	S-1	0-4					0.0	Grey rock with fine to medium sand
1								
2								EOB @ 3ft
3								Refusal @ 3ft
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Groundwater Well Installation Log

GW-1

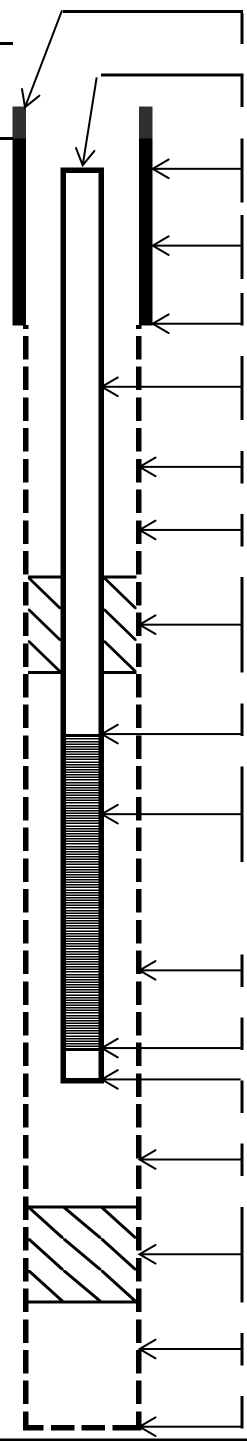
Project	Concourse Village West Apartments
City / Town	Bronx, NY
Client	Azimuth Development Group
Contractor	Tri-State Drilling Technologies
Driller	Paul
GEI Rep.	Nick
GEI Proj. No.	1700655
Location	Lot 49
Install Date	2/8/2017

Survey Datum: NA

Ground Elevation:

General Soil Conditions (Not to Scale)

Date	Time	Distance to ▼ below top of riser pipe



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

Notes: Temporary 1-inch monitoring wells

GEI Consultants

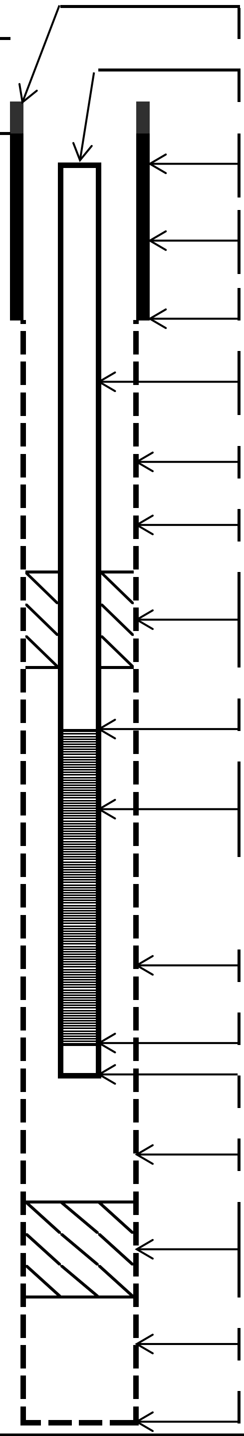
Groundwater Well Installation Log

GW-2

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 49
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/8/2017

Survey Datum: NA

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

General Soil Conditions (Not to Scale)

Date	Time	Distance to ▼ below top of riser pipe

Notes: Temporary 1-inch monitoring wells

GEI Consultants

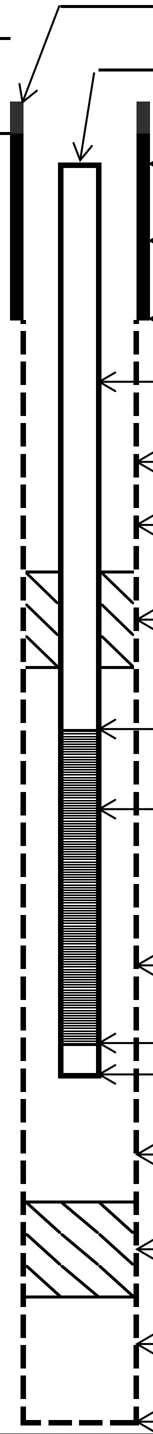
Groundwater Well Installation Log

GW-3

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 49
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/8/2017

Survey Datum: **NA**

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

General Soil Conditions (Not to Scale)

Date	Time	Distance to ▼ below top of riser pipe

Notes: Temporary 1-inch monitoring wells

GEI Consultants

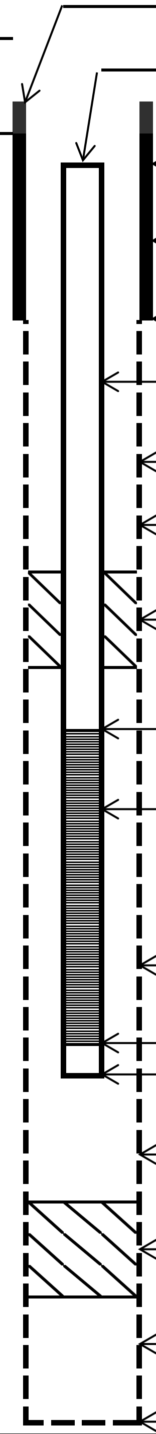
Groundwater Well Installation Log

GW-4

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 49
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/8/2017

Survey Datum: NA

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

General Soil Conditions (Not to Scale)

Date	Time	Distance to ▼ below top of riser pipe

Notes: Temporary 1-inch monitoring wells

GEI Consultants

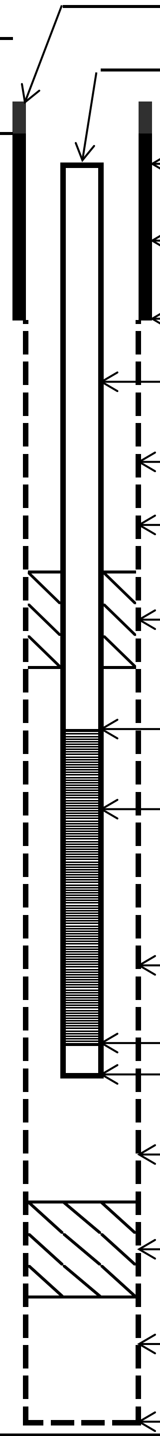
Groundwater Well Installation Log

GW-5

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 35
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/7/2017

Survey Datum: **NA**

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

General Soil Conditions (Not to Scale)

Date	Time	Distance to ▼ below top of riser pipe

Notes: Temporary 1-inch monitoring wells

GEI Consultants

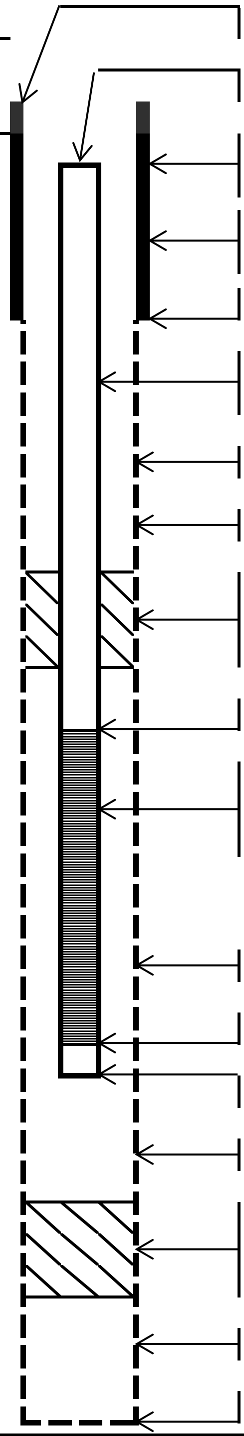
Groundwater Well Installation Log

GW-6

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 35
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/7/2017

Survey Datum: NA

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

Date	Time	Distance to ▼ below top of riser pipe

General Soil Conditions (Not to Scale)

Notes: Temporary 1-inch monitoring wells

GEI Consultants

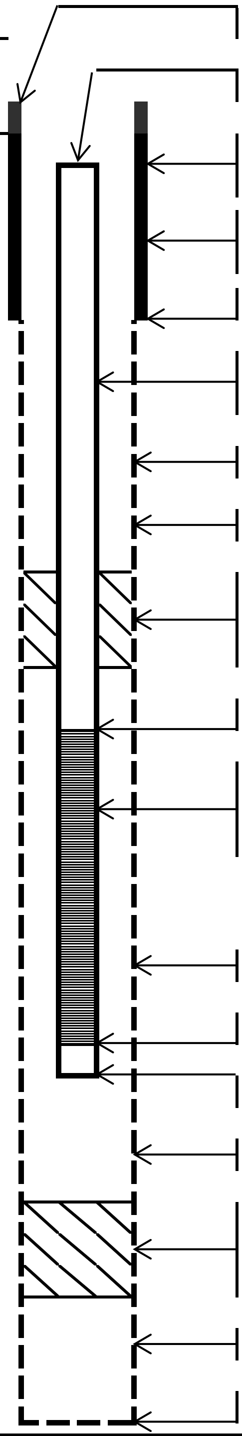
Groundwater Well Installation Log

GW-7

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 35
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/7/2017

Survey Datum: NA

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

Date	Time	Distance to ▼ below top of riser pipe

General Soil Conditions (Not to Scale)

Notes: Temporary 1-inch monitoring wells

GEI Consultants

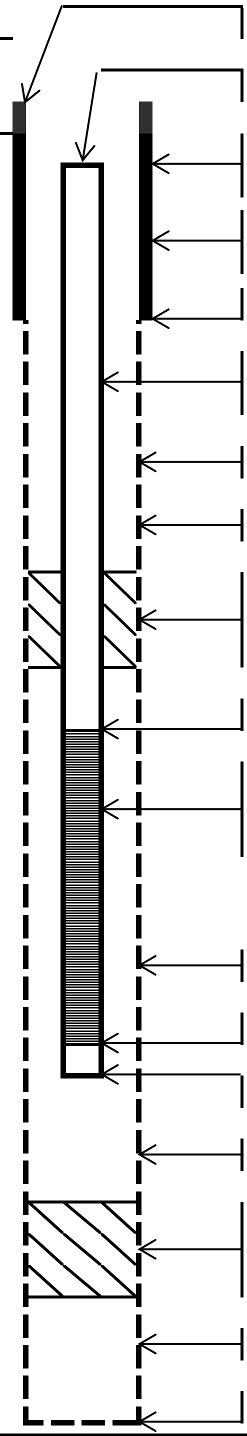
Groundwater Well Installation Log

GW-8

Project	Concourse Village West Apartments	**GEI Proj. No.**	1700655
City / Town	Bronx, NY	**Location**	Lot 35
Client	Azimuth Development Group		
Contractor	Tri-State Drilling Technologies		
Driller	Paul **GEI Rep.** Nick	**Install Date**	2/7/2017

Survey Datum: NA

Ground Elevation:



Length of Surface Casing above Ground	NA
Dist. Top of Surf. Casing to Top of Riser Pipe	1'
Type and Thickness of Seal around Surface Casing	NA
ID of Surface Casing	NA
Type of Surface Casing	NA
Depth Bottom of Surface Casing	NA
ID and OD of Riser Pipe	1-inch monitoring well
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	Native
Diameter of Borehole	3-inch
Depth Top of Seal	28
Type of Seal	
Depth Bottom of Seal	32
Depth Top of Screened Section	32
Type of Screen	PVC
Description of Screen Openings	0.020 Slot
ID and OD of Screened Section	1-inch
Type of Filter Material	#2 Sand
Depth Bottom of Screened Section	42
Depth Bottom of Silt Trap	42.5
Depth Bottom of Filter Material	42.5
Depth Top of Seal	NA
Type of Seal	NA
Depth Bottom of Seal	NA
Type of Backfill below Filter Material	NA
Bottom of Borehole	NA

General Soil Conditions (Not to Scale)

Date	Time	Distance to ▼ below top of riser pipe

Notes: Temporary 1-inch monitoring wells

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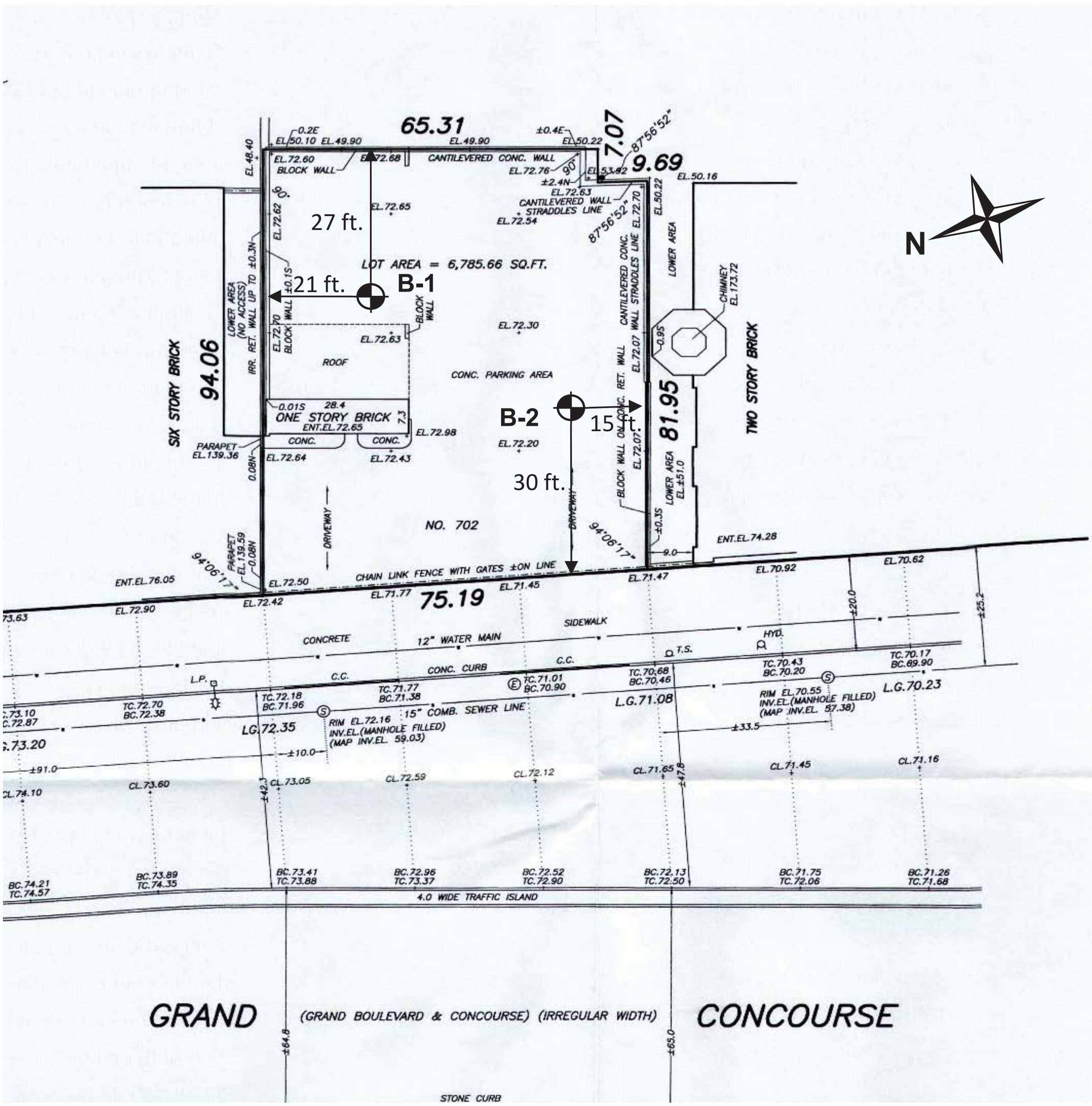


LEGEND:

B-X	Indicates the numbers and approximate locations of test borings performed for this study.

BORING LOCATION PLAN

702 GRAND CONCOURSE

Bronx,
New York

Prepared For:
Concourse Village West Owner, LLC

211-K Gates Road
Little Ferry, New Jersey 07643
(201) 641-1850
fax (201) 641-1655

GTA ENGINEERING SERVICES OF NEW YORK, P.C.

DESIGN BY: *	DRAWN BY: SM	REVIEWED BY: RD
SCALE: NTS	DATE: MAR 2017	PROJECT #: 34170211

Figure 3

NOTES FOR EXPLORATION LOGS

KEY TO USCS TERMINOLOGY AND GRAPHIC SYMBOLS

MAJOR DIVISIONS (BASED UPON ASTM D 2488)			SYMBOLS GRAPHIC	SYMBOLS LETTER
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 15% PASSING THE NO. 200 SIEVE)		GW
				GP
		GRAVELS WITH FINES (MORE THAN 15% PASSING THE NO. 200 SIEVE)		GM
				GC
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LESS THAN 15% PASSING THE NO. 200 SIEVE)		SW
				SP
		SANDS WITH FINES (MORE THAN 15% PASSING THE NO. 200 SIEVE)		SM
				SC
FINE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILT OR CLAY (<15% RETAINED ON THE NO. 200 SIEVE) SILT OR CLAY WITH SAND OR GRAVEL (15% TO 30% RETAINED ON THE NO. 200 SIEVE) SANDY OR GRAVELLY SILT OR CLAY (>30% RETAINED ON THE NO. 200 SIEVE)	SILTS AND LEAN CLAYS LIQUID LIMIT LESS THAN 50		ML
				CL
				OL
		ELASTIC SILTS AND FAT CLAYS LIQUID LIMIT GREATER THAN 50		MH
				CH
				OH
HIGHLY ORGANIC SOILS				PT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE COARSE-GRAINED SOILS WHICH CONTAIN AN ESTIMATED 5 TO 15% FINES BASED ON VISUAL CLASSIFICATION OR BETWEEN 5 AND 12% FINES BASED ON LABORATORY TESTING; AND FINE-GRAINED SOILS WHEN THE PLOT OF LIQUID LIMIT & PLASTICITY INDEX VALUES FALLS IN THE PLASTICITY CHART'S CROSS-HATCHED AREA. FINE-GRAINED SOILS ARE CLASSIFIED AS ORGANIC (OL OR OH) WHEN ENOUGH ORGANIC PARTICLES ARE PRESENT TO INFLUENCE ITS PROPERTIES. LABORATORY TEST RESULTS ARE USED TO SUPPLEMENT SOIL CLASSIFICATION BY THE VISUAL-MANUAL PROCEDURES OF ASTM D 2488.

ADDITIONAL TERMINOLOGY AND GRAPHIC SYMBOLS

	DESCRIPTION		GRAPHIC SYMBOLS
ADDITIONAL DESIGNATIONS	TOPSOIL		
	MAN MADE FILL		
	GLACIAL TILL		
	COBBLES AND BOULDERS		
RESIDUAL SOIL DESIGNATIONS	DESCRIPTION	"N" VALUE	
	HIGHLY WEATHERED ROCK	50 TO 50/1"	
	PARTIALLY WEATHERED ROCK	MORE THAN 50 BLOWS FOR 1" OF PENETRATION OR LESS, AUGER PENETRABLE	

COARSE-GRAINED SOILS
(GRAVEL AND SAND)

DESIGNATION	BLOWS PER FOOT (BPF) "N"
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	>50

NOTE: "N" VALUE DETERMINED AS PER ASTM D 1586

FINE-GRAINED SOILS
(SILT AND CLAY)

CONSISTENCY	BPF "N"
VERY SOFT	<2
SOFT	2 - 4
MEDIUM STIFF	5 - 8
STIFF	9 - 15
VERY STIFF	16 - 30
HARD	>30

NOTE: ADDITIONAL DESIGNATIONS TO ADVANCE SAMPLER INDICATED IN BLOW COUNT COLUMN:
WOH = WEIGHT OF HAMMER
WOR = WEIGHT OF ROD(S)

SAMPLE TYPE

DESIGNATION	SYMBOL
SOIL SAMPLE	S-
SHELBY TUBE	U-
ROCK CORE	R-

WATER DESIGNATION

DESCRIPTION	SYMBOL
ENCOUNTERED DURING DRILLING	
UPON COMPLETION OF DRILLING	
24 HOURS AFTER COMPLETION	

NOTE: WATER OBSERVATIONS WERE MADE AT THE TIME INDICATED. POROSITY OF SOIL STRATA, WEATHER CONDITIONS, SITE TOPOGRAPHY, ETC. MAY CAUSE WATER LEVEL CHANGES.

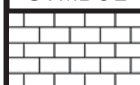
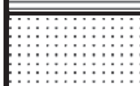
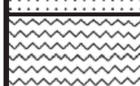
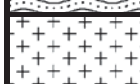
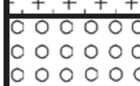
NOTES FOR ROCK DESCRIPTION

WEATHERING TERM	DESCRIPTION
FRESH	ROCK CRYSTALS BRIGHT. COLOR OF CORE IS CONSISTENT. JOINTS SHOW LITTLE STAINING.
SLIGHTLY WEATHERED	ROCK GENERALLY FRESH. JOINTS STAINED AND DISCOLORATION AROUND JOINTS MAY EXTEND UP TO 0.5 INCHES INTO ROCK. SOME CRYSTALS MAY APPEAR DULL OR DISCOLORED.
MODERATELY WEATHERED	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION. MANY VISIBLE MINERALS ARE DULL AND DISCOLORED. ROCK HAS DULL SOUND WHEN HIT BY HAMMER AND HAS SIGNIFICANT STRENGTH LOSS.
HIGHLY WEATHERED	ALL ROCK IS DISCOLORED AND STAINED. ROCK FABRIC IS EVIDENT BUT ZONES OF ROCK HAVE BEEN REDUCED TO SOFT STRENGTH. SOME HARD PIECES OF ROCK ARE USUALLY PRESENT BETWEEN SOFT ZONES.

HARDNESS DESCRIPTION	STRENGTH RANGE (PSI)	FIELD HARDNESS TEST
VERY HARD	>10,000	CANNOT BE SCRATCHED WITH KNIFE. CORE RINGS UNDER HARD BLOWS OF A HAMMER.
HARD	3,500 to 10,000	DIFFICULT TO SCRATCH WITH KNIFE. HARD BLOW OF HAMMER REQUIRED TO BREAK.
MODERATELY HARD	1,500 to 3,500	CAN BE SCRATCHED WITH KNIFE. MODERATE BLOW OF HAMMER BREAKS CORE.
SOFT	500 to 1,500	CAN BE GOUGED OR GROOVED WITH KNIFE. SMALL PIECES CAN BE BROKEN BY HAND.

FRACTURING CLASSIFICATION	DESCRIPTION
HIGHLY FRACTURED	LESS THAN 2 INCHES
MODERATELY FRACTURED	2 INCHES TO 12 INCHES
SLIGHTLY FRACTURED	12 INCHES TO 36 INCHES
MASSIVE	GREATER THAN 36 INCHES

BEDDING DESCRIPTION	SEPARATION
VERY THIN	LESS THAN 2 INCHES
THIN	2 INCHES TO 1 FOOT
MEDIUM	1 FOOT TO 3 FEET
THICK	3 FEET TO 10 FEET
VERY THICK	MORE THAN 10 FEET

GRAPHIC SYMBOL	ROCK DESCRIPTION
	LIMESTONE/DOLOMITE/MARBLE (CARBONATE ROCK)
	SHALE/MUDSTONE/SILTSTONE (FINE-GRAINED SEDIMENTARY ROCKS)
	SANDSTONE
	SLATE/PHYLLITE (FINE-GRAINED METAMORPHIC ROCKS)
	GNEISS/SCHIST (COARSE-GRAINED METAMORPHIC ROCKS)
	BASALT/DIABASE/GABBRO (IGNEOUS ROCKS)
	CONGLOMERATE
	GYPSUM

DESCRIPTION SYNTAX: COLOR, WEATHERING, HARDNESS, FRACTURING, ROCK TYPE, “WITH” BEDDING (IF SEDIMENTARY).

ROCK QUALITY DESIGNATION (RQD) = $$\left[\frac{\text{TOTAL LENGTH OF CORE PIECES THAT ARE 4-INCHES OR LONGER (IN.)}}{\text{TOTAL LENGTH OF CORE RUN (IN.)}}\right] \text{X } 100\%$$

LOG OF BORING NO. B-1

PROJECT: **702 Grand Concourse**
PROJECT NO.: **34170211**
PROJECT LOCATION: **Bronx, NY**

WATER LEVEL (ft):	NE	NE	NE
DATE:	2-15-17	2-16-17	2-16-17
CAVED (ft):	In Auger	NA	BOC

DATE STARTED: **2-15-17**
DATE COMPLETED: **2-16-17**
DRILLING CONTRACTOR: **DK Drilling of New York**
DRILLER: **Dorbal**
DRILLING METHOD: **Mud Rotary**
SAMPLING METHOD: **SPT**

HAMMER TYPE: **Automatic**
GROUND SURFACE ELEVATION: **73 +/-**
DATUM: **NAVD 88**
EQUIPMENT: **Simco 2800**
LOGGED BY: **SM**
CHECKED BY: **RD**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					73.0	0			Concrete Platform	
					72.5				VOID	
					68.0	5	FILL		FILL: Brown, moist, loose, poorly-graded sand with silt and debris (Class 7)	
S-1	5.0	18	4-3-4-8	7						
						10			- medium dense	
S-2	10.0	11	2-7-6-7	13						
						15				
S-3	15.0	9	5-6-5-5	11						
						20				
S-4	20.0	1	5-5-4-5	9						
					51.0		SM		Brown, moist, loose, Silty SAND (Class 6)	
S-5	22.0	17	4-3-3-3	6						
						25			- medium dense (Class 3b)	
S-6	25.0	11	3-4-5-3	9						
						30				

NOTES: **BOC = Backfilled on Completion**
Hole was left open as an additional drain per tenant's request

LOG OF BORING NO. B-1

PROJECT: **702 Grand Concourse**
PROJECT NO.: **34170211**
PROJECT LOCATION: **Bronx, NY**

WATER LEVEL (ft):	NE	NE	NE
DATE:	2-15-17	2-16-17	2-16-17
CAVED (ft):	In Auger	NA	BOC

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-7	30.0	10	5-5-7-9	12			SM		Brown, moist, medium dense, Silty SAND (Class 3b)	
						35				
S-8	35.0	16	6-8-8-11	16						
						40				
S-9	40.0	20	7-10-15-16	25						
						45				
S-10	45.0	11	9-10-13-16	23						
						50				
S-11	50.0	16	9-9-9-9	18					- Red-brown	
						55				
					16.0		HW		Highly weathered rock, presents as: Gray, moist, very dense, Silty Sand (Class 1d)	
S-12	57.0	9	3-6-65/5"	100+						
						60				
S-13	60.0	5	12-7-50/4"	50+	12.0		ROCK		Nx Rock Core Run 61-66 ft. SCHIST BEDROCK: Gray, hard, slightly weathered, slightly fractured (Class 1a) REC: 94% RQD: 94%	
R-1	61.0									
						65				
					7.0				Boring terminated at 66 ft.	

LOG OF BORING NO. B-2

PROJECT: **702 Grand Concourse**
PROJECT NO.: **34170211**
PROJECT LOCATION: **Bronx, NY**

WATER LEVEL (ft):	NE	NE	NE
DATE:	2-14-17	2-15-17	2-15-17
CAVED (ft):	In Auger	NA	BOC

DATE STARTED: **2-14-17**
DATE COMPLETED: **2-15-17**
DRILLING CONTRACTOR: **DK Drilling of New York**
DRILLER: **Dorbal**
DRILLING METHOD: **Mud Rotary**
SAMPLING METHOD: **SPT**

HAMMER TYPE: **Automatic**
GROUND SURFACE ELEVATION: **73 +/-**
DATUM: **NAVD 88**
EQUIPMENT: **Simco 2800**
LOGGED BY: **SM**
CHECKED BY: **RD**

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
					73.0	0			Concrete Platform	
S-1	1.0	6	35-6-3-2	9	72.0		FILL		FILL: Brown, moist, medium dense, silty sand with gravel (Class 7)	
S-2	5.0	10	2-1-2-4	3		5			- loose	
S-3	10.0	8	2-3-2-6	5		10				
S-4	15.0	6	7-7-9-9	16		15			- medium dense	
S-5	20.0	9	6-8-8-5	16	53.0	20	SM		Brown, moist, medium dense, Silty SAND (Class 3b)	
S-6	25.0	7	3-4-2-3	6		25			- loose (Class 6)	
						30				

NOTES: **BOC = Backfilled on Completion**
Hole was left open as an additional drain per tenant's request

GEO-TECHNOLOGY
ASSOCIATES, INC.
211-K Gates Road
Little Ferry, NJ 07643

LOG OF BORING NO. B-2

PROJECT: **702 Grand Concourse**
PROJECT NO.: **34170211**
PROJECT LOCATION: **Bronx, NY**

WATER LEVEL (ft):	NE	NE	NE
DATE:	2-14-17	2-15-17	2-15-17
CAVED (ft):	In Auger	NA	BOC

SAMPLE NUMBER	SAMPLE DEPTH (ft.)	SAMPLE RECOVERY (in.)	SAMPLE BLOWS/6 inches	N (blows/ft.)	ELEVATION (ft.)	DEPTH (ft.)	USCS	GRAPHIC SYMBOL	DESCRIPTION	REMARKS
S-7	30.0	10	5-6-7-8	13			SM		Brown, moist, medium dense, Silty SAND (Class 3b)	
S-8	35.0	10	6-8-12-13	20		35				
S-9	40.0	9	8-11-12-14	23		40				
S-10	44.0	6	46-50/5"	50+	29.0	45	HW		Highly weathered rock, presents as: Brown-gray, moist, very dense, Silty Sand (Class 1d)	
S-11	50.0	0	50/1"	Ref		50				
R-1	52.0				21.0	55	ROCK		Nx Rock Core Run 52-57 ft. SCHIST BEDROCK: Gray, hard, slightly weathered, moderately fractured (Class 1B) REC: 93% RQD: 83%	
R-2	57.0					60			REC: 85% RQD: 80%	
					11.0	65			Boring terminated at 62 ft.	

Appendix B

Standard Operating Procedures

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering

Environmental Standard Operating Procedures Atlantic and New England Regions

June 2011

Table of Contents

Section 7 – Solid Matrix Sampling (SM)

Section 8 – Groundwater (GW)

Section 9 – Surface Water Sampling (SW)

Section 10 – Sediment Sampling (SS)

Section 1

Introduction

STANDARD OPERATING PROCEDURE

1. Introduction

This document presents the Standard Operating Procedures (SOPs) for the Atlantic and New England Regions of GEI Consultants, Inc. (GEI). The primary intent of the document is to promote consistency in application of Standard Operating Procedures (SOPs) for environmental field and some office operations. Application and use of SOPs will be considered and may be discussed in annual staff reviews.

This SOP document encompasses a broad range of activities to improve the planning, implementation, and documentation of most environmental field and some office operations. The methodologies presented in this manual may not be applicable to site-specific situations. If you are uncertain about a procedure, confirm its adequacy with the project manager, client, and/or regulatory bodies to confirm that procedures are consistent with their expectations.

The document is organized according to the chronological sequence of typical work flow proceeding from project setup to field activities, data collection, and report preparation tasks.

Two types of documents are contained herein:

- General Guidance Procedures – Documents intended to be informative and not prescriptive. These documents are designed to provide necessary background information to adequately understand the process.
- Standard Operating Procedures – Documents intended to describe standard procedures and limitations.

2. SOP Layout Design

2.1. Header Information

- Each SOP contains within its name a two letter abbreviation of the general category in which it belongs (i.e. RE-001 means it is in Site Reconnaissance). The table of contents provides the definition for each abbreviation. The SOP name and number is provided in the header and footer of the document. The revision number is provided in the header of each SOP.
- The effective date is provided in the header of each SOP. The effective date provides the date when the revisions to the SOP are in effect and provides information as to the last time the SOP was updated. Each SOP should contain the most up-to-date version and effective date.

2.2. Footer Information

- Each footer contains the page number and total page numbers as well as a second reference to the SOP name. This should help organize and collate pages.

2.3. Body of Text

- Limitations are provided to describe precautions or common issues associated with the performance of the procedure.
- References provide sources consulted for development of the SOP.
- Attachments provide reference to external documentation that should be reviewed in conjunction with the SOP.
- At least one contact person is provided at the bottom of each SOP. These people should be contacted with any questions or comments on the particular SOP. The contact can clarify the SOP or edit as necessary.

2.4. Process for editing/updating SOPs

Should you need to make a global change to an existing SOP, the current .pdf version can be found on the Intranet.

In order to make your changes, you will need to request a WORD copy of the SOP from Andrea Hippler, Jerry Zak or Ryan Hoffman. Once you have made your changes, the SOP should be e-mailed to Jerry Zak, Andrea Hippler and Ryan Hoffman with a note as to what changed.

This document has been provided to all staff performing environmental field tasks for GEI's Atlantic and New England Regions.

3. Attachment

Attachment A – Acronym List

STANDARD OPERATING PROCEDURE

Abbreviations and Acronyms

AOC	Area of Concern
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethyl Benzene, Xylenes
CAMP	Community Air Monitoring Plan
CERCLA	Comprehensive Environmental Response, Cleanup, and Liability Act
CFR	Code of Federal Regulations
COC	Chain of Custody
DL	Detection Limit
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQO	Data Quality Objectives
EC	Engineering Controls
EIS	Environmental Impact Study
EPA	Environmental Protection Agency
FID	Flame Ionization Detector
FS	Feasiblity Study
FWRIA	Fish and Wildlife Resources Impact Analysis
GAC	Granular Activated Carbon
GC/MS	Gas Chromatograph/Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption Spectrometry
GIS	Geographic Information Systems
GPR	Ground-penetrating Radar
HASP	Health and Safety Plan
HOC	Halogenated Organic Compound
HDPE	High Density Polyethylene
HPLC	High Pressure Liquid Chromatography
HSO	Health and Safety Officer
IC	Institutional Controls
ICP	Inductively Coupled Plasma Atomic Emission Spectrometry
IDW	Investigation Derived Waste
LEL	Lower Explosive Limit
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level (for EPA Drinking Water Standards)
MDL	Method Detection Limit
MGP	Manufactured Gas Plant
MSDS	Material Safety Data Sheet
NAPL	Non-aqueous Phase Liquids

NCP	National Contingency Plan
NPL	National Priority List
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan
QHHEA	Qualitative Health and Human Exposure Assessment
RAO	Remedial Action Objectives
RAP	Remedial Action Plan
RCRA	Resource Conservation Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RFP	Request For Proposal
RP	Responsible Party
SARA	Superfund Amendments and Reauthorization Act
SCGs	Standards, Criteria, and Guidance
SMP	Site Management Plan
SOP	Standard Operating Procedure
SOW	Scope of Work or Statement of Work
SPLP	Synthetic Precipitate Leaching Procedure
STEL	Short-Term Exposure Limit
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compounds
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Indentified Compound from Mass Spectrometry
TOC	Total Organic Carbon
TOSCA	Toxic Substance Control Act
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
USGS	United States Geologic Survey
VOC	Volatile Organic Compounds
WP	Work Plan
XRF	X-Ray Fluorescence

MEASUREMENTS

ppm	Parts per million
ppb	Parts per billion

ppbv	Parts per billion by volume
ppmv	Parts per million by volume
bgs	Below Ground Surface
msl	Mean Sea Level
ppbv	Parts per billion by volume
µg/L	Microgram per liter
µg/Kg	Microgram per kilogram
µg/m3	Microgram per cubic meter
mg/L	Milligram per liter
mg/kg	Milligram per kilogram
Mf/L	Million fibers per liter

Section 2

Pre-Mobilization Activities (PM)

STANDARD OPERATING PROCEDURE
PM-001 Utility Markout and Clearance

1. Objective

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

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

2. Execution

Public Utility Markouts

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

<u>The APWA Uniform Color Code</u>

1. **White** – Proposed Excavation
2. **Pink** – Temporary Survey Markings
3. **Red** – Electric Power Lines, Cables, Conduit and Lighting Cables
4. **Yellow** – Gas, Oil, Steam, Petroleum & Gaseous Material
5. **Orange** – Communications, Alarm or Signal Lines, Cables or Conduit
6. **Blue** – Potable Water
7. **Purple** – Reclaimed Water, Irrigation and Slurry Lines
8. **Green** – Sewers and Drain Lines

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

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

Private Utility Markouts

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

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

i. Electro-Magnetic (EM) device: This technology uses an electro-magnetic field in the subsurface to accurately locate metallic lines or non-metallic lines incorporating a metallic trace wire along their surface. The field is created either by direct contact to the pipe or tracewire, or by an induced current via radio waves.
ii. Sewer Sonde: For non-metallic lines where internal access is possible (such as clean-out ports in a sewer), a beacon or 'sonde' that emits a signal to the surface receiver as it is snaked through the pipe provides the same accuracy as the EM detector. If the internal condition of the pipe is desired, a camera can be deployed instead of a simple sonde.
iii. Ground Penetrating Radar (GPR): This technology involves radar waves reflecting to a surface receiver which provides a visual real-time map of the subsurface by which anomalies (such as pipes or tanks) may be detected. It has limitations in clay or wet soils and requires a skilled operator for interpretation. GPR should be considered for high risk utilities (e.g. PVC natural gas lines without trace wire) where line-of-sight project from site entry point to a kiosk or other building is uncertain.

- Utility markout on private property should include clearance for other types of underground structures such as underground storage tanks, septic systems, utility or access tunnels, and in-ground irrigation systems.

3. Limitations

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

4. References

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

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

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

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

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

5. Attachment

Attachment A – Standard Utility Color Codes

6. Contact

Brian Conte
Anne Leifer

SOP PM-001

Attachment A – Standard Utility Color Codes

Color Code	**Utility Description**
Red	Electric
Yellow	Gas-Oil
Orange	Communications
Blue	Water
Green	Sewer
White	Proposed Excavation

Section 3

Site Reconnaissance and Assessments (RE)

STANDARD OPERATING PROCEDURE

RE-001 Site Reconnaissance

1. Objective

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

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

2. Execution

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

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

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

3. Limitations

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

4. References

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

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

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

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

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

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

5. Attachments

Attachment A - Site Reconnaissance Checklist

6. Contact

Gary Iadarola
Anne Leifer

RE-001 Attachment A: Site Reconnaissance Checklist

GEI Job No.:

Date:

Site Reconnaissance performed by:

GEI Project Manager:

Part 1: General Information

Client

Property Name

Address

Size of Site Easements

Paved parking lot areas (patched areas)

USGS Quadrangle GIS Maps

Available bedrock or surficial geology maps

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

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

Describe

Degree of slopes, approx.

Drainage (estimated surface water flow direction)

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

Describe

Stressed or stained vegetation

Describe

Part IV: Hydrogeology (surface water bodies and wetlands)

Describe

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

Describe

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

Describe

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

Describe

Part V: Land Use (current, former)

Describe

Part VI: USTs and/or ASTs

Vent and fill pipes (number and locations)

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

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

Describe

Dumpsters/Trash Collection (past & present)

Waste Materials

Dumped Material or Miscellaneous Debris

Areas of Fill

Part VIII: Utilities

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

Describe

Part IX: Buildings (exterior)

Number of Buildings/Additions

Locations

Size of Buildings

Number of Stories

Age

Describe

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

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

Chemical Storage

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

Floor Drains, Sumps (number and location)

Floor Condition (cracks, spills)

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

Describe

Part XII: Site Abutters (addresses and land uses)

North

East

South

West

Part XIII: Site Vicinity

Names of Cross Streets

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

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

Part XIV: Site Escort

Affiliation

Employed at facility

Part XIV: Additional Comments:

STANDARD OPERATING PROCEDURE

RE-002 All Appropriate Inquiry ASTM 1527-05

1. Objective

Completion of an All-Appropriate Inquiry (AAI) in accordance with ASTM E1527-05

2. Execution

- When requested by a client, GEI performs AAI Environmental Site Assessments (ESAs) generally conforming to the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (E 1527-05).*
- The AAI Environmental Site Assessment (ESA) provides a professional opinion regarding the identification of Recognized Environmental Conditions (REC). AAI has revised the definition of an REC to indicate,"the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, ground water, or surface water of the property."
- AAI stipulates the investigation must be carried out by an Environmental Professional (EP). A purchaser must engage an Environmental Professional who: (i) holds a current Professional Engineer's or Geologist's license and has had three years of relevant full-time experience; (ii) is licensed or certified by a federal or state government to perform environmental inquiries and has had three years of relevant full-time experience; (iii) has a college degree in science and engineering and five years of full-time experience; or (iv) has the equivalent of ten years of relevant full-time experience.
- The AAI shall identify what entity retained GEI to conduct the work and shall specifically define the scope of work contractually agreed upon that was conducted.

2.1. Data Gathering

- The AAI contains nine key components that need to be addressed. The first four must be performed by the EP. Components five thru seven can be performed by either the user or EP, and the remaining two components should be shared between the user and EP.

2.2. Environmental Professional Responsibilities

- **Reviews of Government Records.** The Phase I shall include a review and search of the following standard environmental record sources. The approximate minimum search distances from the subject site are shown as follows. An electronic environmental database search firm shall be retained to assist in the collection and summarization of the search data (e.g. Environmental Data Resources, Inc [EDR]).

Environmental Record	Approximate Minimum Search Distance
Federal NPL Site List	1.0 mile
Federal CERCLIS List	0.5 mile
Federal CERCLIS NFRAP List	0.5 mile
Federal RCRA TSD Facilities List	0.5 mile
Federal RCRA Generators List	Site and adjoining properties
Federal ERNS List	Site
State Lists of Hazardous Waste Sites	1.0 mile
State Landfill and/or Solid Waste Disposal Sites	0.5 mile
State Leaking Underground Storage Tank Lists	0.5 mile
State Registered Underground Storage Tank Information	Site and adjoining properties
State Spills	Site and adjoining properties
CTDEP Leachate and Wastewater Discharge Source	Site and adjoining properties
State Brownfields	0.5 mile
Delisted NPL	0.5 mile
Municipal Records	Site

2.3. Reviews of historical records

- Both the final AAI rule and the interim ASTM E-1527-00 Phase I standard require the environmental professional to review historical documents and records. These documents typically may include, but are not limited to aerial photographs, fire insurance maps, building department records, chain of title documents, and land use records.
- The final AAI rule requires the environmental professional to review historical documents as far back in time as it can be shown that the property contained structures, or the property was first used for residential, agricultural, commercial, industrial, or government purposes. The final AAI rule provides environmental professionals to exercise their professional judgment in determining how far back in time it is necessary to review historical records.

2.4. Interviews

- Interviews must be conducted with several persons knowledgeable about the site activities such as current owner(s) and occupant(s) of the subject property, to collect information on past uses and ownerships of the property, and to identify potential conditions that may indicate the presence of releases or threatened releases of hazardous substances at the subject property.

- Additional interviews may be conducted with parties such as current and past facility managers, past owners, operators, or occupants of the property, and employees of past and current occupants of the subject property, as necessary to meet the objectives of the rule. The final AAI rule allows the Environmental Professional to use his or her discretion to determine whether such interviews are necessary. EPA indicates that such interviews could help gather information that otherwise may not be available from any other source as no owner or occupant of the subject property can be identified and interviewed on the uses and ownerships of the subject property.
- Interviews may be conducted with owners and occupants of neighboring and nearby properties in instances where the subject property has been abandoned and there is evidence of potential unauthorized uses or uncontrolled access. EPA indicates that such interviews could help gather information that otherwise may not be available from any other source as no owner or occupant of the subject property can be identified and interviewed on the uses and ownerships of the subject property.

2.5. Visual inspections

- The AAI rule requires that environmental site assessments include an on-site visual inspection of the subject property, facilities, and improvements on the subject property.
- The AAI rule requires the environmental professional to visually inspect neighboring properties from the subject property line, public rights-of-way, or other vantage points.
- In cases where on-site access to the subject property cannot be obtained to conduct the visual inspection of the subject property, the AAI rule provides a limited exception to the on-site visual inspection requirement and imposes specific documentation and inspection requirements in that situation. Specifically, the AAI rule requires the environmental professional to: (i) visually inspect the subject property via another method (e.g., aerial photography) or from an alternative vantage point (e.g., walk the property line), (ii) document efforts to gain access to the subject property, (iii) document the use of other sources of information to determine the existence of potential environmental contamination, and (iv) express an opinion about the significance of the failure to conduct an on-site visual inspection, as related to the ability of the environmental professional to identify conditions indicative of releases or threatened releases.

2.6. Environmental Professional or User Responsibilities

2.6.1. Searches for environmental cleanup liens

- The AAI rule requires that environmental site assessments include searches for recorded environmental cleanup liens filed against the subject property under federal, state, tribal, or local law. This requirement seeks to identify liens placed upon the property that indicate that environmental response actions were taken to address past releases at, on, or to the subject property.

- The AAI rule allows either the prospective property owner or the Environmental Professional to conduct the search. If the search is performed by the prospective landowner and he or she does not provide the search results to the Environmental Professional, then the Environmental Professional should treat this lack of information as a data gap and should comment upon the significance of this data gap with regard to his or her ability to identify conditions indicative of releases or threatened releases

2.6.2. Specialized knowledge or experience

- If the user is aware of any specialized knowledge or experience that is material to recognized environmental conditions in connection with the property, it is the user's responsibility to communicate any information based on such specialized knowledge or experience to the Environmental Professional. The user should do so before the Environmental Professional conducts the site reconnaissance.

2.6.3. Purchase price vs. value of property if not contaminated

- In a transaction involving the purchase of a parcel of commercial real estate, the user shall consider the relationship of the purchase price of the property to the fair market value of the property if the property was not affected by hazardous substances or petroleum products. The user should try to identify an explanation for a lower price which does not reasonably reflect fair market value if the property were not contaminated, and make a written record of such explanation. Among the factors to consider will be the information that becomes known to the user pursuant to the Phase I Environmental Site Assessment. This standard does not require that a real estate appraisal be obtained in order to ascertain fair market value of the property.

2.7. Shared Responsibilities

2.7.1. Degree of obviousness of contamination

- The obviousness of the presence or likely presence of contamination at the property includes the ability of the user to detect the contamination by appropriate inspection. These criteria are essentially unchanged from the statutory provisions pre-existing the Brownfields Amendments which rely upon case law for clarification.

2.7.2. Commonly known information about property

- If the user is aware of any commonly known or reasonably ascertainable information within the local community about the property that is material to recognized environmental conditions in connection with the property, it is the user's responsibility to communicate such information to the Environmental Professional. The user should do so before the Environmental Professional conducts the site reconnaissance.

3. Limitations

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

4. References

Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process (E 1527-00)

ASTM Revised Standards on Environmental Site Assessments, (2005), E 1527-05

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

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

Standard References for Monitoring Wells (January 1991), The Massachusetts Department of Environmental Protection, DEP Publication #WSC-310-91

The Massachusetts Contingency Plan (July 30, 1993), The Massachusetts Department of Environmental Protection, 310 CMR 40.0483

Transfer Act, Connecticut. General Statutes §22a-134, et seq, October 1, 2001

5. Attachments

Attachment A - Site Reconnaissance Checklist
Attachment B - CTDEP Regulatory Review Checklist 7-05
Attachment C - Local File Search Checklist
Attachment D – ASTM Standard 1527-05

6. Contact

Gary Iadarola

RE-002 Attachment A: Site Reconnaissance Checklist

GEI Job No.:

Date:

Site Reconnaissance performed by:

GEI Project Manager:

Part 1: General Information

Client

Property Name

Address

Size of Site Easements

Paved parking lot areas (patched areas)

USGS Quadrangle GIS Maps

Available bedrock or surficial geology maps

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

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

Describe

Degree of slopes, approx.

Drainage (estimated surface water flow direction)

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

Describe

Stressed or stained vegetation

Describe

Part IV: Hydrogeology (surface water bodies and wetlands)

Describe

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

Describe

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

Describe

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

Describe

Part V: Land Use (current, former)

Describe

Part VI: USTs and/or ASTs

Vent and fill pipes (number and locations)

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

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

Describe

Dumpsters/Trash Collection (past & present)

Waste Materials

Dumped Material or Miscellaneous Debris

Areas of Fill

Part VIII: Utilities

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

Describe

Part IX: Buildings (exterior)

Number of Buildings/Additions

Locations

Size of Buildings

Number of Stories

Age

Describe

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

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

Chemical Storage

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

Floor Drains, Sumps (number and location)

Floor Condition (cracks, spills)

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

Describe

Part XII: Site Abutters (addresses and land uses)

North

East

South

West

Part XIII: Site Vicinity

Names of Cross Streets

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

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

Part XIV: Site Escort

Affiliation

Employed at facility

Part XIV: Additional Comments:

Attachment B: Environmental Regulatory Review Checklist

Client: ______________________________________ **GEI Project No.** ____________

Site Address: ____

Conducted by: _______________________________ **Date:** ____________________

Owners and Tenants Reviewed:

Owners/Tenants	**Others Added from Site History**

CTDEP File Room Hours - Tues, Wed, Thur 9:00 to 3:00; Mon & Fri by appt. Terry Parker (860) 424-3936

Bureau of Waste Management

Registered Underground Storage Tanks (site and adjoining)

- ☐ Review the "UST Inventory" (binder) to get the Site I.D.s
- ☐ Request Individual Files by Site I.D.
- ☐ Request Misc. UST Town File

Leaking Underground Storage Tanks (0.5 mile)

- ☐ Review the "LUST File List" (binder) (files located & reviewed on 4th floor East)

PCB Program (site) (floor East, Ruth Nevers, x2048; 9:00 to 3:00)

- ☐ Review the "PCB Inspection List" (binder)
- ☐ Review the "PCB Complaints Not on the Inspection List" (binder)
- ☐ Request files to review from Ruth

Oil and Chemical Spill Response Division (basement & 4^{th} floor East (see Carlos Guzman or Mayra Granillo))

- ☐ Review "Cumulative Summary of Spill Incidents" (binders --1991 to present; record years reviewed)

  ____
- ☐ Request Spill Reports by Town (request 1970s-1990 and for post 1991 spills identified in binders)

  ____
- ☐ Request Correspondence Files by Town (1970s-1999)

  ____
- ☐ Request 2000 to present Spill & Correspondence Files (4^{th} floor)
- ☐ Review the "O&C Correspondence File List" (files located & reviewed on 4^{th} floor)

Waste Engineering and Enforcement Division

- ☐ Request RCRA/Waste Town File or Inventory File
- ☐ Request RCRA Files by Facility Name
- ☐ Request Solid Waste Files by Facility Name
- ☐ Request Town Solid Waste Files
- ☐ Review Inventory of Hazardous Waste Sites in Connecticut (office)
- ☐ Review the "Addendum to Inventory of Hazardous Waste Disposal Sites" (one mile) and copy town
- ☐ Review Landfill and/or Solid Waste Disposal Sites, Plotted Facilities Maps 4^{th} floor West (0.5 mile)

Attachment B: Environmental Regulatory Review Checklist

Bureau of Water Management

- ☐ Request Industrial Files by Facility Name
- ☐ Request Remediation/Property Transfer Files by Facility Name
- ☐ Request Town File
- ☐ Request Town P-5's (Industrial Surveys)
- ☐ Request Town Order Book and pre-1980 Orders
- ☐ Review Orders (binder)
- ☐ Review Town NOVs (binders)
- ☐ Review "Property Transfer List" (for site)

<u>EPA Databases</u>

National Priority List (NPL) (one mile)
CERCLIS (0.5 mile)
RCRA Hazardous Waste Handlers List (internet)
    Generators (site and adjoining)
    CORRACTS TSD Facilities (one mile)
    Non-CORRACTS TSD Facilities (0.5 mile)

<u>In-office</u>

- ☐ Fax request for yearly <u>summary</u> of haz. waste manifests by company name and town for all years available to Jeanne Brennan 424-4059

PHASE I SITE ASSESSMENTS LOCAL RECORDS REVIEW CHECKLIST

PROJECT NAME ______________________________
PROJECT LOCATION ______________________________
PROJECT NUMBER ______________
DATE ______________
COLLECTOR ______________________________

TAX ASSESSOR'S OFFICE

Photocopy street/property/field card, front and back.

Request old street cards and photocopy

Review Tax Assessors Map for Subject Property - record property boundaries and dimensions (photocopy or trace if possible).

Street Address

Lot #, Map #, Block #

Volume/Page

Acreage

TOWN CLERK

Grantee - Buyer **Grantor** - Seller

Begin with current Vol/Page from Assessor's Card, then search back in Grantee Index.

Current Property Owner(s) Dates

Former Property Owner(s) Dates

Photocopy Assessors Map or Tax Map

Property Maps/Subdivision Maps/Boundary Surveys

Grantor the current owner to find out if they have transferred any of the property since they originally acquired it.

Aerial photographs

PLANNING AND ZONING DEPARTMENT

Request and review file of subject property.

Review zoning map and record effective date and latest revision date, check with personnel that you are reviewing the most recent map.

Ask if there are any proposed new zoning ordinances for subject site, ask for file or plan

Zone of Subject Property

Zone of Adjoining Properties

Site Plans

Special Permit Uses/Variances for Subject Property

Subdivision Plan

Zone of Subject Site for last 20 years

Aquifer Protection District (if applicable)

Flood Insurance Rate Map - record community panel # and effective date

CONSERVATION/WETLANDS OFFICE

Request and review Inland Wetland file for subject property.

Inland Wetlands Map - record title, effective date, and revision date.

Other Natural Resource Maps such as Coastal Area Management or Coastal Zone Maps

BUILDING DEPARTMENT

Request and review file of subject property.

Building Applications and Permits

Certificates of Occupancy

Permits for underground storage tanks (USTs) and/or above ground tanks (AGTs)

Renovation or Demolition Applications and Permits

Does Town require permits to remove or install (USTs)

Plot Plan or As-Built - Review for location of USTs/AGT, dry wells, septic systems, hydraulic lifts, floor drains, and bay drains

Building Materials Schedule (also found on building plans/architectural plans)

Asbestos Removal

Zoning Violations or Cease and Desist Orders (interested in dumping of debris, solid waste, hazardous materials, poor housekeeping, etc.).

ENGINEERING/PUBLIC WORKS/WATER/SEWER DEPARTMENTS

Request file of subject property and record who provides utilities and when service was connected.

Sewer

Water

Gas

Storm Drains on-site and in street

Solid Waste Dumping

Topography Maps with 2 or 5 foot contour intervals (photocopy subject and adjacent properties if available).

Aerials

Landfills within 1/2 mile

HEALTH and/or ENVIRONMENTAL DEPARTMENT (Sanitarian)

Request and review file of subject property.

Septic System (current and former) - Location and Specs

Dry wells

On-Site Wells (Domestic, Production, Irrigation)
Photocopy well construction details for subject and nearby properties

Documented Well Contamination Problems within 1/4 mile

Solid Waste and/or Hazardous Materials Dumping

Illegal Burning

Odors/Vermin

Landfills within 1/2 mile

Obtain copy of plan showing septic system/leaching field location

FIRE DEPARTMENT/FIRE MARSHAL

Request file of subject property and photocopy all registrations, sketches, plans, permits, etc.

Discuss adjacent sites with Fire Marshal and review files if available.

Underground Tanks
(dates installed/removed and location)

Above Ground Tanks (dates installed/removed and location)

Tank Tightness Tests

Hydraulic lifts, floor drains, bay drains

Plot Plan showing site/building layout

Explosions

Fires

Illegal Burning

Spills

Vehicle Accidents

Hazardous Materials Notification (Tier II Forms)

Hazardous Materials Survey Maps (show storage and location of chemicals & hazardous materials)

State Fire Marshal Forms (filed at local FM)

General Correspondence

LOCAL LIBRARY/HISTORICAL SOCIETY/MUSEUM

Business/Company Files/Annual Reports

Historical Records and Maps

Historical Society Files

Files on Superfund Sites within 1 mile

Newspaper Articles

Business/Industry Directories

Sanborn Fire Insurance Maps or Other Historic Maps

Old Street Maps

Is subject property located in a designated Historical District

Any relevance to subject property

Comments and reports of conversations with Municipal Employees and/or Officials:

Designation: E 1527 – 05

Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process[1]

This standard is issued under the fixed designation E 1527; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 *Purpose*—The purpose of this practice is to define good commercial and customary practice in the United States of America for conducting an *environmental site assessment*[2] of a parcel of *commercial real estate* with respect to the range of contaminants within the scope of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. §9601) and *petroleum products*. As such, this practice is intended to permit a *user* to satisfy one of the requirements to qualify for the *innocent landowner*, *contiguous property owner*, or *bona fide prospective purchaser* limitations on CERCLA liability (hereinafter, the "*landowner liability protections*," or "*LLPs*"): that is, the practice that constitutes "*all appropriate inquiry* into the previous ownership and uses of the *property* consistent with good commercial or customary practice" as defined at 42 U.S.C. §9601(35)(B). (See Appendix X1 for an outline of CERCLA's liability and defense provisions.) Controlled substances are not included within the scope of this standard. Persons conducting an *environmental site assessment* as part of an EPA Brownfields Assessment and Characterization Grant awarded under CERCLA 42 U.S.C. §9604(k)(2)(B) must include controlled substances as defined in the Controlled Substances Act (21 U.S.C. §802) within the scope of the assessment investigations to the extent directed in the terms and conditions of the specific grant or cooperative agreement. Additionally, an evaluation of *business environmental risk* associated with a parcel of *commercial real estate* may necessitate investigation beyond that identified in this practice (see Sections 1.3 and 13).

1.1.1 *Recognized Environmental Conditions*—In defining a standard of good commercial and customary practice for conducting an *environmental site assessment* of a parcel of *property*, the goal of the processes established by this practice is to identify *recognized environmental conditions*. The term *recognized environmental conditions* means the presence or likely presence of any *hazardous substances* or *petroleum products* on a *property* under conditions that indicate an existing release, a past release, or a *material threat* of a release of any *hazardous substances* or *petroleum products* into structures on the *property* or into the ground, ground water, or surface water of the *property*. The term includes *hazardous substances* or *petroleum products* even under conditions in compliance with laws. The term is not intended to include *de minimis* conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be *de minimis* are not *recognized environmental conditions*.

1.1.2 *Petroleum Products*—*Petroleum products* are included within the scope of this practice because they are of concern with respect to many parcels of *commercial real estate* and current custom and usage is to include an inquiry into the presence of *petroleum products* when doing an *environmental site assessment* of *commercial real estate*. Inclusion of *petroleum products* within the scope of this practice is not based upon the applicability, if any, of CERCLA to *petroleum products*. (See X1.7 for discussion of *petroleum exclusion* to CERCLA liability.)

1.1.3 *CERCLA Requirements Other Than Appropriate Inquiry*—This practice does not address whether requirements in addition to *all appropriate inquiry* have been met in order to qualify for the *LLPs* (for example, the duties specified in 42 U.S.C. §9607(b)(3)(a) and (b) and cited in Appendix X1, including the continuing obligation not to impede the integrity and effectiveness of *activity and use limitations* (AULs), or the duty to take reasonable steps to prevent releases, or the duty to comply with legally required release reporting obligations).

1.1.4 *Other Federal, State, and Local Environmental Laws*—This practice does not address requirements of any state or local laws or of any federal laws other than the *all appropriate inquiry* provisions of the *LLPs*. *Users* are cautioned that federal, state, and local laws may impose environmental assessment obligations that are beyond the scope of this practice. *Users* should also be aware that there are likely to be other legal obligations with regard to *hazardous substances* or

[1] This practice is under the jurisdiction of ASTM Committee E50 on Environmental Assessment and is the direct responsibility of Subcommittee E50.02 on Commercial Real Estate Transactions.

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[2] All definitions, descriptions of terms, and acronyms are defined in Section 3. Whenever terms defined in 3.2 are used in this practice, they are in *italics*.

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petroleum products discovered on the *property* that are not addressed in this practice and that may pose risks of civil and/or criminal sanctions for non-compliance.

1.1.5 *Documentation*—The scope of this practice includes research and reporting requirements that support the *user's* ability to qualify for the *LLPs*. As such, sufficient documentation of all sources, records, and resources utilized in conducting the inquiry required by this practice must be provided in the written *report* (refer to 8.1.8 and 12.2).

1.2 *Objectives*—Objectives guiding the development of this practice are *(1)* to synthesize and put in writing good commercial and customary practice for *environmental site assessments* for *commercial real estate*, *(2)* to facilitate high quality, standardized *environmental site assessments*, *(3)* to ensure that the standard of *all appropriate inquiry* is practical and reasonable, and *(4)* to clarify an industry standard for *all appropriate inquiry* in an effort to guide legal interpretation of the *LLPs*.

1.3 *Considerations Beyond Scope*—The use of this practice is strictly limited to the scope set forth in this section. Section 13 of this practice identifies, for informational purposes, certain environmental conditions (not an all-inclusive list) that may exist on a *property* that are beyond the scope of this practice but may warrant consideration by parties to a *commercial real estate transaction*. The need to include an investigation of any such conditions in the *environmental professional's* scope of services should be evaluated based upon, among other factors, the nature of the *property* and the reasons for performing the assessment (for example, a more comprehensive evaluation of *business environmental risk*) and should be agreed upon between the *user* and *environmental professional* as additional services beyond the scope of this practice prior to initiation of the *environmental site assessment* process.

1.4 *Organization of This Practice*—This practice has thirteen sections and four appendixes. Section 1 is the Scope. Section 2 is Referenced Documents. Section 3, Terminology, has definitions of terms not unique to this practice, descriptions of terms unique to this practice, and acronyms. Section 4 is Significance and Use of this practice. Section 5 provides discussion regarding *activity and use limitations*. Section 6 describes *User's* Responsibilities. Sections 7-12 are the main body of the *Phase I Environmental Site Assessment*, including evaluation and *report* preparation. Section 13 provides additional information regarding non-scope considerations (see 1.3). The appendixes are included for information and are not part of the procedures prescribed in this practice. Appendix X1 explains the liability and defense provisions of CERCLA that will assist the *user* in understanding the *user's* responsibilities under CERCLA; it also contains other important information regarding CERCLA, the *Brownfields Amendments*, and this practice. Appendix X2 provides the definition of the *environmental professional* responsible for the *Phase I Environmental Site Assessment*, as required in the "*All Appropriate Inquiry*" Final Rule (40 C.F.R. Part 312). Appendix X3 provides an optional User Questionnaire to assist the *user* and the *environmental professional* in gathering information from the *user* that may be material to identifying *recognized environmental conditions*. Appendix X4 provides a recommended table of contents and *report* format for a *Phase I Environmental Site Assessment*.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:* [3]

E 1528 Guide for Environmental Site Assessments: Transaction Screen Process

E 2091 Guide for Use of Activity and Use Limitations, Including Institutional and Engineering Controls

2.2 *Federal Statutes:*

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA" or "Superfund"), as amended by Superfund Amendments and Reauthorization Act of 1986 ("SARA") and Small Business Liability Relief and Brownfields Revitalization Act of 2002 ("Brownfields Amendments"), 42 U.S.C. §§9601 *et seq*.

Emergency Planning and Community Right-To-Know Act of 1986 ("EPCRA"), 42 U.S.C. §§11001 *et seq.*

Freedom of Information Act, 5 U.S.C. §552, as amended by Public Law No. 104-231, 110 Stat. 3048

Resource Conservation and Recovery Act (sometimes also referred to as the Solid Waste Disposal Act), as amended ("RCRA"), 42 U.S.C §6901 *et seq.*

2.3 *USEPA Documents:*

"All Appropriate Inquiry" Final Rule, 40 C.F.R. Part 312

Chapter 1 EPA, Subchapter J-Superfund, Emergency Planning, and Community Right-To-Know Programs, 40 C.F.R Parts 300-399

National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300

2.4 *Other Federal Agency Document:*

OSHA Hazard Communication Regulation, 29 C.F.R. §1910.1200

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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3. Terminology

3.1 This section provides definitions, descriptions of terms, and a list of acronyms for many of the words used in this practice. The terms are an integral part of this practice and are critical to an understanding of the practice and its use.

3.2 *Definitions:*

3.2.1 *abandoned property—property* that can be presumed to be deserted, or an intent to relinquish possession or control can be inferred from the general disrepair or lack of activity thereon such that a reasonable person could believe that there was an intent on the part of the current *owner* to surrender rights to the *property*.

3.2.2 *activity and use limitations*—legal or physical restrictions or limitations on the use of, or access to, a site or facility: *(1)* to reduce or eliminate potential exposure to *hazardous substances* or *petroleum products* in the soil or ground water on the *property*, or *(2)* to prevent activities that could interfere with the effectiveness of a response action, in order to ensure maintenance of a condition of no significant risk to public health or the environment. These legal or physical restrictions, which may include institutional and/or *engineering controls*, are intended to prevent adverse impacts to individuals or populations that may be exposed to *hazardous substances* and *petroleum products* in the soil or ground water on the *property*.[4]

3.2.3 *actual knowledge*—the knowledge actually possessed by an individual who is a real person, rather than an entity. *Actual knowledge* is to be distinguished from constructive knowledge that is knowledge imputed to an individual or entity.

3.2.4 *adjoining properties*—any real *property* or properties the border of which is contiguous or partially contiguous with that of the *property*, or that would be contiguous or partially contiguous with that of the *property* but for a street, road, or other public thoroughfare separating them.

3.2.5 *aerial photographs*—photographs taken from an aerial platform with sufficient resolution to allow identification of development and activities of areas encompassing the *property*. *Aerial photographs* are often available from government agencies or private collections unique to a local area. See 8.3.4.1 of this practice.

3.2.6 *all appropriate inquiry*—that inquiry constituting "*all appropriate inquiry* into the previous ownership and uses of the *property* consistent with good commercial or customary practice" as defined in CERCLA, 42 U.S.C §9601(35)(B), that will qualify a party to a *commercial real estate transaction* for one of threshold criteria for satisfying the *LLPs* to CERCLA liability (42 U.S.C §9601(35)(A) & (B), §9607(b)(3), §9607(q); and §9607(r)), assuming compliance with other elements of the defense. See Appendix X1.

3.2.7 *approximate minimum search distance*—the area for which records must be obtained and reviewed pursuant to Section 8 subject to the limitations provided in that section. This may include areas outside the *property* and shall be measured from the nearest *property* boundary. This term is used in lieu of radius to include irregularly shaped properties.

3.2.8 *bona fide prospective purchaser liability protection*—(42 U.S.C. §9607(r))—a person may qualify as a bona fide prospective purchaser if, among other requirements, such person made "all appropriate inquiries into the previous ownership and uses of the facility in accordance with generally accepted good commercial and customary standards and practices." Knowledge of contamination resulting from *all appropriate inquiry* would not generally preclude this liability protection. A person must make *all appropriate inquiry* on or before the date of purchase. The facility must have been purchased after January 11, 2002. See Appendix X1 for the other necessary requirements that are beyond the scope of this practice.

3.2.9 *Brownfields Amendments*—amendments to CERCLA pursuant to the Small Business Liability Relief and Brownfields Revitalization Act, Pub. L. No. 107-118 (2002), 42 U.S.C. §§9601 *et seq.*

3.2.10 *building department records*—those records of the local government in which the *property* is located indicating permission of the local government to construct, alter, or demolish improvements on the *property*. Often *building department records* are located in the building department of a municipality or county. See 8.3.4.7.

3.2.11 *business environmental risk*—a risk which can have a material environmental or environmentally-driven impact on the business associated with the current or planned use of a parcel of *commercial real estate*, not necessarily limited to those environmental issues required to be investigated in this practice. Consideration of *business environmental risk* issues may involve addressing one or more non-scope considerations, some of which are identified in Section 13.

3.2.12 *commercial real estate*—any real *property* except a *dwelling* or *property* with no more than four *dwelling* units exclusively for residential use (except that a *dwelling* or *property* with no more than four *dwelling* units exclusively for residential use is included in this term when it has a commercial function, as in the building of such *dwellings* for profit). This term includes but is not limited to undeveloped real *property* and real *property* used for industrial, retail, office, agricultural, other commercial, medical, or educational purposes; *property* used for residential purposes that has more than four residential *dwelling* units; and *property* with no more than four *dwelling* units for residential use when it has a commercial function, as in the building of such *dwellings* for profit.

3.2.13 *commercial real estate transaction*—a transfer of title to or possession of real *property* or receipt of a security interest in real *property*, except that it does not include transfer of title to or possession of real *property* or the receipt of a security interest in real *property* with respect to an individual *dwelling* or building containing fewer than five *dwelling* units, nor does it include the purchase of a lot or lots to construct a

[4] The term *AUL* is taken from the ASTM Standard Guide E 2091 to include both legal (that is, institutional) and physical (that is, engineering) controls within its scope. Other agencies, organizations, and jurisdictions may define or utilize these terms differently (for example, EPA and California do not include physical controls within their definitions of "*institutional controls*." Department of Defense and International County/City Management Association use "Land Use Controls." The term "land use restrictions" is used but not defined in the *Brownfields Amendments*).

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dwelling for occupancy by a purchaser, but a *commercial real estate* transaction does include real *property* purchased or leased by persons or entities in the business of building or developing *dwelling* units.

3.2.14 *Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)*—the list of sites compiled by EPA that EPA has investigated or is currently investigating for potential *hazardous substance* contamination for possible inclusion on the *National Priorities List*.

3.2.15 *construction debris*—concrete, brick, asphalt, and other such building materials discarded in the construction of a building or other improvement to *property*.

3.2.16 *contaminated public wells*—public wells used for drinking water that have been designated by a government entity as contaminated by *hazardous substances* (for example, chlorinated *solvents*), or as having water unsafe to drink without treatment.

3.2.17 *contiguous property owner liability protection*—(42 U.S.C. §9607(q))—a person may qualify for the *contiguous property owner liability protection* if, among other requirements, such person owns real *property* that is contiguous to, and that is or may be contaminated by *hazardous substances* from other real *property* that is not owned by that person. Furthermore, such person conducted *all appropriate inquiry* at the time of acquisition of the *property* and did not know or have reason to know that the *property* was or could be contaminated by a release or threatened release from the contiguous *property*. The *all appropriate inquiry* must not result in knowledge of contamination. If it does, then such person did "know" or "had reason to know" of contamination and would not be eligible for the *contiguous property owner liability protection*. See Appendix X1 for the other necessary requirements that are beyond the scope of this practice.

3.2.18 *CORRACTS list*—a list maintained by EPA of *hazardous waste* treatment, storage, or disposal facilities and other RCRA-regulated facilities (due to past interim status or storage of *hazardous waste* beyond 90 days) that have been notified by the U.S. Environmental Protection Agency to undertake corrective action under RCRA. The *CORRACTS list* is a subset of the EPA database that manages RCRA data.

3.2.19 *data failure*—a failure to achieve the historical research objectives in 8.3.1 through 8.3.2.2 even after reviewing the *standard historical sources* in 8.3.4.1 through 8.3.4.8 that are *reasonably ascertainable* and likely to be useful. *Data failure* is one type of *data gap*. See 8.3.2.3.

3.2.20 *data gap*—a lack of or inability to obtain information required by this practice despite *good faith* efforts by the *environmental professional* to gather such information. *Data gaps* may result from incompleteness in any of the activities required by this practice, including, but not limited to *site reconnaissance* (for example, an inability to conduct the *site visit*), and *interviews* (for example, an inability to interview the *key site manager*, regulatory officials, etc.). See 12.7.

3.2.21 *demolition debris*—concrete, brick, asphalt, and other such building materials discarded in the demolition of a building or other improvement to *property*.

3.2.22 *drum*—a container (typically, but not necessarily, holding 55 gal (208 L) of liquid) that may be used to store *hazardous substances* or *petroleum products*.

3.2.23 *dry wells*—underground areas where soil has been removed and replaced with pea gravel, coarse sand, or large rocks. *Dry wells* are used for drainage, to control storm runoff, for the collection of spilled liquids (intentional and non-intentional) and *wastewater* disposal (often illegal).

3.2.24 *due diligence*—the process of inquiring into the environmental characteristics of a parcel of *commercial real estate* or other conditions, usually in connection with a *commercial real estate* transaction. The degree and kind of *due diligence* vary for different properties and differing purposes. See Appendix X1.

3.2.25 *dwelling*—structure or portion thereof used for residential habitation.

3.2.26 *engineering controls (EC)*—physical modifications to a site or facility (for example, capping, slurry walls, or point of use water treatment) to reduce or eliminate the potential for exposure to *hazardous substances* or *petroleum products* in the soil or ground water on the *property*. *Engineering controls* are a type of activity and use limitation (AUL).

3.2.27 *environmental compliance audit*—the investigative process to determine if the operations of an existing facility are in compliance with applicable environmental laws and regulations. This term should not be used to describe this practice, although an *environmental compliance audit* may include an *environmental site assessment* or, if prior audits are available, may be part of an *environmental site assessment*.

3.2.28 *environmental lien*—a charge, security, or encumbrance upon title to a *property* to secure the payment of a cost, damage, debt, obligation, or duty arising out of response actions, cleanup, or other remediation of *hazardous substances* or *petroleum products* upon a *property*, including (but not limited to) liens imposed pursuant to CERCLA 42 U.S.C. §§9607(1) & 9607(r) and similar state or local laws.

3.2.29 *environmental professional*—a person meeting the education, training, and experience requirements as set forth in 40 CFR §312.10(b). See Appendix X2. The person may be an independent contractor or an employee of the *user*.

3.2.30 *environmental site assessment (ESA)*—the process by which a person or entity seeks to determine if a particular parcel of real *property* (including improvements) is subject to *recognized environmental conditions*. At the option of the *user*, an *environmental site assessment* may include more inquiry than that constituting *all appropriate inquiry* or, if the *user* is not concerned about qualifying for the *LLPs*, less inquiry than that constituting *all appropriate inquiry*. An *environmental site assessment* is both different from and less rigorous than an *environmental compliance audit*.

3.2.31 *ERNS list*—EPA's emergency response notification system list of reported CERCLA *hazardous substance* releases or spills in quantities greater than the reportable quantity, as maintained at the National Response Center. Notification requirements for such releases or spills are codified in 40 CFR Parts 302 and 355.

3.2.32 *Federal Register, (FR)*—publication of the United States government published daily (except for federal holidays

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and weekends) containing all proposed and final regulations and some other activities of the federal government. When regulations become final, they are included in the Code of Federal Regulations (CFR), as well as published in the *Federal Register*.

3.2.33 *fill dirt*—dirt, soil, sand, or other earth, that is obtained off-site, that is used to fill holes or depressions, create mounds, or otherwise artificially change the grade or elevation of real *property*. It does not include material that is used in limited quantities for normal landscaping activities.

3.2.34 *fire insurance maps*—maps produced for private fire insurance map companies that indicate uses of properties at specified dates and that encompass the *property*. These maps are often available at local libraries, historical societies, private resellers, or from the map companies who produced them.

3.2.35 *good faith*—the absence of any intention to seek an unfair advantage or to defraud another party; an honest and sincere intention to fulfill one's obligations in the conduct or transaction concerned.

3.2.36 *hazardous substance*—a substance defined as a *hazardous substance* pursuant to CERCLA 42 U.S.C.§9601(14), as interpreted by EPA regulations and the courts:" (A) any substance designated pursuant to section 1321(b)(2)(A) of Title 33, (B) any element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title, (C) any *hazardous waste* having the characteristics identified under or listed pursuant to section 3001 of the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, (42 U.S.C. §6921) (but not including any waste the regulation of which under RCRA (42 U.S.C.§§6901 *et seq.*) has been suspended by Act of Congress), (D) any toxic pollutant listed under section 1317(a) of Title 33, (E) any hazardous air pollutant listed under section 112 of the Clean Air Act (42 U.S.C. §7412), and (F) any imminently hazardous chemical substance or mixture with respect to which the Administrator (of EPA) has taken action pursuant to section 2606 of Title 15. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a *hazardous substance* under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas)." (See Appendix X1.)

3.2.37 *hazardous waste*—any *hazardous waste* having the characteristics identified under or listed pursuant to section 3001 of RCRA, as amended, (42 U.S.C. §6921) (but not including any waste the regulation of which under RCRA (42 U.S.C. §§6901-6992k) has been suspended by Act of Congress). RCRA is sometimes also identified as the Solid Waste Disposal Act. RCRA defines a *hazardous waste*, at 42 U.S.C. §6903, as: "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may—(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

3.2.38 *hazardous waste/contaminated sites*—sites on which a release has occurred, or is suspected to have occurred, of any *hazardous substance*, *hazardous waste*, or *petroleum products*, and that release or suspected release has been reported to a government entity.

3.2.39 *historical recognized environmental condition*—an environmental condition which in the past would have been considered a *recognized environmental condition*, but which may or may not be considered a *recognized environmental condition* currently. The final decision rests with the *environmental professional* and will be influenced by the current impact of the *historical recognized environmental condition* on the *property*. If a past release of any *hazardous substances* or *petroleum products* has occurred in connection with the *property* and has been remediated, with such remediation accepted by the responsible regulatory agency (for example, as evidenced by the issuance of a no further action letter or equivalent), this condition shall be considered an *historical recognized environmental condition* and included in the findings section of the *Phase I Environmental Site Assessment* report. The *environmental professional* shall provide an opinion of the current impact on the *property* of this *historical recognized environmental condition* in the opinion section of the *report*. If this *historical recognized environmental condition* is determined to be a *recognized environmental condition* at the time the *Phase I Environmental Site Assessment* is conducted, the condition shall be identified as such and listed in the conclusions section of the *report*.

3.2.40 *IC/EC registries*—databases of *institutional controls* or *engineering controls* that may be maintained by a federal, state or local environmental agency for purposes of tracking sites that may contain residual contamination and AULs. The names for these may vary from program to program and state to state, and include terms such as Declaration of Environmental Use Restriction database (Arizona), list of "deed restrictions" (California), environmental real covenants list (Colorado), brownfields site list (Indiana, Missouri, Pennsylvania).

3.2.41 *innocent landowner defense*—(42 U.S.C. §§9601(35) & 9607(b)(3))—a person may qualify as one of three types of innocent landowners: (i) a person who "did not know and had no reason to know" that contamination existed on the *property* at the time the purchaser acquired the *property*; (ii) a government entity which acquired the *property* by escheat, or through any other involuntary transfer or acquisition, or through the exercise of eminent domain authority by purchase or condemnation; and (iii) a person who "acquired the facility by inheritance or bequest." To qualify for the first type of innocent landowner LLP, such person must have made *all appropriate inquiry* on or before the date of purchase. Furthermore, the *all appropriate inquiry* must not have resulted in knowledge of the contamination. If it does, then such person did "know" or "had reason to know" of contamination and would not be eligible for the *innocent landowner defense*. See Appendix X1 for the other necessary requirements that are beyond the scope of this practice.

3.2.42 *institutional controls (IC)*—a legal or administrative restriction (for example, "deed restrictions," restrictive covenants, easements, or zoning) on the use of, or access to, a site

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or facility to *(1)* reduce or eliminate potential exposure to *hazardous substances* or *petroleum products* in the soil or ground water on the *property*, or *(2)* to prevent activities that could interfere with the effectiveness of a response action, in order to ensure maintenance of a condition of no significant risk to public health or the environment.. An institutional control is a type of Activity and Use Limitation (AUL).

3.2.43 *interviews*—those portions of this practice that are contained in Section 10 and 11 thereof and address questions to be asked of past and present *owners*, *operators*, and *occupants* of the *property* and questions to be asked of local government officials.

3.2.44 *key site manager*—the person identified by the *owner* or *operator* of a *property* as having good knowledge of the uses and physical characteristics of the *property*. See 10.5.1.

3.2.45 *landfill*—a place, location, tract of land, area, or premises used for the disposal of solid wastes as defined by state solid waste regulations. The term is synonymous with the term *solid waste disposal site* and is also known as a garbage dump, trash dump, or similar term.

3.2.46 *Landowner Liability Protections (LLPs)—landowner liability protections* under CERCLA; these protections include the *bona fide prospective purchaser liability protection*, *contiguous property owner liability protection*, and *innocent landowner defense* from CERCLA liability. See 42 U.S.C. §§9601(35)(A), 9601(40), 9607(b), 9607(q), 9607(r).

3.2.47 *local government agencies*—those agencies of municipal or county government having jurisdiction over the *property*. Municipal and county government agencies include but are not limited to cities, parishes, townships, and similar entities.

3.2.48 *local street directories*—directories published by private (or sometimes government) sources that show ownership, occupancy, and/or use of sites by reference to street addresses. Often *local street directories* are available at libraries, or historical societies, and/or local municipal offices. See 8.3.4.6 of this practice.

3.2.49 *LUST sites*—state lists of leaking *underground storage tank* sites. RCRA gives EPA and states, under cooperative agreements with EPA, authority to clean up releases from UST systems or require *owners* and *operators* to do so. (42 U.S.C. §6991b).

3.2.50 *major occupants*—those tenants, subtenants, or other persons or entities each of which uses at least 40 % of the leasable area of the *property* or any anchor tenant when the *property* is a shopping center.

3.2.51 *material safety data sheet (MSDS)*—written or printed material concerning a *hazardous substance* which is prepared by chemical manufacturers, importers, and employers for hazardous chemicals pursuant to OSHA's Hazard Communication Standard, 29 C.F.R. §1910.1200.

3.2.52 *material threat*—a physically observable or *obvious* threat which is reasonably likely to lead to a release that, in the opinion of the *environmental professional*, is threatening and might result in impact to public health or the environment. An example might include an aboveground storage tank system that contains a *hazardous substance* and which shows evidence of damage. The damage would represent a *material threat* if it is deemed serious enough that it may cause or contribute to tank integrity failure with a release of contents to the environment.

3.2.53 *National Contingency Plan (NCP)*—the National Oil and Hazardous Substances Pollution Contingency Plan, found at 40 C.F.R. Part 300, that is the EPA's blueprint on how *hazardous substances* are to be cleaned up pursuant to CERCLA.

3.2.54 *National Priorities List (NPL)*—list compiled by EPA pursuant to CERCLA 42 U.S.C. §9605(a)(8)(B) of properties with the highest priority for cleanup pursuant to EPA's Hazard Ranking System. See 40 C.F.R. Part 300.

3.2.55 *obvious*—that which is plain or evident; a condition or fact that could not be ignored or overlooked by a reasonable observer while visually or physically observing the *property*.

3.2.56 *occupants*—those tenants, subtenants, or other persons or entities using the *property* or a portion of the *property*.

3.2.57 *operator*—the person responsible for the overall operation of a facility.

3.2.58 *other historical sources*—any source or sources other than those designated in 8.3.4.1 through 8.3.4.8 that are credible to a reasonable person and that identify past uses of the *property*. The term includes, but is not limited to: miscellaneous maps, newspaper archives, internet sites, community organizations, local libraries, historical societies, current *owners* or *occupants* of neighboring properties, and records in the files and/or personal knowledge of the *property owner* and/or *occupants*. See 8.3.4.9.

3.2.59 *owner*—generally the fee *owner* of record of the *property*.

3.2.60 *petroleum exclusion*—the exclusion from CERCLA liability provided in 42 U.S.C. §9601(14), as interpreted by the courts and EPA: "The term (*hazardous substance*) does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a *hazardous substance* under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas)."

3.2.61 *petroleum products*—those substances included within the meaning of the *petroleum exclusion* to CERCLA, 42 U.S.C. §9601(14), as interpreted by the courts and EPA, that is: petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a *hazardous substance* under Subparagraphs (A) through (F) of 42 U.S.C. § 9601(14), natural gas, natural gas liquids, liquefied natural gas, and synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas). (The word fraction refers to certain distillates of crude oil, including gasoline, kerosine, diesel oil, jet fuels, and fuel oil, pursuant to Standard Definitions of Petroleum Statistics.[5])

3.2.62 *Phase I Environmental Site Assessment*—the process described in this practice.

[5] *Standard Definitions of Petroleum Statistics*, American Petroleum Institute, Fourth Edition, 1988.

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3.2.63 *physical setting sources*—sources that provide information about the geologic, hydrogeologic, hydrologic, or topographic characteristics of a *property*. See 8.2.3.

3.2.64 *pits, ponds, or lagoons*—man-made or natural depressions in a ground surface that are likely to hold liquids or sludge containing *hazardous substances* or *petroleum products*. The likelihood of such liquids or sludge being present is determined by evidence of factors associated with the pit, pond, or lagoon, including, but not limited to, discolored water, distressed vegetation, or the presence of an *obvious wastewater* discharge.

3.2.65 *practically reviewable*—information that is *practically reviewable* means that the information is provided by the source in a manner and in a form that, upon examination, yields information relevant to the *property* without the need for extraordinary analysis of irrelevant data. The form of the information shall be such that the *user* can review the records for a limited geographic area. Records that cannot be feasibly retrieved by reference to the location of the *property* or a geographic area in which the *property* is located are not generally *practically reviewable*. Most databases of public records are *practically reviewable* if they can be obtained from the source agency by the county, city, zip code, or other geographic area of the facilities listed in the record system. Records that are sorted, filed, organized, or maintained by the source agency only chronologically are not generally *practically reviewable*. Listings in *publicly available* records which do not have adequate address information to be located geographically are not generally considered *practically reviewable*. For large databases with numerous records (such as RCRA hazardous waste generators and registered *underground storage tanks*), the records are not *practically reviewable* unless they can be obtained from the source agency in the smaller geographic area of zip codes. Even when information is provided by zip code for some large databases, it is common for an unmanageable number of sites to be identified within a given zip code. In these cases, it is not necessary to review the impact of all of the sites that are likely to be listed in any given zip code because that information would not be *practically reviewable*. In other words, when so much data is generated that it cannot be feasibly reviewed for its impact on the *property*, it is not *practically reviewable*.

3.2.66 *property*—the real *property* that is the subject of the *environmental site assessment* described in this practice. Real *property* includes buildings and other fixtures and improvements located on the *property* and affixed to the land.

3.2.67 *property tax files*—the files kept for *property* tax purposes by the local jurisdiction where the *property* is located and may include records of past ownership, appraisals, maps, sketches, photos, or other information that is *reasonably ascertainable* and pertaining to the *property*. See 8.3.4.3.

3.2.68 *publicly available*—information that is *publicly available* means that the source of the information allows access to the information by anyone upon request.

3.2.69 *RCRA generators*—those persons or entities that generate *hazardous wastes*, as defined and regulated by RCRA.

3.2.70 *RCRA generators list*—list kept by EPA of those persons or entities that generate *hazardous wastes* as defined and regulated by RCRA.

3.2.71 *RCRA TSD facilities*—those facilities on which treatment, storage, and/or disposal of *hazardous wastes* takes place, as defined and regulated by RCRA.

3.2.72 *RCRA TSD facilities list*—list kept by EPA of those facilities on which treatment, storage, and/or disposal of *hazardous wastes* takes place, as defined and regulated by RCRA.

3.2.73 *reasonably ascertainable*—information that is *(1) publicly available*, *(2)* obtainable from its source within reasonable time and cost constraints, and *(3) practically reviewable*

3.2.74 *recognized environmental conditions*—the presence or likely presence of any *hazardous substances* or *petroleum products* on a *property* under conditions that indicate an existing release, a past release, or a *material threat* of a release of any *hazardous substances* or *petroleum products* into structures on the *property* or into the ground, ground water, or surface water of the *property*. The term includes *hazardous substances* or *petroleum products* even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a threat to human health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies. Conditions determined to be de minimis are not *recognized environmental conditions*.

3.2.75 *recorded land title records*—records of historical fee ownership, which may include leases, land contracts, and AULs on or of the *property* recorded in the place where land title records are, by law or custom, recorded for the local jurisdiction in which the *property* is located. (Often such records are kept by a municipal or county recorder or clerk.) Such records may be obtained from title companies or directly from the local government agency. Information about the title to the *property* that is recorded in a U.S. district court or any place other than where land title records are, by law or custom, recorded for the local jurisdiction in which the *property* is located, are not considered part of *recorded land title records*. See 8.3.4.4.

3.2.76 *records of emergency release notifications EPCRA*—(42 U.S.C. §11004)—requires *operators* of facilities to notify their local emergency planning committee (as defined in EPCRA) and state emergency response commission (as defined in EPCRA) of any release beyond the facility's boundary of any reportable quantity of any extremely *hazardous substance*. Often the local fire department is the local emergency planning committee. Records of such notifications are "Records of Emergency Release Notifications" (42 U.S.C. 11004).

3.2.77 *records review*—that part that is contained in Section 8 of this practice addresses which records shall or may be reviewed.

3.2.78 *report*—the written *report* prepared by the *environmental professional* and constituting part of a "*Phase I Environmental Site Assessment*," as required by this practice.

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3.2.79 *site reconnaissance*—that part that is contained in Section 9 of this practice and addresses what should be done in connection with the *site visit*. The *site reconnaissance* includes, but is not limited to, the *site visit* done in connection with such a *Phase I Environmental Site Assessment*.

3.2.80 *site visit*—the visit to the *property* during which observations are made constituting the *site reconnaissance* section of this practice.

3.2.81 *solid waste disposal site*—a place, location, tract of land, area, or premises used for the disposal of solid wastes as defined by state solid waste regulations. The term is synonymous with the term *landfill* and is also known as a garbage dump, trash dump, or similar term.

3.2.82 *solvent*—a chemical compound that is capable of dissolving another substance and may itself be a *hazardous substance*, used in a number of manufacturing/industrial processes including but not limited to the manufacture of paints and coatings for industrial and household purposes, equipment clean-up, and surface degreasing in metal fabricating industries.

3.2.83 *standard environmental record sources*—those records specified in 8.2.1.

3.2.84 *standard historical sources*—those sources of information about the history of uses of *property* specified in 8.3.4.

3.2.85 *standard physical setting source*—a current *USGS 7.5 Minute Topographic Map* (if any) showing the area on which the *property* is located. See 8.2.3.

3.2.86 *standard practice*—the activities set forth in this practice.

3.2.87 *standard sources*—sources of environmental, physical setting, or historical records specified in Section 8 of this practice.

3.2.88 *state registered USTs*—state lists of *underground storage tanks* required to be registered under Subtitle I, Section 9002 of RCRA.

3.2.89 *sump*—a pit, cistern, cesspool, or similar receptacle where liquids drain, collect, or are stored.

3.2.90 *TSD facility*—treatment, storage, or disposal facility (see *RCRA TSD facilities*).

3.2.91 *underground injection*—the emplacement or discharge of fluids into the subsurface by means of a well, improved sinkhole, sewage drain hole, subsurface fluid distribution system or other system, or groundwater point source.

3.2.92 *underground storage tank (UST)*—any tank, including underground piping connected to the tank, that is or has been used to contain *hazardous substances* or *petroleum products* and the volume of which is 10 % or more beneath the surface of the ground.

3.2.93 *user*—the party seeking to use Practice E 1527 to complete an *environmental site assessment* of the *property*. A *user* may include, without limitation, a potential purchaser of *property*, a potential tenant of *property*, an *owner* of *property*, a lender, or a *property* manager. The *user* has specific obligations for completing a successful application of this practice as outlined in Section 6.

3.2.94 *USGS 7.5 Minute Topographic Map*—the map (if any) available from or produced by the United States Geological Survey, entitled "*USGS 7.5 Minute Topographic Map*," and showing the *property*.

3.2.95 *visually and/or physically observed*—during a *site visit* pursuant to this practice, this term means observations made by vision while walking through a *property* and the structures located on it and observations made by the sense of smell, particularly observations of noxious or foul odors. The term "walking through" is not meant to imply that disabled persons who cannot physically walk may not conduct a *site visit*; they may do so by the means at their disposal for moving through the *property* and the structures located on it.

3.2.96 *wastewater*—water that *(1)* is or has been used in an industrial or manufacturing process, *(2)* conveys or has conveyed sewage, or *(3)* is directly related to manufacturing, processing, or raw materials storage areas at an industrial plant. *Wastewater* does not include water originating on or passing through or adjacent to a site, such as stormwater flows, that has not been used in industrial or manufacturing processes, has not been combined with sewage, or is not directly related to manufacturing, processing, or raw materials storage areas at an industrial plant.

3.2.97 *zoning/land use records*—those records of the local government in which the *property* is located indicating the uses permitted by the local government in particular zones within its jurisdiction. The records may consist of maps and/or written records. They are often located in the planning department of a municipality or county. See 8.3.4.8.

3.3 *Acronyms:*

3.3.1 *AULs*—Activity and Use Limitations.

3.3.2 *CERCLA*—Comprehensive Environmental Response, Compensation and Liability Act of 1980 (as amended, 42 U.S.C. §§9601 *et seq.*).

3.3.3 *CERCLIS*—Comprehensive Environmental Response, Compensation and Liability Information System (maintained by EPA).

3.3.4 *CFR*—Code of Federal Regulations.

3.3.5 *CORRACTS*—facilities subject to Corrective Action under RCRA.

3.3.6 *EPA*—United States Environmental Protection Agency.

3.3.7 *EPCRA*—Emergency Planning and Community Right to Know Act ((also known as SARA Title III), 42 U.S.C. §§11001-11050 *et seq.*).

3.3.8 *ERNS*—emergency response notification system.

3.3.9 *ESA*—Environmental Site Assessment (different than an *environmental compliance audit*, 3.2.27).

3.3.10 *FOIA*—U.S. Freedom of Information Act (5 U.S.C. §552 as amended by Public Law No. 104-231, 110 Stat.).

3.3.11 *FR*—Federal Register.

3.3.12 *ICs*—Institutional Controls.

3.3.13 *LLP*—Landowner Liability Protections under the *Brownfields Amendments*

3.3.14 *LUST*—Leaking Underground Storage Tank.

3.3.15 *MSDS*—Material Safety Data Sheet.

3.3.16 *NCP*—National Contingency Plan.

3.3.17 *NFRAP*—former CERCLIS sites where no further remedial action is planned under CERCLA.

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3.3.18 *NPDES*—National Pollutant Discharge Elimination System.

3.3.19 *NPL*—National Priorities List.

3.3.20 *PCBs*—polychlorinated biphenyls.

3.3.21 *PRP*—Potentially Responsible Party (pursuant to CERCLA 42 U.S.C. §9607(a)).

3.3.22 *RCRA*—Resource Conservation and Recovery Act (as amended, 42 U.S.C.§§6901 *et seq.*).

3.3.23 *SARA*—Superfund Amendments and Reauthorization Act of 1986 (amendment to CERCLA).

3.3.24 *TSDF*—*hazardous waste* treatment, storage or disposal facility.

3.3.25 *USC*—United States Code.

3.3.26 *USGS*—United States Geological Survey.

3.3.27 *UST*—Underground Storage Tank.

4. Significance and Use

4.1 *Uses*—This practice is intended for use on a voluntary basis by parties who wish to assess the environmental condition of *commercial real estate* taking into account commonly known and *reasonably ascertainable* information. While use of this practice is intended to constitute *all appropriate inquiry* for purposes of the *LLPs*, it is not intended that its use be limited to that purpose. This practice is intended primarily as an approach to conducting an inquiry designed to identify *recognized environmental conditions* in connection with a *property*. No implication is intended that a person must use this practice in order to be deemed to have conducted inquiry in a commercially prudent or reasonable manner in any particular transaction. Nevertheless, this practice is intended to reflect a commercially prudent and reasonable inquiry. (See Section 1.6.)

4.2 *Clarifications on Use*:

4.2.1 *Use Not Limited to CERCLA*—This practice is designed to assist the *user* in developing information about the environmental condition of a *property* and as such has utility for a wide range of persons, including those who may have no actual or potential CERCLA liability and/or may not be seeking the *LLPs*.

4.2.2 *Residential Tenants/Purchasers and Others*—No implication is intended that it is currently customary practice for residential tenants of multifamily residential buildings, tenants of single-family homes or other residential real estate, or purchasers of *dwellings* for one's own residential use, to conduct an *environmental site assessment* in connection with these transactions. Thus, these transactions are not included in the term *commercial real estate* transactions, and it is not intended to imply that such persons are obligated to conduct an *environmental site assessment* in connection with these transactions for purposes of *all appropriate inquiry* or for any other purpose. In addition, no implication is intended that it is currently customary practice for *environmental site assessments* to be conducted in other unenumerated instances (including but not limited to many commercial leasing transactions, many acquisitions of easements, and many loan transactions in which the lender has multiple remedies). On the other hand, anyone who elects to do an *environmental site assessment* of any *property* or portion of a *property* may, in such person's judgment, use this practice.

4.2.3 *Site-Specific*—This practice is site-specific in that it relates to assessment of environmental conditions on a specific parcel of *commercial real estate*. Consequently, this practice does not address many additional issues raised in transactions such as purchases of business entities, or interests therein, or of their assets, that may well involve environmental liabilities pertaining to properties previously owned or operated or other off-site environmental liabilities.

4.3 *Who May Conduct*—A *Phase I Environmental Site Assessment* must be performed by an *environmental professional* as specified in Section 7.5.1. No practical standard can be designed to eliminate the role of judgment and the value and need for experience in the party performing the inquiry. The professional judgment of an *environmental professional* is, consequently, vital to the performance of *all appropriate inquiry*.

4.4 *Additional Services*—As set forth in 12.9, additional services may be contracted for between the *user* and the *environmental professional*. Such additional services may include *business environmental risk* issues not included within the scope of this practice, examples of which are identified in Section 13 under Non-Scope Considerations.

4.5 *Principles*—The following principles are an integral part of this practice and are intended to be referred to in resolving any ambiguity or exercising such discretion as is accorded the *user* or *environmental professional* in performing an *environmental site assessment* or in judging whether a *user* or *environmental professional* has conducted appropriate inquiry or has otherwise conducted an adequate *environmental site assessment*.

4.5.1 *Uncertainty Not Eliminated*—No *environmental site assessment* can wholly eliminate uncertainty regarding the potential for *recognized environmental conditions* in connection with a *property*. Performance of this practice is intended to reduce, but not eliminate, uncertainty regarding the potential for *recognized environmental conditions* in connection with a *property*, and this practice recognizes reasonable limits of time and cost.

4.5.2 *Not Exhaustive*—*All appropriate inquiry* does not mean an exhaustive assessment of a clean *property*. There is a point at which the cost of information obtained or the time required to gather it outweighs the usefulness of the information and, in fact, may be a material detriment to the orderly completion of transactions. One of the purposes of this practice is to identify a balance between the competing goals of limiting the costs and time demands inherent in performing an *environmental site assessment* and the reduction of uncertainty about unknown conditions resulting from additional information.

4.5.3 *Level of Inquiry is Variable*—Not every *property* will warrant the same level of assessment. Consistent with good commercial or customary practice, the appropriate level of *environmental site assessment* will be guided by the type of

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property subject to assessment, the expertise and risk tolerance of the *user*, and the information developed in the course of the inquiry.

4.5.4 *Comparison with Subsequent Inquiry*—It should not be concluded or assumed that an inquiry was not *all appropriate inquiry* merely because the inquiry did not identify *recognized environmental conditions* in connection with a *property*. *Environmental site assessments* must be evaluated based on the reasonableness of judgments made at the time and under the circumstances in which they were made. Subsequent *environmental site assessments* should not be considered valid standards to judge the appropriateness of any prior assessment based on hindsight, new information, use of developing technology or analytical techniques, or other factors.

4.6 *Continued Viability of Environmental Site Assessment*—Subject to Section 4.8, an *environmental site assessment* meeting or exceeding this practice and completed less than 180 days prior to the date of acquisition[6] of the *property* or (for transactions not involving an acquisition) the date of the intended transaction is presumed to be valid.[7] If within this period the assessment will be used by a different *user* than the *user* for whom the assessment was originally prepared, the subsequent *user* must also satisfy the User's Responsibilities in Section 6. Subject to Section 4.8 and the User's Responsibilities set forth in Section 6, an *environmental site assessment* meeting or exceeding this practice and for which the information was collected or updated within one year prior to the the date of acquisition of the *property* or (for transactions not involving an acquisition) the date of the intended transaction may be used provided that the following components of the inquiries were conducted or updated within 180 days of the date of purchase or the date of the intended transaction:

(i) *interviews* with *owners*, *operators*, and *occupants*;

(ii) searches for recorded environmental cleanup liens;

(iii) reviews of federal, tribal, state, and local government records;

(iv) visual inspections of the *property* and of *adjoining properties*; and

(v) the declaration by the *environmental professional* responsible for the assessment or update.

4.7 *Prior Assessment Usage*—This practice recognizes that *environmental site assessments* performed in accordance with this practice will include information that subsequent *users* may want to use to avoid undertaking duplicative assessment procedures. Therefore, this practice describes procedures to be followed to assist *users* in determining the appropriateness of using information in *environmental site assessments* performed more than one year prior to the date of acquisition of the *property* or (for transactions not involving an acquisition) the date of the intended transaction. The system of prior assessment usage is based on the following principles that should be adhered to in addition to the specific procedures set forth elsewhere in this practice:

4.7.1 *Use of Prior Information*—Subject to the requirements set forth in Section 4.6, *users* and *environmental professionals* may use information in prior *environmental site assessments* provided such information was generated as a result of procedures that meet or exceed the requirements of this practice. However, such information shall not be used without current investigation of conditions likely to affect *recognized environmental conditions* in connection with the *property*. Additional tasks may be necessary to document conditions that may have changed materially since the prior *environmental site assessment* was conducted.

4.7.2 *Contractual Issues Regarding Prior Assessment Usage*—The contractual and legal obligations between prior and subsequent *users* of *environmental site assessments* or between *environmental professionals* who conducted prior *environmental site assessments* and those who would like to use such prior *environmental site assessments* are beyond the scope of this practice.

4.8 *Actual Knowledge Exception*—If the *user* or *environmental professional(s)* conducting an *environmental site assessment* has *actual knowledge* that the information being used from a prior *environmental site assessment* is not accurate or if it is *obvious*, based on other information obtained by means of the *environmental site assessment* or known to the person conducting the *environmental site assessment*, that the information being used is not accurate, such information from a prior *environmental site assessment* may not be used.

4.9 *Rules of Engagement*—The contractual and legal obligations between an *environmental professional* and a *user* (and other parties, if any) are outside the scope of this practice. No specific legal relationship between the *environmental professional* and the *user* is necessary for the *user* to meet the requirements of this practice.

5. Significance of Activity and Use Limitations

5.1 *Activity and Use Limitations (AULs)*—AULs are one indication of a past or present release of a *hazardous substance* or *petroleum products*. AULs are an explicit recognition by a federal, tribal, state, or local regulatory agency that residual levels of *hazardous substances* or *petroleum products* may be present on a *property*, and that unrestricted use of the *property* may not be acceptable. AULs are important to both the *user* and the *environmental professional*. Specifically, the *environmental professional* can review agency records and *IC/EC registries* for the presence of AULs on the *property* to determine if a recognized environmental condition is present on the subject *property* (see Section 8.2.1, 8.2.2, and 11.5.1.4). The *user* must comply with AULs to maintain the LLP (see Appendix X1).

5.2 *Different Terms for AULs*—The term AUL is taken from Guide E 2091 to include both legal (that is, institutional) and physical (that is, engineering) controls within its scope. Agencies, organizations, and jurisdictions may define or utilize these terms differently (for example, Department of Defense and International City/County Management Association use "Land Use Controls" and the term "land use restrictions" is used but not defined in the *Brownfields Amendments*).

[6] Under "*All Appropriate Inquiry*" 40 C.F.R. Part 312, EPA defines date of acquisition as the date on which a person acquires title to the *property*.

[7] Subject to meeting the other requirements set forth in this section, for purpose of the *LLPs*, information collected in an assessment conducted prior to the effective date of the federal regulations for *All Appropriate Inquiry* or this practice can be used if the information was generated as a result of procedures that meet or exceed the requirements of the E 1527-97 or -00 standards.

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5.3 *Information Provided by the AUL*—The AUL should provide information on the chemical(s) of concern, the potential exposure pathway(s) that the AUL is intended to control, the environmental medium that is being controlled, and the expected performance objective(s) of the AUL. AULs may be used to provide access to monitoring wells, sampling locations, or remediation equipment.

5.4 *Where AULs Can Be Found*—AULs are often recorded in land title records. AUL information is contained in the restrictions of record on the title, rather than a typical chain of title. Chain of title will not provide information regarding restrictions on title such as restrictive covenants, easements, or other types of AULs. Some AULs are maintained on a state *IC or EC Registry* and may not be recorded in land title records. While some states maintain readily accessible *IC/EC registries*, other states do not. The *environmental professional* is cautioned to determine whether AULs are considered readily available records in the state in which the *property* is located. Some AULs may only exist in project documentation, which may not be readily available to the *environmental professional*. This may be the case in states where project files are archived after a period of years and access to the archives is restricted. AULs imposed upon some properties by local agencies with limited environmental oversight may not be recorded in the land title records, particularly where a local agency has been delegated regulatory authority over environmental programs.

6. User's Responsibilities

6.1 *Scope*—The purpose of this section is to describe tasks to be performed by the *user* that will help identify the possibility of *recognized environmental conditions* in connection with the *property*. These tasks do not require the technical expertise of an *environmental professional* and are generally not performed by *environmental professionals* performing a *Phase I Environmental Site Assessment*. Appendix X3 provides an optional *User* Questionnaire to assist the *user* and the *environmental professional* in gathering information from the *user* that may be material to identifying *recognized environmental conditions*.

6.2 *Review Title and Judicial Records for Environmental Liens or Activity and Use Limitations (AULs)*—*Reasonably ascertainable recorded land title records* and lien records that are filed under federal, tribal, state, or local law should be reviewed to identify *environmental liens* or *activity and use limitations*, if any, that are currently recorded against the *property*. *Environmental liens* and *activity and use limitations* that are imposed by judicial authorities may be recorded or filed in judicial records, and, where applicable, such records should be reviewed. Any *environmental liens* or *activity and use limitations* so identified shall be reported to the *environmental professional* conducting a *Phase I Environmental Site Assessment*. Unless added by a change in the scope of work to be performed by the *environmental professional*, this practice does not impose on the *environmental professional* the responsibility to undertake a review of *recorded land title records* and judicial records for *environmental liens* or *activity and use limitations*. The *user* should either *(1)* engage a title company or title professional to undertake a review of *reasonably ascertainable recorded land title records* and lien records for *environmental liens* or *activity and use limitations* currently recorded against or relating to the *property*, or *(2)* negotiate such an engagement of a title company or title professional as an addition to the scope of work to be performed by the *environmental professional*.

6.2.1 *Reasonably Ascertainable*—Except to the extent that applicable federal, state, local or tribal statutes, or regulations specify any place other than *recorded land title records* for recording or filing *environmental liens* or *activity and use limitations* or specify records to be reviewed to identify the existence of such *environmental liens* or *activity and use limitations*, *environmental liens* or *activity and use limitations* that are recorded or filed any place other than *recorded land title records* are not considered to be *reasonably ascertainable*.

6.3 *Specialized Knowledge or Experience of the User*—If the *user* is aware of any specialized knowledge or experience that is material to *recognized environmental conditions* in connection with the *property*, it is the *user's* responsibility to communicate any information based on such specialized knowledge or experience to the *environmental professional*. The *user* should do so before the *environmental professional* conducts the *site reconnaissance*.

6.4 *Actual Knowledge of the User*—If the *user* has *actual knowledge* of any *environmental lien* or AULs encumbering the *property* or in connection with the *property*, it is the *user's* responsibility to communicate such information to the *environmental professional*. The *user* should do so before the *environmental professional* conducts the *site reconnaissance*.

6.5 *Reason for Significantly Lower Purchase Price*—In a transaction involving the purchase of a parcel of *commercial real estate*, the *user* shall consider the relationship of the purchase price of the *property* to the fair market value of the *property* if the *property* was not affected by *hazardous substances* or *petroleum products*. The *user* should try to identify an explanation for a lower price which does not reasonably reflect fair market value if the *property* were not contaminated, and make a written record of such explanation. Among the factors to consider will be the information that becomes known to the *user* pursuant to the *Phase I Environmental Site Assessment*. This standard does not require that a real estate appraisal be obtained in order to ascertain fair market value of the *property*.

6.6 *Commonly Known or Reasonably Ascertainable Information*—If the *user* is aware of any commonly known or *reasonably ascertainable* information within the local community about the *property* that is material to *recognized environmental conditions* in connection with the *property*, it is the *user's* responsibility to communicate such information to the *environmental professional*. The *user* should do so before the *environmental professional* conducts the *site reconnaissance*.

6.7 *Other*—Either the *user* shall make known to the *environmental professional* the reason why the *user* wants to have the *Phase I Environmental Site Assessment* performed or, if the *user* does not identify the purpose of the *Phase I Environmental Site Assessment*, the *environmental professional* shall assume the purpose is to qualify for an LLP to CERCLA liability and state this in the *report*. In addition to satisfying one of the requirements to qualify for an LLP to CERCLA liability,

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another reason for performing a *Phase I Environmental Site Assessment* might include the need to understand potential environmental conditions that could materially impact the operation of the business associated with the parcel of *commercial real estate*. The *user* and the *environmental professional* may also need to modify the scope of services performed under this practice for special circumstances, including, but not limited to, operating industrial facilities or large tracts of land (large areas or corridors).

7. Phase I Environmental Site Assessment

7.1 *Objective*—The purpose of this *Phase I Environmental Site Assessment* is to identify, to the extent feasible pursuant to the processes prescribed herein, *recognized environmental conditions* in connection with the *property*. (See 1.1.1.)

7.2 *Four Components*—A *Phase I Environmental Site Assessment* shall have four components, as described as follows:

7.2.1 *Records Review*—Review of records; see Section 8,

7.2.2 *Site Reconnaissance*—A visit to the *property*; see Section 9,

7.2.3 *Interviews*:

7.2.3.1 *Interviews* with present and past *owners*, *operators*, and *occupants* of the *property*; see Section 10, and

7.2.3.2 *Interviews* with local government officials; see Section 11, and

7.2.4 *Report*—Evaluation and *report*; see Section 12.

7.3 *Coordination of Parts*:

7.3.1 *Parts Used in Concert*—The *records review*, *site reconnaissance*, and *interviews* are intended to be used in concert with each other. If information from one source indicates the need for more information, other sources may be available to provide information. For example, if a previous use of the *property* as a gasoline station is identified through the *records review*, but the present *owner* and *occupants* interviewed report no knowledge of an *underground storage tank*, the person conducting the *site reconnaissance* should be alert for signs of the presence of an *underground storage tank*.

7.3.2 *User's Obligations*—The *environmental professional* shall note in the *report* whether or not the *user* has reported to the *environmental professional* information pursuant to Section 6.

7.4 *No Sampling*—This practice does not include any testing or sampling of materials (for example, soil, water, air, building materials).

7.5 *Who May Conduct a Phase I*:

7.5.1 *Environmental Professional's Duties*—The *environmental site assessment* must be performed by the *environmental professional* or conducted under the supervision or responsible charge of the *environmental professional*. The *interviews* and *site reconnaissance* shall be performed by a person possessing sufficient training and experience necessary to conduct the *site reconnaissance* and *interviews* in accordance with this practice, and having the ability to identify issues relevant to *recognized environmental conditions* in connection with the *property*. At a minimum, the *environmental professional* must be involved in planning the *site reconnaissance* and *interviews*. Review and interpretation of information upon which the *report* is based shall be performed by the *environmental professional*.

7.5.2 *Information Obtained From Others*—Information for the *records review* needed for completion of a *Phase I Environmental Site Assessment* may be provided by a number of parties including government agencies, third-party vendors, the *user*, and present and past *owners* and *occupants* of the *property*, provided that the information is obtained by or under the supervision of an *environmental professional* or is obtained by a third-party vendor specializing in retrieval of the information specified in Section 8. Prior assessments may also contain information that will be appropriate for usage in a current *environmental site assessment* provided the prior usage procedures set forth in Sections 8, 9, and 10 are followed. The *environmental professional(s)* responsible for the *report* shall review all of the information provided.

7.5.2.1 *Reliance*—An *environmental professional* is not required to verify independently the information provided but may rely on information provided unless he or she has *actual knowledge* that certain information is incorrect or unless it is *obvious* that certain information is incorrect based on other information obtained in the *Phase I Environmental Site Assessment* or otherwise actually known to the *environmental professional*.

8. Records Review

8.1 *Introduction*:

8.1.1 *Objective*—The purpose of the *records review* is to obtain and review records that will help identify *recognized environmental conditions* in connection with the *property*.

8.1.2 *Approximate Minimum Search Distance*—Some records to be reviewed pertain not just to the *property* but also pertain to properties within an additional *approximate minimum search distance* in order to help assess the likelihood of problems from migrating *hazardous substances* or *petroleum products*. When the term *approximate minimum search distance* includes areas outside the *property*, it shall be measured from the nearest *property* boundary. The term *approximate minimum search distance* is used in lieu of radius in order to include irregularly shaped properties.

8.1.2.1 *Adjustment to Approximate Minimum Search Distance*—When allowed by 8.2.1, the *approximate minimum search distance* for a particular record may be adjusted in the discretion of the *environmental professional*. Factors to consider in adjusting the *approximate minimum search distance* include: *(1)* the density (for example, urban, rural, or suburban) of the setting in which the *property* is located; *(2)* the distance that the *hazardous substances* or *petroleum products* are likely to migrate based on local geologic or hydrogeologic conditions; *(3)* the *property* type, *(4)* existing or past uses of surrounding properties, and *(5)* other reasonable factors. The justification for each adjustment and the *approximate minimum search distance* actually used for any particular record shall be explained in the *report*. If the *approximate minimum search distance* is specified as "*property* only," then the search shall be limited to the *property* and may not be reduced unless the particular record is not *reasonably ascertainable*.

8.1.3 *Accuracy and Completeness*—Accuracy and completeness of record information varies among information sources, including governmental sources. Record information is often inaccurate or incomplete. The *user* or *environmental*

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professional is not obligated to identify mistakes or insufficiencies in information provided. However, the *environmental professional* reviewing records shall make a reasonable effort to compensate for mistakes or insufficiencies in the information reviewed that are *obvious* in light of other information of which the *environmental professional* has *actual knowledge*.

8.1.4 *Reasonably Ascertainable/Standard Sources*—Availability of record information varies from information source to information source, including governmental jurisdictions. The *user* or *environmental professional* is not obligated to identify, obtain, or review every possible record that might exist with respect to a *property*. Instead, this practice identifies record information that shall be reviewed from *standard sources*, and the *user* or *environmental professional* is required to review only record information that is *reasonably ascertainable* from those *standard sources*. Record information that is *reasonably ascertainable* means *(1)* information that is *publicly available*, *(2)* information that is obtainable from its source within reasonable time and cost constraints, and *(3)* information that is *practically reviewable*.

8.1.4.1 *Publicly Available*—Information that is *publicly available* means that the source of the information allows access to the information by anyone upon request.

8.1.4.2 *Reasonable Time and Cost*—Information that is obtainable within reasonable time and cost constraints means that the information will be provided by the source within 20 calendar days of receiving a written, telephone, or in-person request at no more than a nominal cost intended to cover the source's cost of retrieving and duplicating the information. Information that can only be reviewed by a visit to the source is *reasonably ascertainable* if the visit is permitted by the source within 20 days of request.

8.1.4.3 *Practically Reviewable*—Information that is *practically reviewable* means that the information is provided by the source in a manner and in a form that, upon examination, yields information relevant to the *property* without the need for extraordinary analysis of irrelevant data. The form of the information shall be such that the *user* can review the records for a limited geographic area. Records that cannot be feasibly retrieved by reference to the location of the *property* or a geographic area in which the *property* is located are not generally *practically reviewable*. Most databases of public records are *practically reviewable* if they can be obtained from the source agency by the county, city, zip code, or other geographic area of the facilities listed in the record system. Records that are sorted, filed, organized, or maintained by the source agency only chronologically are not generally *practically reviewable*. Listings in *publicly available* records which do not have adequate address information to be located geographically are not generally considered *practically reviewable*. For large databases with numerous records (such as *RCRA generators* and registered USTs), the records are not *practically reviewable* unless they can be obtained from the source agency in the smaller geographic area of zip codes. Even when information is provided by zip code for some large databases, it is common for an unmanageable number of sites to be identified within a given zip code. In these cases, it is not necessary to review the impact of all of the sites that are likely to be listed in any given zip code because that information would not be *practically reviewable*. In other words, when so much data is generated that it cannot be feasibly reviewed for its impact on the *property*, it is not required to be reviewed.

8.1.5 *Alternatives to Standard Sources*—Alternative sources may be used instead of *standard sources* if they are of similar or better reliability and detail, or if a standard source is not *reasonably ascertainable*.

8.1.6 *Coordination*—If records are not *reasonably ascertainable* from *standard sources* or alternative sources, the *environmental professional* shall attempt to obtain the requested information by other means specified in this practice, such as questions posed to the current *owner* or *occupant(s)* of the *property* or appropriate persons available at the source at the time of the request.

8.1.7 *Sources of Standard Source Information*—Standard source information or other record information from government agencies may be obtained directly from appropriate government agencies or from commercial services. Government information obtained from nongovernmental sources may be considered current if the source updates the information at least every 90 days or, for information that is updated less frequently than quarterly by the government agency, within 90 days of the date the government agency makes the information available to the public.

8.1.8 *Documentation of Sources Checked*—The *report* shall document each source that was used, even if a source revealed no findings. Sources shall be sufficiently documented, including name, date request for information was filled, date information provided was last updated by source, date information was last updated by original source (if provided other than by original source; see 8.1.7). Supporting documentation shall be included in the *report* or adequately referenced to facilitate reconstruction of the assessment by an *environmental professional* other than the *environmental professional* who conducted it.

8.1.9 *Significance*—If a standard environmental record source (or other sources in the course of conducting the *Phase I Environmental Site Assessment*) identifies the *property* or another site within the *approximate minimum search distance*, the *report* shall include the *environmental professional's* judgment about the significance of the listing to the analysis of *recognized environmental conditions* in connection with the *property* (based on the data retrieved pursuant to 8.2, additional information from the government source, or other sources of information). In doing so, the *environmental professional* may make statements applicable to multiple sites (for example, a statement to the effect that none of the sites listed is likely to have a negative impact on the *property* except ...).

8.2 *Environmental Information*:

8.2.1 *Standard Environmental Record Sources*—The following *standard environmental record sources* shall be reviewed, subject to the conditions of 8.1.1 through 8.1.7. The *approximate minimum search distance* may be reduced, pursuant to 8.1.2.1, for any of these *standard environmental record sources* except the Federal *NPL* site list and Federal RCRA TSD list.

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Standard Environmental Record Sources (where available)	*Approximate Minimum Search Distance* miles (kilometres)
Federal *NPL* site list	1.0 (1.6)
Federal Delisted *NPL* site list	0.5 (0.8)
Federal CERCLIS list	0.5 (0.8)
Federal CERCLIS NFRAP site list	0.5 (0.8)
Federal RCRA CORRACTS facilities list	1.0 (1.6)
Federal RCRA non-CORRACTS TSD facilities list	0.5 (0.8)
Federal *RCRA generators list*	*property* and *adjoining properties*
Federal institutional control/engineering control registries	*property* only
Federal *ERNS list*	*property* only
State and tribal lists of *hazardous waste* sites identified for investigation or remediation:	
State- and tribal-equivalent *NPL*	1.0 (1.6)
State- and tribal-equivalent CERCLIS	0.5 (0.8)
State and tribal *landfill* and/or *solid waste disposal site* lists	0.5 (0.8)
State and tribal leaking storage tank lists	0.5 (0.8)
State and tribal registered storage tank lists	*property* and *adjoining properties*
State and tribal institutional control/ engineering control registries	*property* only
State and tribal voluntary cleanup sites	0.5 (0.8)
State and tribal Brownfield sites	0.5 (0.8)

8.2.2 *Additional Environmental Record Sources*—To enhance and supplement the *standard environmental record sources* in 8.2.1, local records and/or additional state or tribal records shall be checked when, in the judgment of the *environmental professional*, such additional records *(1)* are *reasonably ascertainable*, *(2)* are sufficiently useful, accurate, and complete in light of the objective of the *records review* (see 8.1.1), and *(3)* are generally obtained, pursuant to local good commercial or customary practice, in initial *environmental site assessments* in the type of *commercial real estate transaction* involved. To the extent additional sources are used to supplement the same record types listed in 8.2.1, *approximate minimum search distances* should not be less than those specified above (adjusted as provided in 8.2.1 and 8.1.2.1). Some types of records and sources that may be useful include:

Types of Records

Local Brownfield Lists
Local Lists of *Landfill/Solid Waste Disposal Sites*
Local Lists of *Hazardous waste/Contaminated Sites*
Local Lists of Registered Storage Tanks
Local Land Records (for *activity and use limitations*)
Records of Emergency Release Reports (42 U.S.C. 11004)
Records of Contaminated public wells

Sources

Department of Health/Environmental Division
Fire Department
Planning Department
Building Permit/Inspection Department
Local/Regional Pollution Control Agency
Local/Regional Water Quality Agency
Local Electric Utility Companies (for records relating to PCBs)

8.2.3 *Physical Setting Sources*—A current *USGS 7.5 Minute Topographic Map* (or equivalent) showing the area on which the *property* is located shall be reviewed, provided it is *reasonably ascertainable*. It is the only *standard physical setting source* and the only *physical setting source* that is required to be obtained (and only if it is *reasonably ascertainable*). One or more additional *physical setting sources* may be obtained in the discretion of the *environmental professional*. Because such sources provide information about the geologic, hydrogeologic, hydrologic, or topographic characteristics of a site, discretionary *physical setting sources* shall be sought when *(1)* conditions have been identified in which *hazardous substances* or *petroleum products* are likely to migrate to the *property* or from or within the *property* into the ground water or soil and *(2)* more information than is provided in the current *USGS 7.5 Minute Topographic Map* (or equivalent) is generally obtained, pursuant to local good commercial or customary practice in initial *environmental site assessments* in the type of *commercial real estate transaction involved*, in order to assess the impact of such migration on *recognized environmental conditions* in connection with the *property*.

Mandatory *Standard Physical Setting Source*

USGS—Current 7.5 Minute Topographic Map (or equivalent)

Discretionary and Non-Standard *Physical Setting Sources*

USGS and/or State Geological Survey—Groundwater Maps
USGS and/or State Geological Survey—Bedrock Geology Maps
USGS and/or State Geological Survey—Surficial Geology Maps
Soil Conservation Service—Soil Maps
Other *Physical Setting Sources* that are reasonably credible (as well as *reasonably ascertainable*)

8.3 *Historical Use Information*:

8.3.1 *Objective*—The objective of consulting historical sources is to develop a history of the previous uses of the *property* and surrounding area, in order to help identify the likelihood of past uses having led to *recognized environmental conditions* in connection with the *property*.

8.3.2 *Uses of the Property*—All *obvious* uses of the *property* shall be identified from the present, back to the *property's* first developed use, or back to 1940, whichever is earlier. This task requires reviewing only as many of the *standard historical sources* in 8.3.4.1 through 8.3.4.8 as are necessary and both *reasonably ascertainable* and likely to be useful (as described under *Data Failure* in 8.3.2.3). For example, if the *property* was developed in the 1700s, it might be feasible to identify uses back to the early 1900s, using sources such as *fire insurance maps* or USGS topographic maps (or equivalent). Although other sources such as *recorded land title records* might go back to the 1700s, it would not be required to review them unless they were both *reasonably ascertainable* and likely to be useful. As another example, if the *property* was reportedly not developed until 1960, it would still be necessary to attempt to confirm that it was undeveloped back to 1940. Such confirmation may come from one or more of the *standard historical sources* specified in 8.3.4.1 through 8.3.4.8, or it may come from *other historical sources* (such as someone with personal knowledge of the *property*; see 8.3.4.9). However, checking *other historical sources* (see 8.3.4.9) is not required. For purposes of 8.3.2, the term "developed use" includes agricultural uses and placement of *fill dirt*. The *report* shall describe all identified uses, justify the earliest date identified (for example, records showed no development of the *property* prior to the specific date), and explain the reason for any gaps in the history of use (for example, *data failure*).

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8.3.2.1 *Intervals*—Review of *standard historical sources* at less than approximately five year intervals is not required by this practice (for example, if the *property* had one use in 1950 and another use in 1955, it is not required to check for a third use in the intervening period). If the specific use of the *property* appears unchanged over a period longer than five years, then it is not required by this practice to research the use during that period (for example, if *fire insurance maps* show the same apartment building in 1940 and 1960, then the period in between need not be researched).

8.3.2.2 *General Type of Use*—In identifying previous uses, more specific information about uses is more helpful than less specific information, but it is sufficient, for purposes of 8.3.2, to identify the general type of use (for example: office, retail, and residential) unless it is *obvious* from the source(s) consulted that the use may be more specifically identified. However, if the general type of use is industrial or manufacturing (for example, *zoning/land use records* show industrial zoning), then additional *standard historical sources* should be reviewed if they are likely to identify a more specific use and are *reasonably ascertainable*, subject to the constraints of *data failure* (see 8.3.2.3).

8.3.2.3 *Data Failure*—The historical research is complete when either: *(1)* the objectives in 8.3.1 through 8.3.2.2 are achieved; or *(2) data failure* is encountered. *Data failure* occurs when all of the *standard historical sources* that are *reasonably ascertainable* and likely to be useful have been reviewed and yet the objectives have not been met. *Data failure* is not uncommon in trying to identify the use of the *property* at five year intervals back to first use or 1940 (whichever is earlier). Notwithstanding a *data failure*, *standard historical sources* may be excluded if: *(1)* the sources are not *reasonably ascertainable*, or *(2)* if past experience indicates that the sources are not likely to be sufficiently useful, accurate, or complete in terms of satisfying the objectives. *Other historical sources* specified in 8.3.4.9 may be used to satisfy the objectives, but are not required to comply with this practice. If *data failure* is encountered, the *report* shall document the failure and, if any of the *standard historical sources* were excluded, give the reasons for their exclusion. If the *data failure* represents a significant *data gap*, the *report* shall comment on the impact of the *data gap* on the ability of the *environmental professional* to identify *recognized environmental conditions* (see 12.7).

8.3.3 *Uses of Properties in Surrounding Area*—Uses in the area surrounding the *property* shall be identified in the *report*, but this task is required only to the extent that this information is revealed in the course of researching the *property* itself (for example, an *aerial photograph* or *fire insurance map* of the *property* will usually show the surrounding area). If the *environmental professional* uses sources that include the surrounding area, surrounding uses should be identified to a distance determined at the discretion of the *environmental professional* (for example, if an aerial photo shows the area surrounding the *property*, then the *environmental professional* shall determine how far out from the *property* the photo should be analyzed). Factors to consider in making this determination include, but are not limited to: the extent to which information is *reasonably ascertainable*; the time and cost involved in reviewing surrounding uses (for example, analyzing *aerial photographs* is relatively quick, but reviewing *property tax files* for adjacent properties or reviewing *local street directories* for more than the few streets that surround the site is typically too time-consuming); the extent to which information is useful, accurate, and complete in light of the purpose of the *records review* (see 8.1.1); the likelihood of the information being significant to *recognized environmental conditions* in connection with the *property*; the extent to which potential concerns are *obvious*; known hydrogeologic/geologic conditions that may indicate a high probability of *hazardous substances* or *petroleum products* migration to the *property*; how recently local development has taken place; information obtained from *interviews* and other sources; and local good commercial or customary practice.

8.3.4 *Standard Historical Sources*:

8.3.4.1 *Aerial Photographs*—The term "*aerial photographs*" means photographs taken from an aerial platform with sufficient resolution to allow identification of development and activities of areas encompassing the *property*. *Aerial photographs* are often available from government agencies or private collections unique to a local area.

8.3.4.2 *Fire Insurance Maps*—The term *fire insurance maps* means maps produced for private fire insurance map companies that indicate uses of properties at specified dates and that encompass the *property*. These maps are often available at local libraries, historical societies, private resellers, or from the map companies who produced them.

8.3.4.3 *Property Tax Files*—The term *property* tax files means the files kept for *property* tax purposes by the local jurisdiction where the *property* is located and includes records of past ownership, appraisals, maps, sketches, photos, or other information that is *reasonably ascertainable* and pertaining to the *property*.

8.3.4.4 *Recorded Land Title Records*—The term *recorded land title records* means records of historical fee ownership, which may include leases, land contracts and AULs on or of the *property* recorded in the place where land title records are, by law or custom, recorded for the local jurisdiction in which the *property* is located (often such records are kept by a municipal or county recorder or clerk). Such records may be obtained from title companies or directly from the local government agency. Information about the title to the *property* that is recorded in a U.S. district court or any place other than where land title records are, by law or custom, recorded for the local jurisdiction in which the *property* is located, are not considered part of *recorded land title records*, because often this source will provide only names of previous *owners*, lessees, easement holders, etc. and little or no information about uses or occupancies of the *property*, but when employed in combination with another source *recorded land title records* may provide helpful information about uses of the *property*. This source cannot be the sole historical source consulted. If this source is consulted, at least one additional standard historical source must also be consulted.

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8.3.4.5 *USGS Topographic Maps*—The term USGS Topographic Maps means maps available from or produced by the United States Geological Survey (7.5 minute topographic maps are preferred).

8.3.4.6 *Local Street Directories*—The term *local street directories* means directories published by private (or sometimes government) sources and showing ownership and/or use of sites by reference to street addresses. Often *local street directories* are available at libraries of local governments, colleges or universities, or historical societies.

8.3.4.7 *Building Department Records*—The term *building department records* means those records of the local government in which the *property* is located indicating permission of the local government to construct, alter, or demolish improvements on the *property*. Often *building department records* are located in the building department of a municipality or county.

8.3.4.8 *Zoning/Land Use Records*—The term *zoning/land use records* means those records of the local government in which the *property* is located indicating the uses permitted by the local government in particular zones within its jurisdiction. The records may consist of maps and/or written records. They are often located in the planning department of a municipality or county.

8.3.4.9 *Other Historical Sources*—The term *other historical sources* means any source or sources other than those designated in 8.3.4.1 through 8.3.4.8 that are credible to a reasonable person and that identify past uses of the *property*. This category includes, but is not limited to: miscellaneous maps, newspaper archives, internet sites, community organizations, local libraries, historical societies, current *owners* or *occupants* of neighboring properties, or records in the files and/or personal knowledge of the *property owner* and/or *occupants*.

8.4 *Prior Assessment Usage—Standard historical sources* reviewed as part of a prior *environmental site assessment* do not need to be searched for or reviewed again, but uses of the *property* since the prior *environmental site assessment* should be identified either through *standard historical sources* (as specified in 8.3) or by alternatives to *standard historical sources*, to the extent such information is *reasonably ascertainable*. (See 4.7.)

9. Site Reconnaissance

9.1 *Objective*—The objective of the *site reconnaissance* is to obtain information indicating the likelihood of identifying *recognized environmental conditions* in connection with the *property*.

9.2 *Observation*—On a visit to the *property* (the *site visit*), the *property* shall be *visually and/or physically observed* and any structure(s) located on the *property* to the extent not obstructed by bodies of water, adjacent buildings, or other obstacles shall be observed.

9.2.1 *Exterior*—The periphery of the *property* shall be *visually and/or physically observed*, as well as the periphery of all structures on the *property*, and the *property* should be viewed from all adjacent public thoroughfares. If roads or paths with no apparent outlet are observed on the *property*, the use of the road or path should be identified to determine whether it was likely to have been used as an avenue for disposal of *hazardous substances* or *petroleum products*.

9.2.2 *Interior*—On the interior of structures on the *property*, accessible common areas expected to be used by *occupants* or the public (such as lobbies, hallways, utility rooms, recreation areas, etc.), maintenance and repair areas, including boiler rooms, and a representative sample of occupant spaces, should be *visually and/or physically observed*. It is not necessary to look under floors, above ceilings, or behind walls.

9.2.3 *Methodology*—The *environmental professional* shall document, in the *report*, the method used (for example, grid patterns or other systematic approaches used for large properties, which spaces for *owner* or *occupants* were observed) to observe the *property*.

9.2.4 *Limitations*—The *environmental professional* shall document, in the *report*, general limitations and basis of review, including limitations imposed by physical obstructions such as adjacent buildings, bodies of water, asphalt, or other paved areas, and limiting conditions (for example, snow, rain).

9.2.5 *Frequency*—It is not expected that more than one visit to the *property* shall be made in connection with a *Phase I Environmental Site Assessment*. The one visit constituting part of the *Phase I Environmental Site Assessment* may be referred to as the *site visit*.

9.3 *Prior Assessment Usage*—The information supplied in connection with the *site reconnaissance* portion of a prior *environmental site assessment* may be used for guidance but shall not be relied upon without determining through a new *site reconnaissance* whether any conditions that are material to *recognized environmental conditions* in connection with the *property* have changed since the prior *environmental site assessment*.

9.4 *Uses and Conditions*—The uses and conditions specified in 9.4.1 through 9.4.4.7 should be noted to the extent *visually and/or physically observed* during the *site visit*. The uses and conditions specified in 9.4.4 through 9.4.4.7 should also be the subject of questions asked as part of *interviews* of *owners*, *operators*, and *occupants* (see Section 10). Uses and conditions to be noted shall be recorded in field notes but are only required to be described in the *report* to the extent specified in 9.4.1 through 9.4.4.7. The *environmental professional(s)* performing the *Phase I Environmental Site Assessment* are obligated to identify uses and conditions only to the extent that they may be *visually and/or physically observed* on a *site visit*, as described in this practice, or to the extent that they are identified by the *interviews* (see Sections 10 and 11) or *record review* (see Section 8) processes described in this practice.

9.4.1 *General Site Setting*:

9.4.1.1 *Current Use(s) of the Property*—The current use(s) of the *property* shall be identified in the *report*. Any current uses likely to involve the use, treatment, storage, disposal, or generation of *hazardous substances* or *petroleum products* shall be identified in the *report*. Unoccupied occupant spaces should be noted. In identifying current uses of the *property*, more specific information is more helpful than less specific information. (For example, it is more useful to identify uses such as a hardware store, a grocery store, or a bakery rather than simply retail use.)

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9.4.1.2 *Past Use(s) of the Property*—To the extent that indications of past uses of the *property* are *visually and/or physically observed* on the *site visit*, or are identified in the *interviews* or *record review*, they shall be identified in the *report*, and past uses so identified shall be described in the *report* if they are likely to have involved the use, treatment, storage, disposal, or generation of *hazardous substances* or *petroleum products*. (For example, there may be signs indicating a past use or a structure indicating a past use.)

9.4.1.3 *Current Uses of Adjoining Properties*—To the extent that current uses of *adjoining properties* are *visually and/or physically observable* on the *site visit*, or are identified in the *interviews* or *records review*, they shall be identified in the *report*, and current uses so identified shall be described in the *report* if they are likely to indicate *recognized environmental conditions* in connection with the *adjoining properties* or the *property*.

9.4.1.4 *Past Uses of Adjoining Properties*—To the extent that indications of past uses of *adjoining properties* are *visually and/or physically observed* on the *site visit*, or are identified in the *interviews* or *record review*, they shall be noted and past uses so identified shall be described in the *report* if they are likely to indicate *recognized environmental conditions* in connection with the *adjoining properties* or the *property*.

9.4.1.5 *Current or Past Uses in the Surrounding Area*—To the extent that the general type of current or past uses (for example, residential, commercial, industrial) of properties surrounding the *property* are *visually and/or physically observed* on the *site visit* or going to or from the *property* for the *site visit*, or are identified in the *interviews* or *record review*, they shall be noted and uses so identified shall be described in the *report* if they are likely to indicate *recognized environmental conditions* in connection with the *property*.

9.4.1.6 *Geologic, Hydrogeologic, Hydrologic, and Topographic Conditions*—The topographic conditions of the *property* shall be noted to the extent *visually and/or physically observed* or determined from *interviews*, as well as the general topography of the area surrounding the *property* that is *visually and/or physically observed* from the periphery of the *property*. If any information obtained shows there are likely to be *hazardous substances* or *petroleum products* on the *property* or on nearby properties and those *hazardous substances* or *petroleum products* are of a type that may migrate, topographic observations shall be analyzed in connection with geologic, hydrogeologic, hydrologic, and topographic information obtained pursuant to *records review* (see 8.2.3) and *interviews* to evaluate whether *hazardous substances* or *petroleum products* are likely to migrate to the *property*, or within or from the *property*, into ground water or soil.

9.4.1.7 *General Description of Structures*—The *report* shall generally describe the structures or other improvements on the *property*, for example: number of buildings, number of stories each, approximate age of buildings, ancillary structures (if any), etc.

9.4.1.8 *Roads*—Public thoroughfares adjoining the *property* shall be identified in the *report* and any roads, streets, and parking facilities on the *property* shall be described in the *report*.

9.4.1.9 *Potable Water Supply*—The source of potable water for the *property* shall be identified in the *report*.

9.4.1.10 *Sewage Disposal System*—The sewage disposal system for the *property* shall be identified in the *report*. Inquiry shall be made as to the age of the system as part of the process under Sections 8, 10, or 11.

9.4.2 *Interior and Exterior Observations*:

9.4.2.1 *Current Use(s) of the Property*—The current use(s) of the *property* shall be identified in the *report*. Any current uses likely to involve the use, treatment, storage, disposal, or generation of *hazardous substances* or *petroleum products* shall be identified in the *report*. Unoccupied occupant spaces should be noted. In identifying current uses of the *property*, more specific information is more helpful than less specific information. (For example, it is more useful to identify uses such as a hardware store, a grocery store, or a bakery rather than simply retail use.)

9.4.2.2 *Past Use(s) of the Property*—To the extent that indications of past uses of the *property* are *visually and/or physically observed* on the *site visit*, or are identified in the *interviews* or *records review*, they shall be identified in the *report*, and past uses so identified shall be described in the *report* if they are likely to have involved the use, treatment, storage, disposal, or generation of *hazardous substances* or *petroleum products*. (For example, there may be signs indicating a past use or a structure indicating a past use.)

9.4.2.3 *Hazardous Substances and Petroleum Products in Connection with Identified Uses*—To the extent that present uses are identified that use, treat, store, dispose of, or generate *hazardous substances* and *petroleum products* on the *property*: *(1)* the *hazardous substances* and *petroleum products* shall be identified or indicated as unidentified in the *report*, and *(2)* the approximate quantities involved, types of containers (if any) and storage conditions shall be described in the *report*. To the extent that past uses are identified that used, treated, stored, disposed of, or generated *hazardous substances* and *petroleum products* on the *property*, the information shall be identified to the extent it is *visually and/or physically observed* during the *site visit* or identified from the *interviews* or the *records review*.

9.4.2.4 *Storage Tanks*—Above ground storage tanks, or *underground storage tanks* or vent pipes, fill pipes or access ways indicating *underground storage tanks* shall be identified (for example, content, capacity, and age) to the extent *visually and/or physically observed* during the *site visit* or identified from the *interviews* or *records review*.

9.4.2.5 *Odors*—Strong, pungent, or noxious odors shall be described in the *report* and their sources shall be identified in the *report* to the extent *visually and/or physically observed* or identified from the *interviews* or *records review*.

9.4.2.6 *Pools of Liquid*—Standing surface water shall be noted. Pools or *sumps* containing liquids likely to be *hazardous substances* or *petroleum products* shall be described in the *report* to the extent *visually and/or physically observed* or identified from the *interviews* or *records review*.

9.4.2.7 *Drums*—To the extent *visually and/or physically observed* or identified from the *interviews* or *records review*, *drums* shall be described in the *report*, whether or not they are leaking, unless it is known that their contents are not *hazardous*

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substances or *petroleum products* (in that case the contents should be described in the *report*). *Drums* often hold 55 gal (208 L) of liquid, but containers as small as 5 gal (19 L) should also be described.

9.4.2.8 *Hazardous Substance and Petroleum Products Containers (Not Necessarily in Connection With Identified Uses)*—When containers identified as containing *hazardous substances* or *petroleum products* are *visually and/or physically observed* on the *property* and are or might be a recognized environmental condition: the *hazardous substances* or *petroleum products* shall be identified or indicated as unidentified in the *report*, and the approximate quantities involved, types of containers, and storage conditions shall be described in the *report*.

9.4.2.9 *Unidentified Substance Containers*—When open or damaged containers containing unidentified substances suspected of being *hazardous substances* or *petroleum products* are *visually and/or physically observed* on the *property*, the approximate quantities involved, types of containers, and storage conditions shall be described in the *report*.

9.4.2.10 *PCBs*—Electrical or hydraulic equipment known to contain PCBs or likely to contain PCBs shall be described in the *report* to the extent *visually and/or physically observed* or identified from the *interviews* or *records review*. Fluorescent light ballast likely to contain PCBs does not need to be noted.

9.4.3 *Interior Observations*:

9.4.3.1 *Heating/Cooling*—The means of heating and cooling the buildings on the *property*, including the fuel source for heating and cooling, shall be identified in the *report* (for example, heating oil, gas, electric, radiators from steam boiler fueled by gas).

9.4.3.2 *Stains or Corrosion*—To the extent *visually and/or physically observed* or identified from the *interviews*, stains or corrosion on floors, walls, or ceilings shall be described in the *report*, except for staining from water.

9.4.3.3 *Drains and Sumps*—To the extent *visually and/or physically observed* or identified from the *interviews*, floor drains and *sumps* shall be described in the *report*.

9.4.4 *Exterior Observations*:

9.4.4.1 *Pits, Ponds, or Lagoons*—To the extent *visually and/or physically observed* or identified from the *interviews* or *records review*, *pits, ponds, or lagoons* on the *property* shall be described in the *report*, particularly if they have been used in connection with waste disposal or waste treatment. *Pits, ponds, or lagoons* on properties adjoining the *property* shall be described in the *report* to the extent they are *visually and/or physically observed* from the *property* or identified in the *interviews* or *records review*.

9.4.4.2 *Stained Soil or Pavement*—To the extent *visually and/or physically observed* or identified from the *interviews*, areas of stained soil or pavement shall be described in the *report*.

9.4.4.3 *Stressed Vegetation*—To the extent *visually and/or physically observed* or identified from the *interviews*, areas of stressed vegetation (from something other than insufficient water) shall be described in the *report*.

9.4.4.4 *Solid Waste*—To the extent *visually and/or physically observed* or identified from the *interviews* or *records review*, areas that are apparently filled or graded by non-natural causes (or filled by fill of unknown origin) suggesting trash *construction debris*, *demolition debris*, or other solid waste disposal, or mounds or depressions suggesting trash or other solid waste disposal, shall be described in the *report*.

9.4.4.5 *Waste Water*—To the extent *visually and/or physically observed* or identified from the *interviews* or *records review*, waste water or other liquid (including storm water) or any discharge into a drain, ditch, *underground injection* system, or stream on or adjacent to the *property* shall be described in the *report*.

9.4.4.6 *Wells*—To the extent *visually and/or physically observed* or identified from the *interviews* or *records review*, all wells (including *dry wells*, irrigation wells, injection wells, abandoned wells, or other wells) shall be described in the *report*.

9.4.4.7 *Septic Systems*—To the extent *visually and/or physically observed* or identified from the *interviews* or *records review*, indications of on-site septic systems or cesspools should be described in the *report*.

10. Interviews With Past and Present Owners and Occupants

10.1 *Objective*—The objective of *interviews* is to obtain information indicating *recognized environmental conditions* in connection with the *property*.

10.2 *Content—Interviews* with past and present *owners*, *operators*, and *occupants* of the *property*, consist of questions to be asked in the manner and of persons as described in this section. The content of questions to be asked shall attempt to obtain information about uses and conditions as described in Section 9, as well as information described in 10.8 and 10.9.

10.3 *Medium*—Questions to be asked pursuant to this section may be asked in person, by telephone, or in writing, in the discretion of the *environmental professional*.

10.4 *Timing*—Except as specified in 10.8 and 10.9, it is in the discretion of the *environmental professional* whether to ask questions before, during, or after the *site visit* described in Section 9, or in some combination thereof.

10.5 *Who Should be Interviewed*:

10.5.1 *Key Site Manager*—Prior to the *site visit*, the *owner* should be asked to identify a person with good knowledge of the uses and physical characteristics of the *property* (the *key site manager*). Often the *key site manager* will be the *property* manager, the chief physical plant supervisor, or head maintenance person. (If the *user* is the current *property owner*, the *user* has an obligation to identify a *key site manager*, even if it is the *user* himself or herself.) If a *key site manager* is identified, the person conducting the *site visit* shall make at least one reasonable attempt (in writing or by telephone) to arrange a mutually convenient appointment for the *site visit* when the *key site manager* agrees to be there. If the attempt is successful, the *key site manager* shall be interviewed in conjunction with the *site visit*. If such an attempt is unsuccessful, when conducting the *site visit*, the *environmental professional* shall inquire whether an identified *key site manager* (if any) or if a person with good knowledge of the uses and physical characteristics of the *property* is available to be interviewed at that time; if so, that person shall be interviewed. In any case, it is within the discretion of the *environmental*

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professional to decide which questions to ask before, during, or after the *site visit* or in some combination thereof.

10.5.2 *Occupants*—A reasonable attempt shall be made to interview a reasonable number of *occupants* of the *property.*

10.5.2.1 *Multi-Family Properties*—For multi-family residential properties, residential *occupants* do not need to be interviewed, but if the *property* has nonresidential uses, *interviews* should be held with the nonresidential *occupants* based on criteria specified in 10.5.2.2.

10.5.2.2 *Major Occupants*—Except as specified in 10.5.2.1, if the *property* has five or fewer current *occupants*, a reasonable attempt shall be made to interview a representative of each one of them. If there are more than five current *occupants*, a reasonable attempt shall be made to interview the major occupant(s) and those other *occupants* whose operations are likely to indicate *recognized environmental conditions* in connection with the *property.*

10.5.2.3 *Reasonable Attempts to Interview*—Examples of reasonable attempts to interview those *occupants* specified in 10.5.2.2 include (but are not limited to) an attempt to interview such *occupants* when making the *site visit* or calling such *occupants* by telephone. In any case, when there are several *occupants* to interview, it is not expected that the *site visit* must be scheduled at a time when they will all be available to be interviewed.

10.5.2.4 *Occupant Identification*—The *report* shall identify the *occupants* interviewed and the duration of their occupancy.

10.5.3 *Prior Assessment Usage*—Persons interviewed as part of a prior *Phase I Environmental Site Assessment* consistent with this practice do not need to be questioned again about the content of answers they provided at that time. However, they should be questioned about any new information learned since that time, or others should be questioned about conditions since the prior *Phase I Environmental Site Assessment* consistent with this practice.

10.5.4 *Past Owners, Operators, and Occupants*—*Interviews* with past *owners*, *operators*, and *occupants* of the *property* who are likely to have material information regarding the potential for contamination at the *property* shall be conducted to the extent that they have been identified and that the information likely to be obtained is not duplicative of information already obtained from other sources.

10.5.5 *Interview Requirements for Abandoned Properties*—In the case of inquiries conducted at abandoned properties where there is evidence of potential unauthorized uses of the *abandoned property* or evidence of uncontrolled access to the *abandoned property*, *interviews* with one or more *owners* or *occupants* of neighboring or nearby properties shall be conducted.

10.6 *Quality of Answers*—The person(s) interviewed should be asked to be as specific as reasonably feasible in answering questions. The person(s) interviewed should be asked to answer in *good faith* and to the extent of their knowledge.

10.7 *Incomplete Answers*—While the person conducting the interview(s) has an obligation to ask questions, in many instances the persons to whom the questions are addressed will have no obligation to answer them.

10.7.1 *User*—If the person to be interviewed is the *user* (the person on whose behalf the *Phase I Environmental Site Assessment* is being conducted), the *user* has an obligation to answer all questions posed by the person conducting the interview, in *good faith*, to the extent of his or her *actual knowledge* or to designate a *key site manager* to do so. If answers to questions are unknown or partially unknown to the *user* or such *key site manager*, this interview section of the *Phase I Environmental Site Assessment* shall not thereby be deemed incomplete.

10.7.2 *Non-user*—If the person conducting the interview(s) asks questions of a person other than a *user* but does not receive answers or receives partial answers, this section of the *Phase I Environmental Site Assessment* shall not thereby be deemed incomplete, provided that *(1)* the questions have been asked (or attempted to be asked) in person, by electronic mail, or by telephone and written records have been kept of the person to whom the questions were addressed and the responses, or *(2)* the questions have been asked in writing sent by first class mail or by private, commercial carrier and no answer or incomplete answers have been obtained and at least one reasonable follow up (telephone call or written request) was made again asking for responses.

10.8 *Questions About Helpful Documents*—Prior to the *site visit*, the *property owner*, *key site manager* (if any is identified), and *user* (if different from the *property owner*) shall be asked if they know whether any of the documents listed in 10.8.1 exist and, if so, whether copies can and will be provided to the *environmental professional* within reasonable time and cost constraints. Even partial information provided may be useful. If so, the *environmental professional* conducting the *site visit* shall review the available documents prior to or at the beginning of the *site visit.*

10.8.1 *Helpful Documents*:

10.8.1.1 Environment site assessment *reports*,

10.8.1.2 Environment compliance audit *reports*,

10.8.1.3 Environmental permits (for example, solid waste disposal permits, *hazardous waste* disposal permits, *wastewater* permits, NPDES permits, *underground injection* permits),

10.8.1.4 Registrations for underground and above-ground storage tanks,

10.8.1.5 Registrations for *underground injection* systems,

10.8.1.6 *Material safety data sheets*,

10.8.1.7 Community right-to-know plan,

10.8.1.8 Safety plans; preparedness and prevention plans; spill prevention, countermeasure, and control plans; etc.,

10.8.1.9 *Reports* regarding hydrogeologic conditions on the *property* or surrounding area,

10.8.1.10 Notices or other correspondence from any government agency relating to past or current violations of environmental laws with respect to the *property* or relating to *environmental liens* encumbering the *property*,

10.8.1.11 *Hazardous waste* generator notices or *reports*,

10.8.1.12 Geotechnical studies,

10.8.1.13 Risk assessments, and

10.8.1.14 Recorded AULs.

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10.9 *Proceedings Involving the Property*—Prior to the *site visit*, the *property owner*, *key site manager* (if any is identified), and *user* (if different from the *property owner*) shall be asked whether they know of: *(1)* any pending, threatened, or past litigation relevant to *hazardous substances* or *petroleum products* in, on, or from the *property*; *(2)* any pending, threatened, or past administrative proceedings relevant to *hazardous substances* or *petroleum products* in, on or from the *property*; and *(3)* any notices from any governmental entity regarding any possible violation of environmental laws or possible liability relating to *hazardous substances* or *petroleum products*.

11. Interviews With State and/or Local Government Officials

11.1 *Objective*—The objective of *interviews* with state and/or local government officials is to obtain information indicating *recognized environmental conditions* in connection with the *property*.

11.2 *Content*—*Interviews* with state and/or local government officials consist of questions to be asked in the manner and of persons as described in this section. The content of questions to be asked shall be decided in the discretion of the *environmental professional(s)* conducting the *Phase I Environmental Site Assessment*, provided that the questions shall generally be directed towards identifying *recognized environmental conditions* in connection with the *property*.

11.3 *Medium*—Questions to be asked may be asked in person or by telephone, in the discretion of the *environmental professional*.

11.4 *Timing*—It is in the discretion of the *environmental professional* whether to ask questions before or after the *site visit* described in Section 9, or in some combination thereof.

11.5 *Who Should Be Interviewed*:

11.5.1 *State and/or Local Agency Officials*—A reasonable attempt shall be made to interview at least one staff member of any one of the following types of state and/or *local government agencies*:

11.5.1.1 Local fire department that serves the *property*,

11.5.1.2 State and/or local health agency or local/regional office of state health agency serving the area in which the *property* is located,

11.5.1.3 State and/or local agency or local/regional office of state agency having jurisdiction over *hazardous waste* disposal or other environmental matters in the area in which the *property* is located, or

11.5.1.4 Local agencies responsible for the issuance of building permits or groundwater use permits that document the presence of AULs which may identify a recognized environmental condition in the area in which the *property* is located.

11.6 *Prior Assessment Usage*—Persons interviewed as part of a prior *Phase I Environmental Site Assessment* consistent with this practice do not need to be questioned again about the content of answers they provided at that time. However, they should be questioned about any new information learned since that time, or others should be questioned about conditions since the prior *Phase I Environmental Site Assessment* consistent with this practice.

11.7 *Quality of Answers*—The person(s) interviewed should be asked to be as specific as reasonably feasible in answering questions. The person(s) interviewed should be asked to answer in *good faith* and to the extent of their knowledge.

11.8 *Incomplete Answers*—While the person conducting the interview(s) has an obligation to ask questions, in many instances the persons to whom the questions are addressed will have no obligation to answer them. If the person conducting the interview(s) asks questions but does not receive answers or receives partial answers, this section shall not thereby be deemed incomplete, provided that questions have been asked (or attempted to be asked) in person or by telephone and written records have been kept of the person to whom the questions were addressed and their responses.

12. Evaluation and Report Preparation

12.1 *Report Format*—The *report* for the *Phase I Environmental Site Assessment* should generally follow the recommended *report* format attached as Appendix X4 unless otherwise required by the *user*.

12.2 *Documentation*—The findings, opinions and conclusions in the *Phase I Environmental Site Assessment report* shall be supported by documentation. If the *environmental professional* has chosen to exclude certain documentation from the *report*, the *environmental professional* shall identify in the *report* the reasons for doing so (for example, a confidentiality agreement). Supporting documentation shall be included in the *report* or adequately referenced to facilitate reconstruction of the assessment by an *environmental professional* other than the *environmental professional* who conducted it. Sources that revealed no findings also shall be documented.

12.3 *Contents of Report*—The *report* shall include those matters required to be included in the *report* pursuant to various provisions of this practice. The *report* shall also identify the *environmental professional* and the person(s) who conducted the *site reconnaissance* and *interviews*. In addition, the *report* shall state whether the *user* reported to the *environmental professional* any information pursuant to the *user's* responsibilities described in Section 6 of this practice (for example, an *environmental lien* or AUL encumbering the *property* or any relevant specialized knowledge or experience of the *user*).

12.4 *Scope of Services*—The *report* shall describe all services performed in sufficient detail to permit another party to reconstruct the work performed.

12.5 *Findings*—The *report* shall have a findings section which identifies known or suspect *recognized environmental conditions*, and *historical recognized environmental conditions*, and de minimis conditions.

12.6 *Opinion*—The *report* shall include the *environmental professional's* opinion(s) of the impact on the *property* of conditions identified in the findings section. The logic and reasoning used by the *environmental professional* in evaluating information collected during the course of the investigation related to such conditions shall be discussed. Frequently, items initially suspected to be a recognized environmental condition are subsequently determined, upon further evaluation, to not be considered a *recognized environmental condition*. The opinion shall specifically include the *environmental professional's* rationale for concluding that a condition is or is not currently a *recognized environmental condition*. Conditions identified by

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the *environmental professional* as *recognized environmental conditions* currently shall be listed in the conclusions section of the *report*.

12.6.1 *Additional Investigation*—The *environmental professional* should provide an opinion regarding additional appropriate investigation, if any, to detect the presence of *hazardous substances* or *petroleum products*. This opinion should only be provided in the unusual circumstance when greater certainty is required regarding the identified recognized environmental conditions. A *Phase I Environmental Site Assessment* which includes such an opinion by the *environmental professional* does not render the assessment incomplete. This opinion is not intended to constitute a requirement that the *environmental professional* include any recommendations for Phase II or other assessment activities.

12.7 *Data Gaps*—The *report* shall identify and comment on significant *data gaps* that affect the ability of the EP to identify *recognized environmental conditions* and identify the sources of information that were consulted to address the *data gaps*. A *data gap* by itself is not inherently significant. For example, if a *property's* historical use is not identified back to 1940 because of *data failure* (see 8.3.2.3), but the earliest source shows that the *property* was undeveloped, this *data gap* by itself would not be significant. A *data gap* is only significant if other information and/or professional experience raises reasonable concerns involving the *data gap*. For example, if a building on the *property* is inaccessible during the *site visit*, and the *environmental professional's* experience indicates that such a building often involves activity that leads to a recognized environmental condition, the inability to inspect the building would be a significant *data gap* warranting comment.

12.8 *Conclusions*—The *report* shall include a conclusions section that summarizes all *recognized environmental conditions* connected with the *property*. The *report* shall include one of the following statements:

12.8.1 "We have performed a *Phase I Environmental Site Assessment* in conformance with the scope and limitations of ASTM Practice E 1527 of [insert address or legal description], the *property*. Any exceptions to, or deletions from, this practice are described in Section [ ] of this *report*. This assessment has revealed no evidence of *recognized environmental conditions* in connection with the *property*," or

12.8.2 "We have performed a *Phase I Environmental Site Assessment* in conformance with the scope and limitations of ASTM Practice E 1527 of [insert address or legal description], the *property*. Any exceptions to, or deletions from, this practice are described in Section [ ] of this *report*. This assessment has revealed no evidence of *recognized environmental conditions* in connection with the *property* except for the following: (list)."

12.9 *Additional Services*—Any additional services contracted for between the *user* and the *environmental professional(s)*, including a broader scope of assessment, more detailed conclusions, liability/risk evaluations, recommendation for Phase II testing, remediation techniques, etc., are beyond the scope of this practice, and should only be included in the *report* if so specified in the terms of engagement between the *user* and the *environmental professional*.

12.10 *Deviations*—All deletions and deviations from this practice (if any) shall be listed individually and in detail, including client-imposed constraints, and all additions should be listed.

12.11 *References*—The *report* shall include a references section to identify published referenced sources relied upon in preparing the *Phase I Environmental Site Assessment*. Each referenced source shall be adequately annotated to facilitate retrieval by another party.

12.12 *Signature*—The *environmental professional(s)* responsible for the *Phase I Environmental Site Assessment* shall sign the *report*.

12.13 *Environmental Professional Statement*—As required by 40 CFR 312.21(d), the *report* shall include the following statements of the *environmental professional(s)* responsible for conducting the *Phase I Environmental Site Assessment* and preparation of the *report*.

12.13.1 "[I, We] declare that, to the best of [my, our] professional knowledge and belief, [I, we] meet the definition of *Environmental professional* as defined in §312.10 of 40 CFR 312" and

12.13.2 "[I, We] have the specific qualifications based on education, training, and experience to assess a *property* of the nature, history, and setting of the subject *property*. [I, We] have developed and performed the all appropriate inquiries in conformance with the standards and practices set forth in 40 CFR Part 312."

12.14 *Appendices*—The *report* shall include an appendix section containing supporting documentation and the qualifications of the *environmental professional* and the qualifications of the personnel conducting the *site reconnaissance* and *interviews* if conducted by someone other than an *environmental professional*.

13. Non-Scope Considerations

13.1 *General*:

13.1.1 *Additional Issues*—There may be environmental issues or conditions at a *property* that parties may wish to assess in connection with *commercial real estate* that are outside the scope of this practice (the non-scope considerations). As noted by the legal analysis in Appendix X1 of this practice, some substances may be present on a *property* in quantities and under conditions that may lead to contamination of the *property* or of nearby properties but are not included in CERCLA's definition of *hazardous substances* (42 U.S.C. §9601(14)) or do not otherwise present potential CERCLA liability. In any case, they are beyond the scope of this practice.

13.1.2 *Outside Standard Practices*—Whether or not a *user* elects to inquire into non-scope considerations in connection with this practice or any other *environmental site assessment*, no assessment of such non-scope considerations is required for appropriate inquiry as defined by this practice.

13.1.3 *Other Standards*—There may be standards or protocols for assessment of potential hazards and conditions associated with non-scope conditions developed by governmental entities, professional organizations, or other private entities.

13.1.4 *Compliance With AULs*—Parties who wish to qualify for one of the *LLPs* will need to know whether they are in compliance with AULs, including land use restrictions that

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were relied upon in connection with a response action. A determination of compliance with AULs is beyond the scope of this practice.

13.1.5 *List of Additional Issues*—Following are several non-scope considerations that persons may want to assess in connection with *commercial real estate*. No implication is intended as to the relative importance of inquiry into such non-scope considerations, and this list of non-scope considerations is not intended to be all-inclusive:

13.1.5.1 Asbestos-Containing Building Materials,

13.1.5.2 Radon,

13.1.5.3 Lead-Based Paint,

13.1.5.4 Lead in Drinking Water,

13.1.5.5 Wetlands,

13.1.5.6 Regulatory compliance,

13.1.5.7 Cultural and historic resources,

13.1.5.8 Industrial hygiene,

13.1.5.9 Health and safety,

13.1.5.10 Ecological resources,

13.1.5.11 Endangered species,

13.1.5.12 Indoor air quality,

13.1.5.13 Biological agents, and

13.1.5.14 Mold.

APPENDIXES

(Nonmandatory Information)

X1. LEGAL BACKGROUND TO FEDERAL LAW AND THE PRACTICES ON ENVIRONMENTAL ASSESSMENTS IN COMMERCIAL REAL ESTATE TRANSACTIONS

INTRODUCTION

The Legal Task Group of Subcommittee E50.02 on Environmental Assessments In Commercial Real Estate Transactions provides the following background to the "*all appropriate inquiry*" obligation under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Asset Conservation, Lender Liability, and Deposit Insurance Protection Act of 1996 (the "Lender Liability Amendments"), and the Small Business Liability Relief and Brownfields Revitalization Act of 2001 (the "*Brownfields Amendments*"). This background to CERCLA, (also commonly known as the Superfund law), outlines the parties' potential liability for the cleanup of *hazardous substances* under CERCLA, potentially available protections from such liability, the requirement for "*all appropriate inquiry*" under CERCLA, the statutory definition of *hazardous substances*, *petroleum products* and *petroleum exclusion* to CERCLA, and reasons why certain constituents of potential environmental concern are excluded from the scope of CERCLA and this practice. The Legal Task Group also notes that, with the changes to CERCLA brought about by the *Brownfields Amendments* and the implementation of said amendments by EPA, the Environmental Transaction Screen Practice (E 1528), although still a useful transactional environmental screening tool, no longer meets the requirement for "*all appropriate inquiry*" which is key to establishing CERCLA's *landowner liability protections*, or *LLPs*.

Practice E 1527 has been developed to define "*all appropriate inquiry*" for purposes of establishing any of the three *LLPs* available under CERCLA as amended by the *Brownfields Amendments*. This Legal Appendix makes informational reference to the other criteria, beyond the "*all appropriate inquiry*" criterion, that are necessary for successfully asserting any of the three *LLPs*. This practice and Legal Appendix do not address other business risk issues, such as the presence of other constituents of potential environmental concern (such as asbestos, radon and mold/fungi). Finally, this Legal Appendix is intended for informational purposes only and is not intended to be nor interpreted as legal advice.

The specter of strict, joint and several liability under the Federal Superfund law, and analogous state environmental laws, has been a primary driver of Environmental Assessments in Commercial Real Estate Transactions. A knowledge of

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CERCLA, and especially its potential *landowner liability protections*, or *LLPs*, is crucial to understanding and applying Practice E 1527.

X1.1 CERCLA Liability[8]

X1.1.1 Each of the following elements must be established by a plaintiff (that is, government or private party) before a defendant may be found liable under CERCLA for response costs at a site:[9]

X1.1.1.1 The site is a facility, as defined at 42 U.S.C. §9601(9);[10]

X1.1.1.2 A release or threatened release of a hazardous substance from the site occurred (§9607(a)(4)) (release is defined at §9601(22) as any "*spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment (including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance, or pollutant or contaminant)*"); "Hazardous substance" is defined at §9601(14) and is discussed in section X1.6 (Statutory Definition of Hazardous Substance);

X1.1.1.3 A release or threatened release caused the incurrence of response costs. Response costs are indirectly defined at §9601(25) to mean costs related to both removal actions (§9601(23)) and remedial actions (§9601(24)); and

X1.1.1.4 Defendants fall within at least one of the four classes of potentially responsible parties identified in §9607(a). These classes include:

X1.1.1.5 The (current) *owner* and *operator*[11] of a facility;

X1.1.1.6 Any person who at the time of disposal of any *hazardous substance* owned or operated any facility at which such *hazardous substances* were disposed of;

X1.1.1.7 Any person who by contract, agreement, or otherwise arranged for disposal or treatment or transport of *hazardous substances*; and

X1.1.1.8 Any person who accepts or accepted any *hazardous substances* for transport to a disposal or treatment facility selected by such person.

X1.1.1.9 The CERCLA *contiguous property owner liability protection* excludes from the definition of "*owner*" or "*operator*" a person who owns real *property* that is "contiguous" to, and that is or may be contaminated by *hazardous substances* from other real *property* that is not owned by that person but "solely by reason of the contamination."

X1.1.1.10 When it promulgated CERCLA and the amendments thereto, Congress recognized potential hardships that CERCLA liability could place on holders of security interests in *property* (for example, lenders) where those parties were not responsible for acts or omissions of others that caused or contributed to *property* contamination. In an effort to ease these burdens, Congress created the so-called "secured creditor" exemption within the definition of "*owner* or *operator*" which, in very brief terms, exempts persons holding an "indicia of

[8] 42 U.S.C. §9607(a). (All statutory references are to Title 42 of the United States Code, unless otherwise specified.)

[9] See *United States v. Aceto Agric. Chems Corp.*, 872 F.2d 1373 (8th Cir. 1989). Private plaintiffs, as well as the government, may seek response costs under Superfund from defendants. While many *users* of these ASTM practices or other private parties may think in terms of how to defend against Superfund liability, they should be aware of the alternative option of conducting a cleanup and then seeking response costs from other responsible parties.

[10] 42 U.S.C. §9601(9) defines the term "facility" to mean "(A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, *landfill*, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a *hazardous substance* has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any vessel."

[11] 42 U.S.C. §9601(20)(A) defines "*owner* or *operator*" as any person owning or operating a facility or the person who owned, operated or otherwise controlled activities at a facility immediately prior to such facility's transfer to a unit of state or local government due to bankruptcy, foreclosure, tax delinquency, abandonment or similar means. The term *owner* or *operator* does not include a person, who, without participating in the management of a facility, holds indicia of ownership primarily to protect his security interest in the facility (this exemption is commonly referred to as the secured creditor exemption) See 42 U.S.C.§9601(E). Persons who have been found liable as *owners* include: bankruptcy estates (*In re Duplan Corp.*, 212 F.3d 144 (2d Cir. 2000)), trustees (*Briggs & Stratton Corp. v. Concrete Sales & Servs., Inc.*, 20 F. Supp. 2d 1356 (M.D. Ga. 1998)), passive landlords (*Nurad, Inc. v. William E. Hooper & Sons Co.*, 966 F.2d 837 (4th Cir. 1992); *United States. v. A & N Cleaners & Launderers, Inc.*, 788 F. Supp. 1317 (S.D.N.Y. 1992)), parent corporations (*United States. v. Kayser-Roth, Corp.*, 910 F.2d 24 (1st Cir. 1990)), easement holders (*United States v. Union Gas Co.*, 35 ERC (BNA) 1750 (E.D. Pa. 1992)), and franchisors (*Shell Oil Co. v. Meyers*, No. 79504-9801-CV-043, 1998 Ind. Lexis 755 (Ind. Sup. Ct. Jan. 18, 1998)). Some courts have also sought to expand liability to former *owners* and *operators* of facilities that did not own or operate the facility at the time of actual disposition and/or release of *hazardous substances*, but during whose tenure passive migration of *hazardous substances* was occurring. *Briggs & Stratton Corp. v. Concrete Sales & Servs.*, Inc., 20 F. Supp. 2d 1356 (M.D. Ga. 1998). It appears that the majority of courts however, require that the past *owner* or *operator* actively disposed of the *hazardous substances. ABB Indus. Sys., Inc. v. Prime Tech, Inc.*, 120 F.2d 1351 (2d Cir. 1997).

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ownership primarily to protect his security interest" so long as the person did not participate in the management of the facility. Numerous courts and state legislatures have recognized the secured creditor exemption[12] and in 1992 EPA sought to further clarify the scope of the exemption through its "Lender Liability" rule.[13]

X1.1.1.11 In 1994, the Lender Liability rule was struck down (see *Kelley v. EPA*, 15 F.3d 1100 (D.C. Cir), reh'g denied 25 F.3d 1088 (D.C. Cir. 1994)). Subsequently, in September 1996, Congress passed the Lender Liability Amendments[14] which amended CERCLA sections 101 and 107 to clarify the scope of the secured creditor exemption (as well as the fiduciary liability exemption[15]).

X1.1.1.12 The Lender Liability Amendments to CERCLA make it clear that a secured creditor or lender will not fall within the definition of "*owner* or *operator*" (and therefore be potentially liable under CERCLA) where the lender merely holds an indicia of ownership and acts primarily to protect its security interest in a facility (for example, through foreclosure or post foreclosure acts) but does not participate in the management of the facility. (See 42 U.S.C. §9601(20)(E-G)).[16]

X1.1.1.13 The Lender Liability Amendments clarify that (i) the term "participate in management" --(I) means actually participating in the management or operational affairs of a vessel or facility; and (II) does not include merely having the capacity to influence, or the unexercised right to control, vessel or facility operations; and (ii) a person that is a lender and that holds indicia of ownership primarily to protect a security interest in a vessel or facility shall be considered to participate in management only if, while the borrower is still in possession of the vessel or facility encumbered by the security interest, the person --(I) exercises decision making control over the environmental compliance related to the vessel or facility, such that the person has undertaken responsibility for the *hazardous substance* handling or disposal practices related to the vessel or facility; or (II) exercises control at a level comparable to that of a manager of the vessel or facility, such that the person has assumed or manifested responsibility --(aa) for the overall management of the vessel or facility encompassing day-to-day decision making with respect to environmental compliance. 42 U.S.C. §9601(20)(F)(i)(I),(ii)(I-II)(aa).

X1.1.2 In order to recover response costs, a government plaintiff must prove that the costs were not inconsistent with the National Oil and Hazardous Substances Pollution Contingency Plan (commonly referred to as the *National Contingency Plan* or *NCP*), 40 C.F.R. Part 300.[17] A private plaintiff must prove its costs were necessary costs of response consistent with the *NCP*. 42 U.S.C. §9607 (a)(4).[18]

X1.1.3 If there is a release or threatened release of *hazardous substances* on a site, private parties, even if they are not PRPs, may decide to incur response costs and seek recovery from other private parties, and PRPs may seek contribution from other PRPs.

X1.1.4 There is an important difference between the government's burden to show that its response costs are "not inconsistent with the *NCP*" and the burden a private party bears to show that its response costs are "consistent with the *NCP*." See §9607(a)(4)(A) and (B). Courts have interpreted this statutory difference to give the government a rebuttable presumption that its response costs are consistent with the *NCP*, whereas a private party who incurs response costs and seeks recovery from responsible parties bears the burden of proving its response costs were consistent with the *NCP*.[19] The 1990 amendments to the *NCP* provide that private plaintiffs only have to demonstrate "substantial compliance" with the *NCP* rather than strict technical compliance as long as a CERCLA-quality cleanup is achieved. The *NCP* requirements for a private party response-action are set forth at 40 C.F.R. §300.700. Some cases have held that cleanup costs incurred pursuant to a consent decree will be presumed to be in compliance with the *NCP*.[20]

X1.2 Defenses to CERCLA Liability

X1.2.1 Assuming all the elements of liability exist (and no specific exclusion to liability applies), a party may still avoid CERCLA liability by meeting one of the so-called affirmative defenses listed in §9607(b). These listed affirmative defenses are exclusive of other common law defenses that a defendant could assert.[21] Section 9607(b) provides that a party shall not be liable under 42 U.S.C. §9607(a) if it can establish by a preponderance of the evidence [the lowest evidentiary standard available, meaning more probable than not] that the release or

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[12] See *In re: Bergsoe Metal Corp.*, 910 F.2d 668 (9th Cir. 1990); *Guidice v. BFG Electroplating and Mfg. Co.*, 732 F. Supp. 556 (W.D. Pa. 1989); *United States v. Mirabile*, 23 ERC (BNA) 1511 (E.D. Pa. 1985). But see *United States v. Fleet Factors Corp.*, 901 F.2d 1550 (11th Cir. 1990); *United States v. Maryland Bank and Trust Co.*, 632 F. Supp. 573 (D. Md. 1986).

[13] See 57 Fed. Reg. 18344 (Apr. 29, 1992).

[14] Pub. L. No. 104-208, §§2501-2505, 110 Stat. 3009 (Sept. 30, 1996).

[15] A discussion of the Superfund liability exemptions applicable to fiduciaries such as trustees, receivers and conservators as a result of the 1996 Lender Liability Amendments is presented in "Fiduciary Liability: A New Safe Harbor Under CERCLA," Lawrence J. Horan III, Environmental Regulation and Permitting, Spring 1997, John Wiley & Sons. See also *Canadyne-Georgia, Corp. v. Bank of Am.*, 174 F. Supp. 2d 1360 (M.D. Ga. 2001) wherein a bank acting in the capacity of a co-trustee of a trust whose assets included a general partnership interest in a contaminated *property* was found exempt from Superfund liability.

[16] See, for example, *Monarch Tile, Inc. v. City of Florence*, 212 F.3d 1219, 1222 (11th Cir. 2000), and *United States v. Marvin Pesses, et al.* (No. 90-0654 (W.D. Pa. May 6, 1998). *United States v. Pesses*, No. 90-CV-0654, 1998 U.S. Dist. Lexis 7902 (W.D. Pa. May 6, 1998).

[17] The *National Contingency Plan* is the federal government's blueprint on how *hazardous substances* are to be cleaned up pursuant to CERCLA. See 42 U.S.C. §9605; 40 C.F.R. Part 300.

[18] See *Dedham Water Co. v. Cumberland Farms Dairy, Inc.*, 889 F.2d 1146 (1st Cir. 1989); other cases cited at ABA, *Natural Resources, Energy, and Environmental Law: 1989 The Year In Review*, p. 215, n. 155.

[19] *Amland Properties Corp. v. Aluminum Co. of America*, 711 F. Supp. 784, 794 (D. N.J. 1989); *Artesian Water Co. v. New Castle County*, 659 F. Supp. 1269, 1291 (D. Del. 1987); *United States v. Northeastern Pharmaceutical and Chemical Co.*, 579 F. Supp. 823 (W.D. Mo. 1984), *aff'd in part, rev'd on other grounds*, 810 F.2d 726 (8th Cir. 1986), *cert. denied*, 484 U.S. 848 (1987).

[20] *United States v. Western Processing Co.*, 1991 U.S. Dist. LEXIS 16021 (W.D. Wash. July 31, 1991).

[21] *United States v. Aceto Agricultural Chemicals Corp.*, 872 F.2d 1373 (8th Cir. 1989). But see *United States v. Marisol, Inc.*, 725 F. Supp. 833 (M.D. Pa. 1989) (equitable defenses under Superfund may be available after the development of a factual record). The equitable defenses may be considered by the Court when resolving or apportioning contribution claims under 42 U.S.C. §9613(f). *AT&T Global Info. Solutions Co. v. Union Tank Car Co.*, 1997 U.S. Dist. LEXIS 6090 (S.D. Ohio March 31, 1997).

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threat of release of a *hazardous substance* and the damages resulting therefrom were caused solely by—*(1)* an act of God; *(2)* an act of war; *(3)* the third party defense. The so-called CERCLA *innocent landowner defense* is a subset of the CERCLA third party defense in 42 U.S.C. §9607(b)(3). See 42 U.S.C. §9601(35).

X1.2.2 In the context of a *commercial real estate transaction*, whether the 9607(b)(3) third party defense will be available turns on the meaning of "contractual relationship." By statutory definition, the term "contractual relationship" includes land contracts, deeds and other instruments transferring title or possession and, therefore would preclude use of the third party defense. Congress, however, in defining the term contractual relationship (see 42 U.S.C. §9601(35)(A)), provided for the *innocent landowner defense*, the assertion of which requires that the release or threatened release of *hazardous substance(s)* occurred on the *property* prior to the defendant acquiring the *property* and the defendant "did not know and had no reason to know of the *hazardous substance*" with respect to the *property*. Section 9601(35)(B) then clarifies that "*all appropriate inquiry*" must be undertaken by the defendant in order to establish that the defendant "did not know and had no reason to know of the *hazardous substance*."

X1.2.2.1 The 1986 SARA Amendments modified CERCLA's definition of "contractual relationship" in §9601(35)(A). As a result, a contractual relationship specifically "includes, but is not limited to, land contracts, deeds, easements, leases or other instruments transferring title or possession ..." The presence of such contractual relationships with third parties would act to negate the §9607(b)(3) third party defense unless the real *property* on which the facility is located was acquired by the defendant after disposal or placement of the *hazardous substance* ... and one or more of the following circumstances is also established by the defendant by a preponderance of the evidence: (i) At the time the defendant acquired the facility the defendant did not know and had no reason to know that any *hazardous substance* which is the subject of the release or threatened release was disposed of on, in, or at the facility; (ii) The defendant is the government . . .; (iii) The defendant acquired the facility by inheritance or bequest."

X1.2.3 Thus, the key elements necessary to qualify for the CERCLA §9607(b)(3) third party defense include the following:

X1.2.3.1 The release or threat of release of *hazardous substance* was caused solely by a third party,

X1.2.3.2 The third party is not an employee or agent of the defendant, or the acts or omissions of the third party did not occur in connection with a direct or indirect contractual relationship to the defendant, or if there was a contractual relationship, the defendant acquired the *property* after disposal or placement of the *hazardous substance*, and at the time the defendant acquired the facility the defendant **did not know and had no reason to know** [emphasis added] that any *hazardous substance* that is the subject of the release or threatened release was disposed of on, in, or at the facility, and

X1.2.3.3 The defendant exercised due care with respect to the *hazardous substances*, and

X1.2.3.4 Took precautions against foreseeable acts or omissions of the third party.[22]

X1.2.4 The SARA Amendments clarify the meaning of §9601(35)(B)'s "had no reason to know" and provide guidance as to the meaning of "*all appropriate inquiry*" by stating: "To establish that the defendant had no reason to know of the matter described in subparagraph §9601(35)(A)(i), the defendant must demonstrate to a court that: (i) on or before the date on which the defendant acquired the facility, the defendant carried out all appropriate inquiries, as provided in clauses (ii) and (iv), into the previous ownership and uses of the facility in accordance with generally accepted good commercial and customary standards and practices; and (II) the defendant took reasonable steps to (aa) stop any continuing release; and (bb) prevent any future threatened release; and (cc) prevent or limit any human, environmental, or natural resources exposure to any previously released *hazardous substance*."

X1.2.4.1 To further clarify the scope of "*all appropriate inquiry*," the *Brownfields Amendments* mandate that the U.S. Environmental Protection Agency promulgate regulatory standards and practices "for the purpose of satisfying the requirement to carry out all appropriate inquiries under §9601(35)(B)(i)." 42 U.S.C. §9601(35)(B)(ii).

X1.2.4.2 To guide EPA in meeting this mandate, Congress specified ten criteria to be included in the regulatory standards and practices to be established by EPA. The ten criteria include: (i) the results of an inquiry by an *environmental professional*; (ii) *interviews* with past and present *owners*, *operators*, and *occupants* of the facility for the purpose of gathering information regarding the potential for contamination at the facility; (iii) reviews of historical sources, such as chain-of-title documents, *aerial photographs*, *building department records*, and land use records, to determine previous uses and occupancies of the real *property* since the *property* was first developed; (iv) searches for recorded environmental cleanup liens against the facility that are filed under Federal, State, or local law; (v) reviews of Federal, State and local governmental records, waste disposal records, *underground storage tank* records, and *hazardous waste* handling, treatment, disposal and spill records, concerning contamination at or near the facility; (vi) visual inspections of the facility and of *adjoining properties*; (vii) specialized knowledge or experience on the part of the defendant; (viii) the relationship of the purchase price to the value of the *property*, if the *property* was not contaminated; (ix) commonly known or *reasonably ascertainable* information about the *property*; and (x) the degree of obviousness of the presence or likely presence of contamination at the *property*, and the ability to detect contamination by appropriate investigation. 42 U.S.C. §9601(35)(B)(iii).

X1.3 Interim Standards and Practices Until EPA Regulatory Standards and Practices are Established

X1.3.1 Congress, recognizing the need for immediate clarification of the "*all appropriate inquiry*" included in the *Brownfields Amendments* specific interim standards to clarify

[22] *United States v. A&N Cleaners & Launderers, Inc.*, 854 F. Supp. 229, 239 (S.D.N.Y. 1994).

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"*all appropriate inquiry*" in *commercial real estate transactions* until such time as EPA should establish regulatory standards and practices. 42 U.S.C. §9601(35)(B)(iv).

X1.3.2 Congress promulgated two separate sets of interim standards and practices through the *Brownfields Amendments* (i) a standard and practice applicable to *property* purchased before May 31, 1997; and (ii) a standard and practice for *commercial real estate transactions* occurring on or after May 31, 1997.

X1.3.3 The interim Standard and Practice applicable to commercial properties purchased prior to May 31, 1997 sets forth five elements to be considered by a court in determining whether a defendant conducted "*all appropriate inquiry*": (i) any specialized knowledge or experience on the part of the defendant; (ii) the relationship of the purchase price to the value of the *property* if the *property* were not contaminated; (iii) commonly known or *reasonably ascertainable* information about the *property*; (iv) the obviousness of the presence or likely presence of contamination at the *property*; and (v) the ability of the defendant to detect the contamination by appropriate inspection. These criteria are essentially unchanged from the statutory provisions pre-existing the *Brownfields Amendments* which rely upon case law for clarification.

X1.3.4 The interim Standard and Practice applicable to commercial properties purchased on or after May 31, 1997 sets forth a single criteria for meeting "*all appropriate inquiry*" and states: "the procedures of the American Society for Testing and Materials, including the document known as standard E1527-97, entitled 'Standard Practice for Environmental Site Assessment: Phase I Environmental Site Assessment Process' shall satisfy the requirements" for "*all appropriate inquiry*." Notably, the wording of this provision appears to be expansive in that it cites "the procedures of the American Society for Testing and Materials" and then goes on to include Practice E 1527-97. EPA subsequently clarified that Practice E1527-00 satisfied the interim Standard and Practice for "*all appropriate inquiry*" (See 68 FR 24888, May 9, 2003).

X1.3.5 While not applicable to commercial real restate transactions, the *Brownfields Amendments* also provide a separate and reduced standard for meeting "*all appropriate inquiry*" applicable to properties for residential use or other similar use purchased by a nongovernmental or noncommercial entity. Under this reduced standard, the performance of a facility inspection and title search which does not reveal a basis for further investigation would satisfy "*all appropriate inquiry*" (See 42 U.S.C. §9601(35)(B)(v)).

X1.4 Case Law Interpretation of "All Appropriate Inquiry" in Commercial Real Estate Transactions

X1.4.1 While the *Brownfields Amendments* outline and direct EPA to promulgate regulations and/or guidance identifying requirements necessary to meet "*all appropriate inquiry*," it is premature to conclude what those requirements may actually be. However, in promulgating its interim provisions, Congress made clear what will satisfy, during the interim period, "*all appropriate inquiry*." For *property* transactions occurring prior to May 31, 1997, CERCLA will require a court to consider a party's specialized knowledge or experience and further mandates a court to consider: what is "*reasonably ascertainable* information about the *property*," what contamination is obviously present, and the party's "ability to detect such contamination". These requirements are essentially the same as those predating the *Brownfields Amendments* and inherently rely on case law interpretation. The continued use of terms "appropriate" and "reasonably" and "specialized knowledge and experience" and "ability" in conjunction with the specific person attempting to utilize the *LLPs* signifies that Congress did not intend the appropriateness of the inquiry be judged by a bright line standard. In contrast, Congress has set forth a far more explicit interim standard for *property* transactions occurring on or after May 31, 1997 by specifying that ASTM protocols (including Practice E1527-97) meet the requirements of "*all appropriate inquiry*."

X1.4.2 *Court Interpretations of The Appropriate Level of Inquiry*:

X1.4.2.1 As suggested above, case law continues to define the parameters for "*all appropriate inquiry*," at least for pre-May 31, 1997 *commercial real estate transactions*. A review of this case law reveals that the requirements for meeting "*all appropriate inquiry*" to achieve the *LLPs* can vary depending upon the nature of the *property* and transaction. As articulated by one court, "[w]hat constitutes appropriate inquiry is a mixed question of law and fact and will depend on the totality of the circumstances." *Advance Technology Corp. v. Eliskim*, Inc. 87 F. Supp. 2d 780, 785 (N.D. Ohio 2000). The statutory language, including the *Brownfields Amendments*, Congressional history, and common sense, support this conclusion with case law describing what constitutes "*all appropriate inquiry*."[23]

X1.4.2.2 While not specifically stated in CERCLA, the duty to make inquiry under this provision shall be judged as of the time of acquisition. Defendants shall be held to a higher standard as public awareness of the hazards associated with hazardous releases has grown, as reflected by this Act, the 1980 Act [CERCLA] and other Federal and State statutes. Moreover, good commercial or customary practice with respect to inquiry in an effort to minimize liability shall mean that a reasonable inquiry must have been made in all circumstances, in light of best business and land transfer principles. Those engaged in commercial transactions should, however, be held to a higher standard than those who are engaged in private residential transactions.[24]

[23] See, for example, *United States v. Serafini*, 706 F. Supp. 346 (M.D. Pa. 1988), 791 F. Supp. 107 (M.D. Pa. 1990) (By entertaining disputed facts as to the custom and practice of viewing land prior to purchase, the court implied that appropriate inquiry necessarily varies on a site-by-site basis); *United States v. Pacific Hide and Fur Depot, Inc.*, 716 F. Supp. 1341 (D. Idaho 1989) (No inquiry was required by those who received an ownership interest in *property* via corporate stock transfer and warranty deed under the facts of this case); *International Clinical Laboratories, Inc. v. Stevens*, 1990 U.S. Dist. LEXIS 3685' 30 ERC 2066, 20 ELR 20,560 (E.D.N.Y. 1990) (Despite a long history of toxic *wastewater* disposal and presence of the site on the state's *hazardous waste* disposal site list, the purchaser was able to establish the *innocent landowner defense* since there were no visible environmental problems at the site, the defendant had no knowledge of environmental problems at the site and the purchase price did not reflect a reduction on account of the problem).

[24] H.R. Rep. No. 962, 99th Cong., 2d Sess. 187 (1986), *reprinted at* 1986 U.S.C.C.A.N. 3276, 3280.

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X1.4.3 *The Minimum Inquiries to Satisfy "All Appropriate Inquiry"*:

X1.4.3.1 Recognizing that the extent of inquiry is not static and may change with the underlying circumstances, the next question is what specific level of inquiry, if any, is required to meet any of the three *LLPs*?

X1.4.3.2 The interim standards set forth in the *Brownfields Amendments* outline the basic level of inquiry necessary to support the *LLPs*. However, it is important to understand that additional inquiry ultimately may be necessary depending upon the outcome of base-level inquiry. For instance, the outcome of initial inquiry may indicate the necessity for additional subsurface investigation (commonly referred to as a "Phase II" environmental investigation) and in some arenas such subsurface investigation has become routine in *commercial real estate transactions*. It is important to note, however, that even a subsurface investigation has its limitations since one can always dig down one foot deeper, take one more sample, or conduct one more test. The problem of how much inquiry should be conducted, or at what level a party should begin, in one sense involves proving a negative, that is, that no contamination is present.[25] Since, according to the statute, inquiries should be judged by the circumstances existing at the time of acquisition, then there could be some properties and parties to real estate transactions where it may be appropriate to begin the inquiry with an intrusive subsurface investigation in order to support the particular LLP.

X1.4.3.3 At the other extreme, the minimum level of inquiry that a party would be expected to conduct is found by looking at the least environmentally obtrusive class of *property* and party from a CERCLA perspective. This transaction likely involves the lay buyer of a residence. Assuming these parties meet the other prerequisites for establishing an LLP, what level of environmental inquiry must they conduct to avoid CERCLA liability? Prior to the *Brownfields Amendments*, the answer was probably none, unless a particular residential purchaser or renter has some specialized knowledge about or experience with the *property* in question that would lead a court to conclude that the purchaser should have made some inquiries about the environmental conditions of the *property*. Post *Brownfields Amendments*, it is clear that the statute requires at least an onsite inspection and a title search for non commercial residential properties.[26] Even so, it seems unlikely that Congress intends to change its position and begin tasking residential *owners* with investigation and cleanup obligations. EPA has previously established its position in its 1991 statement of enforcement policy to the effect that it will not generally pursue *owners* of single family residences pursuant to CERCLA.[27] Therefore, for some properties and purchasers of real estate for residential purposes, it is appropriate to conduct minimal environmental inquiry in order to qualify for an *LLP*. The language of the recent *Brownfields Amendments* indicates that even purchasers of *property* for residential uses must now conduct an inspection and title search to meet its "*all appropriate inquiry*" obligation.[28]

X1.4.3.4 The minimum level of appropriate inquiry under CERCLA, therefore, may range from little or no inquiry (such as a private party purchasing real estate for its own residential use) to conducting an intrusive subsurface investigation. Even so, commercial and customary practices and best business and land transfer principles, do not always dictate that *environmental site assessments* be conducted, particularly those real estate transactions involving smaller properties, vacant land, or transactions of low monetary value. This practice and the minimum level of inquiry set forth under this practice, therefore, actually raises the average level of inquiry that should be performed, especially in these more limited types of transactions, where the parties want to establish *all appropriate inquiry* to qualify for one or more of the *LLPs*.

X1.4.3.5 The burden of proof is on the defendant to show by a preponderance of the evidence that the defendant qualifies for any *LLP* or other defense to CERCLA liability.[29] This is the least onerous burden of proof available to a party in litigation. The defendant must show only that the evidence offered to support the level of inquiry that was taken at the time of acquisition is of greater weight or more convincing than the evidence offered in opposition to it. In other words, the evidence on the inquiry issue taken as a whole shows that the fact sought to be proved is more probable than not. There may be technical or business judgments on whether the inquiry conducted or any other fact in a particular case is sufficient to meet the needs or concerns of a party to the real estate transaction. The bottom line, however, is that the judgment on whether the specific facts of a case, in light of the statutory language, are sufficient to produce liability or a viable defense to liability is a legal one, and such judgments constitute the practice of law.

X1.4.3.6 The Legal Task Group notes that, although Practice E 1528 (Transaction Screen) was originally intended to satisfy the initial level of inquiry for the *innocent landowner defense*, as a result of the *Brownfields Amendments* and the criteria mandated to be followed by EPA to establish "*all appropriate inquiry*," it appears that Practice E 1528, unless modified, likely will no longer meet the threshold for "*all appropriate inquiry*."

[25] The inability to prove a negative creates a dilemma for the potential defendant. If the party's inquiry discovers contamination, then under the statute, the party will not be able to avail itself of either the *Contiguous Property Owner protection* or *innocent landowner defense*. If the inquiry does not discover contamination, EPA or another private party can argue in a response action that the inquiry was not "appropriate" and, if concurred by the court, the defendant would not qualify for protection provided by these *LLPs*. This dilemma is explicitly recognized by Subcommittee E50.02 as beyond any reasonable interpretation of Congressional intent. The scope of the E50.02 Standard Practice resolves the party's dilemma in the only reasonable way by stating: "It should not be concluded or assumed that the inquiry was not appropriate inquiry merely because the inquiry did not identify existing *recognized environmental conditions* in connection with a *property*. *Environmental site assessments* must be evaluated based on the reasonableness of the judgments made at the time and under the circumstances in which they were made." See 4.5.4.

[26] 42 U.S.C. 9601(35)(B)(v).

[27] EPA, *Policy Towards Owners of Residential Property at Superfund Sites*, OSWER Directive No. 9834.6, July 3, 1991.

[28] 42 U.S.C. 9601(35)(B)(v).

[29] *United States v. Domenic Lombardi Realty, Inc.*, 290 F. Supp. 2d 198 (D.R.I. 2003).

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X1.5 Landowner Liability Protections under the Brownfields Amendments

X1.5.1 On January 11, 2002, the *Brownfields Amendments* became law and amended CERCLA §9607 by adding two new subsections providing protection from CERCLA liability: (i) The *Contiguous Property Owner* liability protection pursuant to 42 U.S.C. §9607(q); and (ii) the *Bona Fide Prospective Purchaser liability protection* pursuant to 42 U.S.C. §9607(r), and amended the *innocent landowner defense*. 42 U.S.C. §9601(35)(B)(i)(II).

X1.5.2 *The Contiguous Property Owner (CPO) Liability Protection*—42 U.S.C. §9607(q) excludes from *owner* or *operator* status "a person that owns real *property* that is contiguous to or otherwise similarly situated with respect to, and that is or may be contaminated by a release or threatened release of *hazardous substance* from, real *property* that is not owned by that person solely by reason of the contamination if: (i) the person did not cause, contribute, or consent to the release or threatened release; (ii) the person is not: (a) potentially liable, or affiliated with any other person that is potentially liable, for response costs at a facility through any direct or indirect familial relationship or any contractual, corporate, or financial relationship (other than a contractual, corporate, or financial relationship that is created by a contract for the sale of goods or services), or (b) the result of a reorganization of a business entity that was potentially liable; (iii) the person takes reasonable steps to: (a) stop any continuing release, (b) prevent any threatened future release, and (c) prevent or limit human, environmental, or natural resource exposure to any *hazardous substance* released on or from *property* owned by that person; (iv) the person provides full cooperation, assistance, and access to persons that are authorized to conduct response actions or natural resource restoration at the vessel or facility from which there has been a release or threatened release (including the cooperation and access necessary for the installation, integrity, operation, and maintenance of any complete or partial response action or natural resource restoration at the vessel or facility); (v) the person: (a) is in compliance with any land use restrictions established or relied on in connection with the response action at the facility, and (b) does not impede the effectiveness or integrity of any institutional control employed in connection with a response action; (vi) the person is in compliance with any request for information or administrative subpoena issued by the President under this Act; (vii) the person provides all legally required notices with respect to the discovery or release of any *hazardous substances* at the facility; and (viii) at the time at which the person acquired the *property*, the person; (a) conducted *all appropriate inquiry* within the meaning of 42 U.S.C. §9601(35)(B) with respect to the *property*, and (b) did not know or have reason to know that the *property* was or could be contaminated by a release or threatened release of one or more *hazardous substances* from other real *property* not owned or operated by the person."

X1.5.2.1 The *Brownfields Amendments* indicate that, to qualify for the CPO liability protection, a person must establish by a preponderance of the evidence that the conditions in clauses (i) through (viii) of subparagraph §9607(q)(1)(A) (see above) have been met.

X1.5.3 *The Bonafide Prospective Purchaser (BFPP) Liability Protection*—The second protection from CERCLA liability is the BFPP liability protection pursuant to 42 U.S.C. §9607(r) which provides for a limitation on §9607(a)(1) liability for persons meeting the definition of a BFPP whose potential liability for a release or threatened release is based solely on the purchaser's being considered to be an *owner* or *operator* of a facility. The exclusion apparently requires that the BFPP does not impede the performance of a response action or natural resource restoration.

X1.5.3.1 The statutory text indicates that, in order to take advantage of the BFPP liability protection, the potentially responsible party must meet the definition of a BFPP. As defined at 42 U.S.C. §9601(40), the term BFPP means a person (or a tenant of a person) that acquires ownership of a facility after the date of enactment [that is, January 11, 2002] and that establishes each of the following by a preponderance of the evidence: (i) all disposal of *hazardous substances* at the facility occurred before the person acquired the facility; (ii) the person made "all appropriate inquiries" into the previous ownership and uses of the facility in accordance with generally accepted good commercial and customary standards and practices in accordance with the standards and practices referred to in clauses (ii) and (iv) of paragraph (35)(B) or in the case of *property* in residential or other similar use at the time of purchase by a nongovernmental or noncommercial entity, a facility inspection and title search that reveal no basis for further investigation shall be considered to satisfy the requirements of this subparagraph; (iii) the person provides all legally required notices with respect to the discovery or release of any *hazardous substances* at the facility; (iv) the person exercises appropriate care with respect to *hazardous substances* found at the facility by taking reasonable steps to (a) stop any continuing release, (b) prevent any threatened future release; and (c) prevent or limit human, environmental, or natural resource exposure to any previously released *hazardous substance*; (v) the person provides full cooperation, assistance, and access to persons that are authorized to conduct response actions or natural resource restoration at a vessel or facility (including the cooperation and access necessary for the installation, integrity, operation, and maintenance of any complete or partial response actions or natural resource restoration at the vessel or facility); (vi) the person (a) is in compliance with any land use restrictions established or relied on in connection with the response action at a vessel or facility, and (b) does not impede the effectiveness or integrity of any *institutional control* employed at the vessel or facility in connection with a response action; (vii) the person complies with any request for information or administrative subpoena issued by the President under this Act; (viii) the person is not (a) potentially liable, or affiliated with any other person that is potentially liable, for response costs at a facility through (xx) any direct or indirect familial relationship; or (yy) any contractual, corporate, or financial relationship (other than a contractual, corporate, or financial relationship that is created by the instruments by which title to the facility is conveyed or financed or by a

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contract for the sale of goods or services); or (b) the result of a reorganization of a business entity that was potentially liable.

X1.5.4 On March 6, 2003, the EPA issued the "Common Elements" Interim Guidance Memorandum regarding criteria landowners must meet to achieve and maintain *LLPs*. The Guidance only covered the criteria "common" to all three *LLPs*. These common elements include two threshold criteria: "*all appropriate inquiry*" and "no-affiliation" with a liable party; and five continuing obligations: *(1)* complying with land use restrictions and *institutional controls*; *(2)* taking reasonable steps with respect to *hazardous substance* releases; *(3)* providing full cooperation, assistance, and access to persons that are authorized to conduct response actions or natural resource restoration; *(4)* complying with information requests and administrative subpoenas; and *(5)* providing legally required notices.

X1.5.4.1 The no-affiliation threshold question refers to the "affiliation" language in the BFPP and CPO provisions. See 42 U.S.C. §9601(40)(H), and 42 U.S.C. §9607(q)(1)(A)(ii), respectively.

X1.5.4.2 The *Innocent Landowner defense* does not include this "affiliation" language but requires that no "contractual relationship" exist between the landowner and the third party causing *hazardous substance* contamination.

X1.5.4.3 The "continuing obligations" common elements are beyond the scope of this standard and Legal Appendix.

X1.6 CERCLA Definition of Hazardous Substance

X1.6.1 CERCLA defines *hazardous substance* by referring to five other statutes as well as to a separate grant of authority in CERCLA to designate *hazardous substances*. See 42 U.S.C. §§9601(14)(A)-(F), 9602(a). The following is a description of the relevant portions of these statutory provisions:

X1.6.1.1 42 U.S.C. §9601(14)(A): "[A]ny substance designated pursuant to section 1321(b)(2)(A) of Title 33." Title 33 U.S.C. §1321 is a section of the Clean Water Act and refers to, among other things, *hazardous substance* liability. 33 U.S.C. §1321(b)(2)(A) states that the EPA shall develop, "as may be appropriate, regulations designating as *hazardous substances*, other than oil as defined in this section, such elements and compounds which, when discharged in any quantity into or upon" the navigable waters of the United States ..., present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches."

X1.6.1.2 42 U.S.C. §9601(14)(B): "[A]ny element, compound, mixture, solution, or substance designated pursuant to section 9602 of this title." Section 9602 gives EPA the authority to designate as a *hazardous substance*, in addition to those substances covered by the statutes cross-referenced in 42 U.S.C. §9601(14), "such elements, compounds, mixtures, solutions, and substances which, when released into the environment may present substantial danger to the public health or welfare or the environment...."

X1.6.1.3 42 U.S.C. §9601(14)(C): "[A]ny hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act [also known as the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6921] (but not including any waste the regulation of which under the Solid Waste Disposal Act [42 U.S.C. §§6901 *et seq.*] has been suspended by Act of Congress)." The Solid Waste Disposal Act Amendments of 1980 amended RCRA. 42 U.S.C. §6921 of RCRA provides authority to the EPA to develop criteria for identifying characteristics of hazardous waste and for listing particular hazardous wastes within the meaning of 42 U.S.C. §6903(5). RCRA defines hazardous waste to mean "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may—(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." 42 U.S.C. §6903(5). For the identification and listing of hazardous wastes under RCRA, see 40 C.F.R. Part 261.

X1.6.1.4 42 U.S.C. §9601(14)(D): "[A]ny toxic pollutant listed under Section 1317(a) of Title 33." Section 1317(a) of Title 33 refers to toxic and pretreatment effluent standards under the Clean Water Act. The EPA is charged in this section with publishing and revising from time to time a list of toxic pollutants, taking "into account toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms in any waters, the importance of the affected organisms, and the nature and extent of the effect of the toxic pollutant on such organisms." Each toxic pollutant listed according to this section shall be subject to effluent limitations. For toxic pollutant effluent standards, see 40 C.F.R. §§129.1 *et seq.*

X1.6.1.5 42 U.S.C. §9601(14)(E): "[A]ny hazardous air pollutant listed under Section 112 of the Clean Air Act [42 U.S.C. §7412]." That section deals with national emission standards for hazardous air pollutants. The EPA is charged here with publishing and revising from time to time "a list which includes each hazardous air pollutant for which [it] intends to establish an emission standard under this section." The term "hazardous air pollutant" means an air pollutant that in EPA's judgment "causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness." For emission standards for hazardous pollutants, see 40 C.F.R. §§61.01 *et seq.*

X1.6.1.6 42 U.S.C. §9601(14)(F): "[A]ny imminently hazardous chemical substance or mixture with respect to which the [EPA] has taken action pursuant to Section 2606 of Title 15." Section 2606 of Title 15 deals with imminent hazards under the Toxic Substances Control Act (TSCA). The EPA is authorized under 15 U.S.C. §2606 to seize an imminently hazardous chemical substance or mixture or seek other relief, such as requiring notice to *users* of the chemical substance or public notice of the risk associated with the substance or mixture. The term "imminently hazardous chemical substance or mixture" means a chemical substance or mixture which presents an imminent and unreasonable risk of serious or widespread injury to health or the environment." TSCA, 15 U.S.C. §2606(f).

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X1.6.2 After Subsections A–F, outlined above, the CERCLA definition of "hazardous substance" goes on to state: "The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas)." 42 U.S.C. §9601(14).

X1.6.3 The EPA has collected a list of "those substances in the statutes referred to in section 101(14) of the Act" [42 U.S.C. §9601(14)]" 40 C.F.R. §302.1 (See "List of Hazardous Substances and Reportable Quantities," 40 C.F.R. Part 302, Table 302). This list changes with notices in the *Federal Register*. Also, any time a new *hazardous waste* is listed under RCRA, the waste automatically becomes a *hazardous substance*.

X1.7 Petroleum Products

X1.7.1 Under the *petroleum exclusion* of CERCLA (42 U.S.C. §9601(14)), petroleum and crude oil have been explicitly excluded from the definition of *hazardous substances* under CERCLA. Nevertheless, *petroleum products* are included within the scope of this practice and the Legal Appendix because they are of concern in many *commercial real estate transactions* and current custom and usage is to include an inquiry into the presence of *petroleum products* in an *environmental site assessment*. Inclusion of *petroleum products* within the scope of this practice is not based upon the applicability, if any, of CERCLA to *petroleum products*.

X1.7.2 One reason to include *petroleum products* within the scope of this practice is because to do so reflects custom and usage: when environmental assessments are conducted in connection with *commercial real estate transactions*, they customarily include an assessment of the presence or likely presence of *petroleum products* under conditions that may lead to contamination. For example, environmental assessments ordinarily seek to assess whether there may be underground or aboveground storage tank systems that may be leaking, whether those tanks contain *petroleum products* or some other product.

X1.7.3 In addition, although CERCLA may exclude *petroleum products*, other laws require cleanup of releases or spills of *petroleum products*. For example, *petroleum products* sometimes (for example, when they cannot be reclaimed from soil) become *hazardous wastes* subject to RCRA Subtitle C (42 U.S.C §6921 *et seq.*), must be cleaned up if released from *underground storage tanks* pursuant to RCRA Subtitle I (42 U.S.C. §6991 *et seq.*), must be cleaned up pursuant to the Oil Pollution Act of 1990 (33 U.S.C. §§1321 *et seq.*), and must be cleaned up if released into the navigable waters of the United States pursuant to the Clean Water Act (33 U.S.C. §§1251 *et seq.*).

X1.7.4 Moreover, case law and EPA interpretations of the *petroleum exclusion* require an analysis of the facts of each case to determine whether a particular petroleum product is included in CERCLA's *petroleum exclusion*. The exclusion has been broadly interpreted to exclude gasoline and leaded gasoline from CERCLA's definition of *hazardous substances* regardless of the fact that gasoline and leaded gasoline contain certain indigenous components and additives which have themselves been designated as hazardous pursuant to CERCLA. See *Wilshire Westwood Associates v. Atlantic Richfield Corp.*, 881 F.2d 801 (9th Cir. 1989). This interpretation was narrowed when a judicial distinction was made between petroleum fractions produced by distillation processes and waste products resulting from contaminated tank scale. See *United States v. Western Processing Co.*, 761 F. Supp. 713 (W.D. Wash. 1991). Another decision narrowly interpreted CERCLA's *petroleum exclusion* to be inapplicable to oil-related wastes containing *hazardous substances* because the primary purpose of the exclusion is to remove "spills or other releases strictly of oil" from the scope of CERCLA response and liability (not releases of *hazardous substances* mixed with oil). See *City of New York v. Exxon Corp.*, 744 F. Supp. 474 (S.D.N.Y. 1990). One recent decision has potentially expanded the *petroleum exclusion* to include both unused and used *petroleum products* as well as *hazardous substances* inherent in or added to unused petroleum during the refining process. *Organic Chemical Site PRP Group v. Total Petroleum, Inc.*, 58 F. Supp. 2d 755 (W.D. Mich. 1999). More recently, the *petroleum exclusion* was held not applicable in an instance where petroleum had commingled with *hazardous substances* in the subsurface beneath a refinery. *Tosco Corp. v. Koch Industries, Inc.* 216 F3d 886 (10th Cir. 2000). For additional discussion, see EPA Memorandum entitled, "The Petroleum Exclusion Under the Comprehensive Environmental Response Compensation and Liability Act," issued by EPA's General Counsel, Francis S. Blake, July 31, 1987.

X1.8 Exclusion of Certain Constituents of Potential Environmental Concern from CERCLA

X1.8.1 The information that follows is provided to explain why the following constituents of potential environmental concern are not necessarily covered by CERCLA's "*all appropriate inquiry*" obligation thereunder:

X1.8.2 As a preliminary matter, it should be noted that an *environmental site assessment* that does not address substances excluded from CERCLA (whether those substances are excluded because they are *petroleum products* or by virtue of other characteristics) but that otherwise constitutes "*all appropriate inquiry* into the previous ownership and uses of the *property* consistent with good commercial or customary practice" should nevertheless entitle the *user* to the *LLPs*, assuming that other requirements of the provisions are met.

X1.8.3 *Radon*:

X1.8.3.1 A case discussing CERCLA and radon is *Amoco Oil Co. v. Borden, Inc.*, 889 F.2d 664 (5th Cir. 1989). This case dealt with a private cost recovery action by the buyer of a site against the seller for response costs relating to radiation from phosphogypsum wastes left on the site. Radon emanated from these radioactive wastes. The case points out that the "EPA has designated radionuclides as *hazardous substances* under §9602(a) of CERCLA... . Additionally, the ... EPA under §112 of the Clean Air Act ... lists radionuclides as a hazardous air pollutant. Radon and its daughter products are considered radionuclides, which are defined as 'any nuclide that emits radiation.'" *Id.* at 668-69. Therefore, radon is a CERCLA

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hazardous substance. Also, when discussing what constitutes a release of a *hazardous substance* under the statute, the statute is plain that there is no quantitative requirement and that a release, broadly defined at 42 U.S.C. §9601(22), of any amount constitutes a CERCLA release.

X1.8.3.2 Liability under CERCLA depends on several factors, as noted in X1.1. Only one of four factors is the release or threatened release of a *hazardous substance*. The other three factors are *(1)* the site is a facility, *(2)* the defendant falls within at least one of four classes of potentially responsible parties (PRPs), and *(3)* the release or threatened release caused the plaintiff (that can be the government or another private party) to incur response costs. Further, response costs must not be inconsistent with the *National Contingency Plan (NCP)*, and must not be limited by 42 U.S.C.§9604(a)(3). And, of course, there is no need to raise the *LLPs* and their *all appropriate inquiry* requirements unless the elements of liability will be met.

X1.8.3.3 Where radon from any source occurs in a building, three of the liability elements under CERCLA are met. There is a release of a *hazardous substance*, the building is a facility, and we can assume the defendant is a PRP. However, under 42 U.S.C. §9604(a)(3)(A), "[r]emedial actions taken in response to *hazardous substances* as they occur naturally are specifically excluded from the *NCP* and are therefore not recoverable." *Amoco Oil Co. v. Borden, Inc.*, 889 F.2d at 570.[30]

X1.8.3.4 Therefore, no liability under CERCLA attaches for naturally occurring radon. If a party to a real estate transaction wants to look for radon within a building, no amount of radon investigation will have any bearing on one's *LLPs* under CERCLA. Investigation of naturally occurring radon would be included, if at all, in the portion of the practice and Legal Appendix that deals with non-scope issues.

X1.8.4 *Asbestos*:

X1.8.4.1 The analysis of asbestos is similar to that involving radon. Before considering appropriate inquiry responsibilities, the four elements of CERCLA liability must be satisfied. Once again, as with radon, they are not met.

X1.8.4.2 42 U.S.C. §9604(a)(3)(B) prohibits response actions involving a release or threat of release "from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures." There are a number of cases dealing with asbestos that interpret this statutory language. One such case is *First United Methodist Church of Hyattsville v. United States Gypsum Co.*, 882 F.2d 862 (4th Cir. 1989), that cites to other relevant cases.

X1.8.4.3 In *First United* the church brought a private cost recovery action against the manufacturer of asbestos-containing acoustical plaster. In holding that the action was barred by a state statute of repose (a certain time allowed by statute for bringing litigation) and that CERCLA did not preempt the state statute of repose, the court stated that §9604(a)(3)(B) of CERCLA "represents much more than a procedural limitation on the President's authority; it is a substantive limitation of the breadth of CERCLA itself."[31] Therefore, the limitations of §9604(a)(3) apply to private parties as well.

X1.8.4.4 Citing to the legislative history, the *First United* court concluded, "[i]n view of this clear expression of Congressional intent, we wil[l] not expand CERCLA to encompass asbestos-removal actions." 882.F.2d at 868. The court also stated:[32] "we note that this interpretation of CERCLA fully comports with the most fundamental guide to statutory construction—common sense. To extend CERCLA's strict liability scheme to all past and present *owners* of buildings containing asbestos as well as to all persons who manufactured, transported, and installed asbestos products into buildings, would be to shift literally billions of dollars of removal cost liability based on nothing more than an improvident interpretation of a statute that Congress never intended to apply in this context. [FN12[33]] ... Certainly, if Congress had intended for CERCLA to address the monumental asbestos problem, it would have said so more directly when it passed SARA.

X1.8.4.5 Since asbestos that is a part of the structure of, and results in exposure within, residential buildings or business or community structures is excluded from CERCLA liability, it should not be investigated pursuant to a party's "*all appropriate inquiry*" obligation in order to establish one of the *LLPs*. Like naturally occurring radon, investigation of asbestos-containing materials that are part of the structure of buildings should be included, if at all, in the portion of this practice that deals with non-scope issues. Note, however, if asbestos is disposed of on a site and, therefore, is no longer part of the structure of a building, the cleanup of the disposed asbestos is subject to CERCLA response actions. Likewise, if a building is sold with the knowledge that it will be demolished, one court

[30] 42 U.S.C. §9604(a)(3) and (4) state "(3) Limitations on response - The President shall not provide for a removal or remedial action under this section in response to a release or threat of release—(A) of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found; (B) from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures; or (C) into public or private drinking water supplies due to deterioration of the system through ordinary use. "(4) EXCEPTION TO LIMITATIONS—Notwithstanding paragraph 3 of this subsection, to the extent authorized by this section, the President may respond to any release or threat of release if in the President's discretion, it constitutes a public health or environmental emergency and no other person with the authority and capability to respond to the emergency will do so in a timely manner." (Emphasis added).

[31] One such case is *First United Methodist Church of Hyattsville v. United States Gypsum Co.*, 882 F.2d 862 (4th Cir. 1989), that cites to other relevant cases.

[32] The same at 869; See also *3550 Stevens Creek Associates v. Barclays Bank of California*, 915 F.2d 1355 (9th Cir. 1990).

[33] *FN12*—It is for this reason, that Congress simply did not intend for CERCLA to remedy the asbestos-removal problem, that we decline to follow the reasoning of *Prudential, Knox and Covalt* in rejecting First United's preemption argument. Instead of recognizing the fact that CERCLA is out of context in this situation, these courts rejected similar attempts to invoke the statute by construing CERCLA's key terms in a way to exclude asbestos-removal actions. *Covalt*, 860 F.2d [1434] at 1438-39 (defining" environment" to exclude the interior of a workplace); *Knox*, 690 F. Supp at 756-57 (defining "release" in terms of "spills" or "disposal"); *Prudential*, [711 F. Supp 1244] at 1254-55 (defining "disposal" to exclude the sale of a product for consumer use). We find this analysis unsatisfactory because it runs the risk of unnecessarily restricting the scope of CERCLA merely to dispose of claims that the statute was never intended to encompass in the first place. It is far better to simply acknowledge the inapplicability of CERCLA to asbestos-removal claims than to restrict its operative terms."

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ruled that the sale constitutes a disposal falling under CERCLA's liability provisions.[34]

X1.8.5 *Lead in Drinking Water*—Lead in drinking water can be evaluated in terms of the exclusions of 42 U.S.C. §9604(a)(3)(B) and (C), in an analysis similar to the analysis applied above to radon and asbestos. While there is no reported case law on lead in drinking water as related to CERCLA, the statutory language seems clear that these environmental hazards are not encompassed by CERCLA's appropriate inquiry responsibilities.

X1.8.6 *Lead-Based Paint*—Lead-based paint hazards can be evaluated in terms of the exclusions of 42 U.S.C. §9604(a)(3)(B) and (C), in an analysis similar to the analysis applied above to radon and asbestos. While no reported case law was found on the presence or use of lead-based paint as related to CERCLA, the statutory language seems clear that lead-based paint hazards are not encompassed by CERCLA's appropriate inquiry responsibilities. Note, however, like asbestos, where there is a disposal of these substances on the site or in a facility, CERCLA liability may arise.

X1.8.7 *Mold, Fungi and Microbial Growth in Building Structures*—These hazards can be evaluated in terms of the exclusion of 42 U.S.C. §9604(a)(3)(A), in an analysis similar to the analysis applied above to radon and asbestos. While there is no reported case law on these environmental issues as they relate to CERCLA, the statutory language seems clear that these environmental hazards are not encompassed by CERCLA's appropriate inquiry responsibilities.

[34] *CP Holdings, Inc. v. Goldberg-Zoino & Associates, Inc.*, 769 F. Supp. 432 (D.N.H. 1991).

X2. DEFINITION OF ENVIRONMENTAL PROFESSIONAL AND RELEVANT EXPERIENCE THERETO, PURSUANT TO 40 CFR.10

X2.1 Environmental Professional

X2.1.1 *Environmental Professional* means:

(1) a person who possesses sufficient specific education, training, and experience necessary to exercise professional judgment to develop opinions and conclusions regarding conditions indicative of releases or threatened releases (see §312.1(c)) on, at, in, or to a property, sufficient to meet the objectives and performance factors in §312.20(e) and (f).

(2) Such a person must: (i) hold a current Professional Engineer's or Professional Geologist's license or registration from a state, tribe, or U.S. territory (or the Commonwealth of Puerto Rico) and have the equivalent of three (3) years of full-time relevant experience; or (ii) be licensed or certified by the federal government, a state, tribe, or U.S. territory (or the Commonwealth of Puerto Rico) to perform environmental inquiries as defined in §312.21 and have the equivalent of three (3) years of full-time relevant experience; or (iii) have a Baccalaureate or higher degree from an accredited institution of higher education in a discipline of engineering or science and the equivalent of five (5) years of full-time relevant experience; or (iv) have the equivalent of ten (10) years of full-time relevant experience.

(3) An environmental professional should remain current in his or her field through participation in continuing education or other activities.

(4) The definition of environmental professional provided above does not preempt state professional licensing or registration requirements such as those for a professional geologist, engineer, or site remediation professional. Before commencing work, a person should determine the applicability of state professional licensing or registration laws to the activities to be undertaken as part of the inquiry identified in §312.21(b).

(5) A person who does not qualify as an environmental professional under the foregoing definition may assist in the conduct of all appropriate inquiries in accordance with this part if such person is under the supervision or responsible charge of a person meeting the definition of an environmental professional provided above when conducting such activities.

X2.2 Relevant Experience

X2.2.1 *Relevant experience*, as used in the definition of environmental professional in this section, means: participation in the performance of all appropriate inquiries investigations, environmental site assessments, or other site investigations that may include environmental analyses, investigations, and remediation which involve the understanding of surface and subsurface environmental conditions and the processes used to evaluate these conditions and for which professional judgment was used to develop opinions regarding conditions indicative of releases or threatened releases (see §312.1(c)) to the subject property.

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X3. USER QUESTIONNAIRE

INTRODUCTION

In order to qualify for one of the *Landowner Liability Protections (LLPs)*[35] offered by the Small Business Liability Relief and Brownfields Revitalization Act of 2001 (the "*Brownfields Amendments*"),[36] the *user* must provide the following information (if available) to the *environmental professional*. Failure to provide this information could result in a determination that "*all appropriate inquiry*" is not complete.

(1.) Environmental cleanup liens that are filed or recorded against the site (40 CFR 312.25).
Are you aware of any environmental cleanup liens against the *property* that are filed or recorded under federal, tribal, state or local law?

(2.) Activity and land use limitations that are in place on the site or that have been filed or recorded in a registry (40 CFR 312.26).
Are you aware of any AULs, such as *engineering controls*, land use restrictions or *institutional controls* that are in place at the site and/or have been filed or recorded in a registry under federal, tribal, state or local law?

(3.) Specialized knowledge or experience of the person seeking to qualify for the LLP (40 CFR 312.28).
As the *user* of this *ESA* do you have any specialized knowledge or experience related to the *property* or nearby properties? For example, are you involved in the same line of business as the current or former *occupants* of the *property* or an adjoining *property* so that you would have specialized knowledge of the chemicals and processes used by this type of business?

(4.) Relationship of the purchase price to the fair market value of the *property* if it were not contaminated (40 CFR 312.29).
Does the purchase price being paid for this *property* reasonably reflect the fair market value of the *property*? If you conclude that there is a difference, have you considered whether the lower purchase price is because contamination is known or believed to be present at the *property*?

(5.) Commonly known or *reasonably ascertainable* information about the *property* (40 CFR 312.30).
Are you aware of commonly known or *reasonably ascertainable* information about the *property* that would help the *environmental professional* to identify conditions indicative of releases or threatened releases? For example, as *user*,
(a.) Do you know the past uses of the *property*?
(b.) Do you know of specific chemicals that are present or once were present at the *property*?
(c.) Do you know of spills or other chemical releases that have taken place at the *property*?
(d.) Do you know of any environmental cleanups that have taken place at the *property*?

(6.) The degree of obviousness of the presence of likely presence of contamination at the *property*, and the ability to detect the contamination by appropriate investigation (40 CFR 312.31).
As the *user* of this *ESA*, based on your knowledge and experience related to the *property* are there any *obvious* indicators that point to the presence or likely presence of contamination at the *property*?

[35] *Landowner Liability Protections*, or *LLPs*, is the term used to describe the three types of potential defenses to Superfund liability in EPA's *Interim Guidance Regarding Criteria Landowners Must Meet in Order to Qualify for Bona Fide Prospective Purchaser, Contiguous Property Owner, or Innocent Landowner Limitations on CERCLA Liability* ("*Common Elements*" Guide) issued on March 6, 2003.
[36] P.L. 107-118.

X3.1 In addition, certain information should be collected, if available, and provided to the *environmental professional* selected to conduct the Phase I. This information is intended to assist the *environmental professional* but is not necessarily required to qualify for one of the *LLPs*. The information includes:

(*a*) the reason why the Phase I is required,

(*b*) the type of *property* and type of *property* transaction, for example, sale, purchase, exchange, etc.,

(*c*) the complete and correct address for the *property* (a map or other documentation showing *property* location and boundaries is helpful),

(*d*) the scope of services desired for the Phase I (including whether any parties to the *property* transaction may have a required standard scope of services on whether any considerations beyond the requirements of Practice E 1527 are to be considered),

(*e*) identification of all parties who will rely on the Phase I *report*,

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(f) identification of the site contact and how the contact can be reached,

(g) any special terms and conditions which must be agreed upon by the *environmental professional*, and

(h) any other knowledge or experience with the *property* that may be pertinent to the *environmental professional* (for example, copies of any available prior *environmental site assessment reports*, documents, correspondence, etc., concerning the *property* and its environmental condition).

X4. RECOMMENDED TABLE OF CONTENTS AND REPORT FORMAT

X4.1 Summary

X4.2 Introduction

X4.2.1 Purpose
X4.2.2 Detailed Scope-of-Services
X4.2.3 Significant Assumptions
X4.2.4 Limitations and Exceptions
X4.2.5 Special Terms and Conditions
X4.2.6 User Reliance

X4.3 Site Description

X4.3.1 Location and Legal Description
X4.3.2 Site and Vicinity General Characteristics
X4.3.3 Current Use of the *Property*
X4.3.4 Descriptions of Structures, Roads, Other Improvements on the Site (including heating/cooling system, sewage disposal, source of potable water)
X4.3.5 Current Uses of the Adjoining Properties

X4.4 User Provided Information

X4.4.1 Title Records
X4.4.2 Environmental Liens or Activity and Use Limitations
X4.4.3 Specialized Knowledge
X4.4.4 Commonly Known or Reasonably Ascertainable Information
X4.4.5 Valuation Reduction for Environmental Issues
X4.4.6 Owner, Property Manager, and Occupant Information
X4.4.7 Reason for Performing *Phase I*
X4.4.8 Other

X4.5 Records Review

X4.5.1 Standard Environmental Record Sources
X4.5.2 Additional Environmental Record Sources
X4.5.3 Physical Setting Source(s)
X4.5.4 Historical Use Information on the *Property*
X4.5.5 Historical Use Information on Adjoining Properties

X4.6 Site Reconnaissance

X4.6.1 Methodology and Limiting Conditions
X4.6.2 General Site Setting
X4.6.3 Exterior Observations
X4.6.4 Interior Observations

X4.7 Interviews

X4.7.1 Interview with Owner
X4.7.2 Interview with Site Manager
X4.7.3 Interviews with Occupants
X4.7.4 Interviews with Local Government Officials
X4.7.5 Interviews with Others

X4.8 Findings

X4.9 Opinion

X4.10 Conclusions

X4.11 Deviations

X4.12 Additional Services

X4.13 References

X4.14 Signature(s) of Environmental Professional(s)

X4.15 Qualification(s) of Environmental Professional(s)

X4.16 Appendices

X4.16.1 Site (Vicinity) Map
X4.16.2 Site Plan
X4.16.3 Site Photographs
X4.16.4 Historical Research Documentation (aerial photographs, fire insurance maps, historical topographical maps, etc.)
X4.16.5 Regulatory Records Documentation
X4.16.6 Interview Documentation
X4.16.7 Special Contractual Conditions between User and Environmental Professional
X4.16.8 Qualification(s) of the Environmental Professional(s)

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Section 4

Field Documentation (FD)

STANDARD OPERATING PROCEDURE

FD-001 Field Notebook

1. Objective

Describe methods for documentation of field activities.

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

2. Execution

- Use a separate all-weather bound notebook for each site/location/project number. Spiral notebooks should not be used because pages can be easily removed.
- Write neatly using black or blue pen, preferably a waterproof pen. Use of pencil is also acceptable only with approval of the project manager, such as in but not limited to, certain field conditions [e.g., cold or wet weather].
- Write the project name, project number, book number (i.e., 1 of 3), and date on the front cover. On the inside cover, identify the project name, project number, and "Return Book To:" the office address of the project manager.
- Number all of the pages of the field book starting with the first entry.
- Record activities as they occur. Record only facts and observations, regardless of whether they appear to be relevant at that time.
- Identify conditions or events that could affect/impede your ability to observe conditions (e.g. snow-covered ground surface, inability to access areas of interest).
- Neatly cross out mistakes using a single line and initial them. Erasures are not permitted.
    - If an error is made on an entry in the field notebook, the individual who made the entry should make the corrections. The corrections must be initialed and dated by the person making the correction.
- Sign or initial and date the bottom of every page with an entry if the project requires such documentation.
- Place a diagonal line through unused portions of a page.
- Record the following information upon each arrival at the site:
    - Date/time/weather.
    - GEI personnel.
    - Purpose of visit/daily objectives.
    - People (client, contractor, landowners, etc.) present upon GEI arrival.

- Record the following information during the course of the day:
    - Conversations with contractors/subcontractors, clients, visitors, GEI staff, landowners (site or abutters). If possible, record complete names, titles, and affiliations.
    - Time of arrival and departure of individuals.
    - Activities as they occur.

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

3. References

New Jersey DEP Field Sampling Procedures Manual, August 2005.

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

4. Attachments

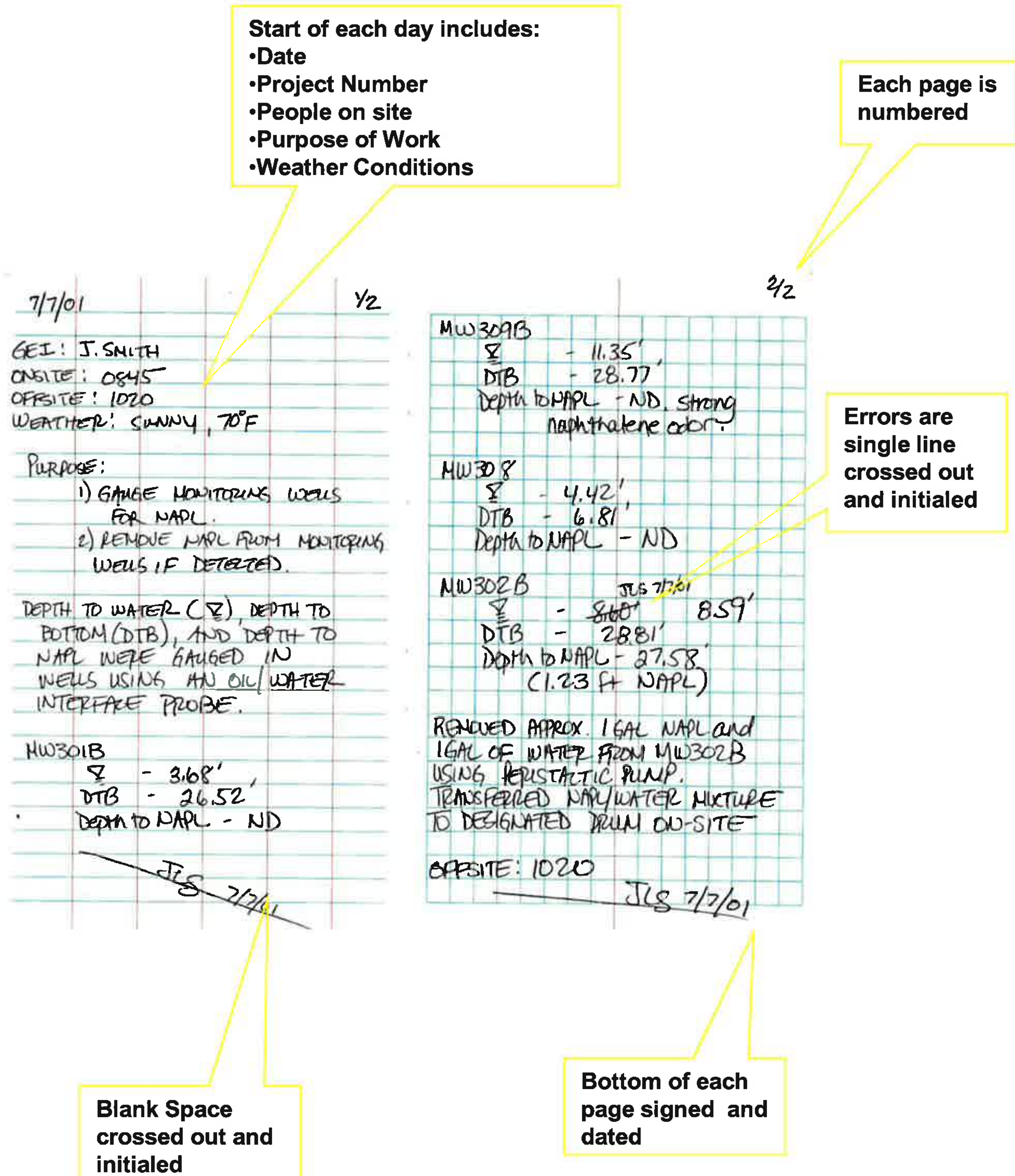
Attachment A - Example Field Notes

5. Contact

Melissa Felter
Leslie Lombardo

SOP FD-001

Attachment A – Example Field Notes



7/7/01 1/2

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

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

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

MW301B
∇ - 3.68'
DTB - 26.52'
Depth to NAPL - ND

JLS 7/7/01

2/2

MW309B
∇ - 11.35'
DTB - 28.77'
Depth to NAPL - ND. Strong naphthalene odor.

MW308
∇ - 4.42'
DTB - 6.81'
Depth to NAPL - ND

MW302B
∇ - ~~8.60'~~ 8.59' JLS 7/7/01
DTB - 28.81'
Depth to NAPL - 27.58'
(1.23 ft NAPL)

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

OFFSITE: 1020

JLS 7/7/01

STANDARD OPERATING PROCEDURE

FD-002 Field Observation Report

1. Objective

Describe methods to generate a Field Observation Report.

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

2. Execution

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

3. Limitations

- The Field Observation Report is not a substitute for the field notebook.
- Not all projects require daily Field Observation Reports.
- The Field Observation Report should be based primarily on factual information. Opinions, if necessary, should be identified as such. Any speculation should be clearly noted in the report as such.

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

4. References

New Jersey DEP Field Sampling Procedures Manual, August 2005

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

5. Attachments

Attachment A - Example Field Observation Report

6. Contact

Melissa Felter
Leslie Lombardo

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	1 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

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

Time of Arrival: 0700 **Departure: 1440** **Weather: Overcast, Raining, 55^{0}F**

Persons Contacted, Company
Jane Doe, ABC Contracting

GEI Representatives
Bill Smith

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

Observations:

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

2. **Subgrade Preparation**
    a. Subgrade preparation for the sidewalk and guard booth areas at the site is complete.

3. **Dewatering**
    a. No dewatering occurred today.

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

FIELD OBSERVATION REPORT

Project :	Guard Booth Upgrades	**Date:**	November 8, 2006
Client :	ACME Industries	**Report No.**	1
Contractor:	ABC Contracting	**Page:**	2 of 2
Subcontractor:	NA	**GEI Proj. No.**	99999-0

Picture 1: Sidewalk excavation and bollard layout

By: Bill Smith	**Reviewed By:**

GEI Consultants

STANDARD OPERATING PROCEDURE

FD-003 Sample Management and Chain of Custody

1. Objective

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

2. Project Setup

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

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

3. Sampling Execution

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

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

3.1. Chain-of-Custody (COC) Completion

- Fill out COC neatly and in permanent ink. Alternatively, an Excel version of the GEI COC is available and can be filled out electronically.
- Certain analyses (i.e. air analysis by TO-15) require specialized, laboratory issued COCs. Make sure any specialized COCs are available before sample collection.
- Record the project name and number, the sampler's name(s) and the state where the samples were collected.
- For each sample, enter the sample identification number, date and time (military time) collected, the number of sample containers, and any additional information to fulfill project, client or regulatory requirements.
- Record the type of analysis (including laboratory method; e.g. EPA-SW846 Method XX) requested and the preservative (if appropriate) in the vertical boxes.
- Field duplicates should be anonymous to the laboratory, but must be recorded for use by the Data Group. To keep track of this information, link the field duplicate with the proper sample in the field notebook. If required by the Project Manager or Data Group, also document this information on or attach a note to the GEI copy of the COC.
- Trip blanks for large sites should be named similar to the samples they are collected with so that there are not two of the same sample name for the same site. For example, "OU1TB-122509" and "OU3TB-122509" would avoid any mistakes.
- Strike incorrect entries on the COC with a single line, followed by the initials of the person making the correction, the date, and the correct entry.
- When sample custody is ready to be relinquished, complete the bottom of the form with date and time (military time) and signatures of relinquisher and receiver of samples as indicated. The sample collector is always the first signature while the analytical laboratory is the final signature. Theoretically, all individuals handling the samples between collection and laboratory should sign the form; however, if a common carrier (i.e., Federal Express, UPS) is used for shipping, GEI must identify the carrier in the 'Received by' box on the

COC. If the sampler hand delivers the samples to the laboratory, the received box must be signed by the laboratory.

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

4. Limitations

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

5. References

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

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

6. Attachments

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

7. Contact

Brian Skelly
Leslie Lombardo

Chain of Custody Record

STL-4124 (0901)

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

EXAMPLE · COC

SEVERN TRENT **STL**
Severn Trent Laboratories, Inc.

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

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil		Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Analysis (Attach list if more space is needed): VOC 8260B	SVOC 8270C	TO-15 + NAPHTHALENE	Special Instructions/ Conditions of Receipt
CGSB-01 (0-2)	12-31-07	1130				X		X						X	X		
CGSB-02 (3-4)	12-31-07	1250				X		X						X	X		
CGSB-02 (3-4) MS	12-31-07	1250				X		X						X	X		
CGSB-02 (3-4) MSD	12-31-07	1250				X		X						X	X		
CGSB-XX (5-6)	12-31-07	0800				X		X						X	X		
CGTB-123107	12-31-07	1400					TB				X			X			
CGGW-01	12-31-07	1430		X				X			X			X	X		
CGSG-01	12-31-07	0700-1500	X													X	CANISTER# 2613 REGULATOR# 779

~~NJ~~ NEW JERSEY : "~~CLP data package deliverables~~"

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

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

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

QC Requirements (Specify) NYS Cat B ASP deliverable send to Lorie MacKinnon. Send EDD to datagroup@geiconsultants.com

	Date	Time		Date	Time
1. Relinquished By: Melissa J Felter	12-31-07	1600	1. Received By: FedEx WAYBILL 923117-4432	12-31-07	
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments
USED FLOW CONTROLLER FOR AIR SAMPLE INCLUDED

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

EXAMPLE COC

Chain-of-Custody Record

Laboratory: Accutest

Laboratory Job # (Lab use only)

GEI Consultants
400 Unicorn Park Dr.
Woburn, MA 01801
PH: 781.721.4000
FX: 781.721.4073

Project Information

Project Name: MWRA - Low Service Storage Tank

Project Location: Stoneham, MA

Project Number: 093400

Project Manager: D. Aghjayan

Send Report to: rseigener@geiconsultants.com

Send EDD to: labdata@geiconsultants.com

MCP PRESUMPTIVE CERTAINTY REQUIRED – YES NO

If Yes, Are MCP Analytical Methods Required? YES NO NA

If Yes, Are Drinking Water Samples Submitted? YES NO NA

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Sample Handling

Samples Field Filtered YES NO NA

Sampled Shipped With Ice YES NO

Lab Sample Number	GEI Sample ID	Collection Date	Collection Time	Matrix	No. of Bottles	Sampler(s) Initials	PCBs (None)	VPH Fractions Only (MeOH)	EPH Fractions Only (None)	SVOCs (None)	VOCs, % Solids** (MeOH)	Conductivity (None)	RCRA 8 Metals* (None)	TPH by GC/FID DRO (None)	Sample Specific Remarks
	093400-LS6-S5(19'-21')	12/29/2009	9:30	SO	3	JMR		x			x				
	093400-LS6-COMP (FILL)	12/29/2009	9:30	SO	1	JMR	x		x	x		x	x	x	
	093400-LS6-COMP (NATIVE)	12/29/2009	15:00	SO	1	JMR	x		x	x		x	x	x	
	093400-LS8-COMP	12/29/2009	14:00	SO	1	JMR	x		x	x		x	x	x	
	093400-LS9-S4 (8'-8'-5")	12/30/2009	14:30	SO	3	JMR		x			x				
	093400-LS9-COMP	12/30/2009	15:00	SO	1	JMR	x		x	x		x	x	x	

MCP Level Needed: GEI requires the most stringent Method 1 MCP standard be met for all analytes whenever possible.

Relinquished by (signature)	Date	Time	Received by (signature)
1. Joseph M. [signature] (sampler)	12/30/09	16:30	1. GEI FRIDGE
2. GEI FRIDGE	1/4/10	1310	2. Naomi [signature]
3. Naomi [signature]	1/4/10	1310	3. [signature]
4.			4.

Turnaround Time (Business days):

Normal _X_ Other ____
10-Day ____ 7-Day ____
5-Day ____ 3-Day ____

Before submitting rush turnaround samples, you **must** notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

Please use MA Landfill List

* Please run TCLP analysis for RCRA 8 Metals results that exceed the 20 times rule.

** Please use % solids sample for VOC and VPH analysis of 093400-LS6-COMP (FILL), 093400-LS6-COMP (NATIVE), 093400-LS8-COMP, and 093400-LS9-COMP

Chain-of-Custody Record

Laboratory:

Laboratory Job # (Lab use only)

GEI Consultants
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
PH: 860.368.5300
FX: 860.368.5307

Project Information

Project Name/Number:

Project Location:

Project Contact:

Phone Number:

Page __ of __

Send Report to:

Send EDD to: datagroup@geiconsultants.com

Deliverables:

If Yes, Have You Met Minimum Field QC Requirements? YES NO NA

Sample Handling

Samples Field Filtered
YES NO NA

Samples Shipped With Ice
YES NO

Lab Sample Number	GEI Sample ID	Collection Date	Collection Time	Matrix	No. of Bottles	Sampler(s) Initials	Preservative / Analysis									Sample Specific Remarks

Relinquished by	Date	Time	Received by
Relinquished by sampler: (signature) 1.	Date :	Time:	Received by: (signature) 1.
Relinquished by: (signature) 2.	Date :	Time:	Received by: (signature) 2.
Relinquished by: (signature) 3.	Date :	Time:	Received by: (signature) 3.
Relinquished by: (signature) 4.	Date :	Time:	Received by: (signature) 4.

Turnaround Time (Business days):

Normal _____ **Other** _____
10-Day _____ **7-Day** _____
5-Day _____ **3-Day** _____

Before submitting rush turnaround samples, you **must** notify the laboratory to confirm that the TAT can be achieved.

Additional Requirements/Comments/Remarks:

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY

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

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

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

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

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

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

PACKING SAMPLES FOR SHIPMENT BACK TO THE LABORATORY

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

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

STANDARD OPERATING PROCEDURE
FD-004 Photo Documentation

1. Objective

Describe methods to document and retain photographic records.

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

2. Execution

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

3. Limitations

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

4. References

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

5. Attachments

Attachment A – Example of Photo Documentation Template

6. Contact

Melissa Felter
Leslie Lombardo

Attachment A – Example of Photo Documentation Template

GEI Consultants, Inc.

Project: Project Name

Location: Project Location

Photographer: K. Barber

Date: 10/25/07

Photo No.: 1

Direction: N

Comments:
Entrance of site with tree mulching operations.

Photographer: K.Barber

Date: 10/25/07

Photo No.: 2

Direction: W

Comments:
On-site building built in 1936.

STANDARD OPERATING PROCEDURE
FD-005 Field Observation of Bedrock Outcroppings

1. Objective

Describe procedures for documentation of bedrock outcrops in the field.

2. Execution

- If available, review available surficial and bedrock geology, and USGS maps prior to conducting field observation of bedrock outcrops

- Check the magnetic declination for your site and adjust your Brunton pocket transit or similar compass accordingly.

- In the field, identify and record outcrop location on a map (e.g. topographic map, aerial photos, etc.), and, if appropriate, using latitude and longitude (or UTM coordinates) measured with a GPS (SOP FD-007).

- Record description of geology observed using the references provided in this SOP, or other guidelines approved by the Project Manager. Use sketches to supplement geology description, if appropriate.

- Measure and record strike and dip of geologic features using a Brunton compass pocket transit or similar compass, if appropriate.

- Document geological observations with digital photos.

- Collect and label rock samples, if appropriate.

3. Limitations

- Field personnel performing bedrock mapping should be trained in the fundamentals of rock classification and bedrock mapping.
- At all times follow safety procedure as defined in the site-specific Health and Safety Plans.

4. References

GEI Geotechnical Manual, dated January, 2004.

ASTM D6032-08 Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core, 2008

ASTM D2113-08, Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation, 2008

ASTM D5079-08. Standard Practices for Preserving and Transporting Rock Core Samples, 2008.

Barnes, J.W. and Lisle. R.J., Basic Geological Mapping, Fourth Edition, John Wiley & Sons, Ltd., 2004.

Compton, Robert R, "Geology in the Field, Section 3 Basic Procedures for Outcrops" July 1985.

Day, R.W., Geotechnical Engineer's Portable Handbook, McGraw-Hill, 2000.

D.U. Deere and D.W. Deere, The Rock Quality Designation (RQD) Index in Practice, Rock Classification Systems for Engineering Purposes, STP 984, ASTM, 1988,

Earth Manual, Part I, Third Edition, U.S. Department of the Interior, Bureau of Reclamation, 1998.

Engineering Geology Field Manual, Second Edition, Volume I, U.S. Department of the Interior, Bureau of Reclamation, 1998 Reprinted 2001.

Engineering Geology Field Manual, Second Edition, Volume II, U.S. Department of the Interior, Bureau of Reclamation, 2001.

Field Guide For Rock Core Logging and Fracture Analysis, Midwest Geosciences Group Press, 2005.

Hunt, R.E., Geotechnical Engineering Investigation Handbook, Second Edition, Taylor & Francis Group, LLC, 2005.

U.S. Army Corps of Engineers, Rock Foundations, EM 1110-1-2908, November 30, 1994.

U.S. Army Corps of Engineers, Chapter 4 Borehole Logging, EM 1110-1-4000, November 1, 1998.

Walker, J. D. and Cohen, H.A., The Geoscience Handbook, AGI Data Sheets, Fourth Edition, 2006.

5. Attachments

Attachment A – General Guidelines on Observing Bedrock Outcroppings

6. Contact

Melissa Felter
Heather Haley

- Look over the outcrop and nearby outcrops broadly in order to spot the principal bodies of rock or other materials. Walk around or over large outcrops several times and view them from various distances.
- Do all the bodies of rock appear to have once continued beyond the outcrop, or do some end there against other bodies? Do they end against faults, intrusive contacts, or unconformities? Why does the outcrop itself end where it does? Does it grade into soil or is it overlain by surficial deposits?
- Continue to study the outcrop from a moderate distance. Are the rock bodies tabular, irregular, lenticular, or some other distinctive shape?
- What are their orientations and dimensions? If they are internally layered, are the layers parallel to any of their bounding surfaces? In overall view, do any rock bodies appear variable?
- Now study the boundaries (contact surfaces) between the bodies, both at a moderate distance and up close. Are they sharp or gradational? Do they cut across grains or structures in either adjacent body? Do any rocks or deposits vary in color or texture near these contacts?
- Break off, or scoop up, samples of the main materials, and examine weathered as well as fresh surfaces with a hand lens. Identify the constituent mineral and rock grains, and note their sizes, shapes, and surface features, as well as their part in the overall fabric and porosity of the rock or deposit.
- To test for the distribution of soft mineral grains, especially carbonates, probe grains with a needle, apply dilute HCl, and examine weathered surfaces for pits and insoluble residues. Estimate the composition of each sample, in percent by volume of each kind of grain, and identify the rock or material. Even if it seems obscure, give it a provisional name.
- Now examine the rocks closely for primary fabrics and structures. Look especially for structures that establish tops and bottoms of deposited layers that were once sediments or igneous deposits. Do relations at contacts support these indications of sequence?
- Look for all features indicative of depositional current direction or direction of magmatic flow. Measure a number of them in order to judge their consistency.
- To detect deformation, see if rock layers, veins, or planar structures have been folded. If no folds are obvious, perhaps foliations, cleavages, or lineations indicate folding.
- Whether the rocks are folded or not, examine them for grains or other small bodies that have been deformed into planar or linear shapes that

give a measure of deformation. How are these grains oriented relative to other structures?

- Examine all faults, even those that displace rocks as little as a centimeter. Are there gouges or breccia along them? Any indications of actual directions of displacement? Are the faults younger than other tectonic features?
- To determine the physical state of the rocks, especially if they are sedimentary, test the degree of compaction and cementation by hefting dry samples (porous rocks are lighter than nonporous ones), by their reaction to breaking in the hands and to hammer blows, and by the rate they soak up water. Depth and strength of weathering generally increase with porosity and permeability.
- What are the typical spacings and orientations of joints in the different rocks? Are there secondary color changes, and are they related to fractures? Fracturing and weathering characteristics may help in identifying the same rock unit in other outcrops.
- Bring together all observations made thus far in order to identify rocks and structures that were originally obscure, or to refine identifications.
- Systematically measure and record: (a) the thickness of each layered unit of rock; (b) structural attitudes of all primary structures, such as bedding; and (c) attitudes of all secondary features, such as folds and faults.
- Collect rocks that seem particularly useful, either as typical samples or to resolve identifications.
- Before interpreting the various rocks and structures, be sure that you have observed all possible indications of relative ages of the rocks in the outcrop.

STANDARD OPERATING PROCEDURE

FD-006 Handheld Global Positioning Receiver Operation

1. Objective

Use handheld global positioning system (GPS) receivers to locate sample points and site features with “Mapping-Grade” accuracy.

Use handheld GPS receivers to “stake out” proposed sample point locations within the limits of “Mapping Grade” accuracy.

2. Execution

- Handheld GPS receivers provide a low-cost and user-friendly method for locating sample points and site features with a fair degree of horizontal accuracy.
- In simplistic terms, GPS works by measuring the distance from numerous orbiting satellites to a point on the earth surface. Individual satellites broadcast their real-time location in terms of x,y and z coordinates, and the distance from each satellite is measured as a function of the length of time that a time-stamped signal takes to reach the receiver. Built-in GPS software derives new points by intersecting the distances from known orbital locations – in much the same way that points are located by intersecting tape-measured distances from building corners or other pre-existing site features.
- Late-model handheld GPS receivers utilize a real-time differential correction technique called WAAS (Wide Area Augmentation System). This system was designed to provide greater confidence and reliability in using GPS data for commercial aircraft landing approaches, and the additional correction improves all GPS operations.
- Handheld GPS receivers display navigational information on a variety of standard pages. Although each manufacturer uses slightly different formats, all receivers toggle back and forth between the following visual presentations:
- A “satellite” page displays the relative orbital location of all GPS satellites that are currently being tracked by the receiver. The display may include information on the real-time geometrical strength of the solution: satellite intercepts that cross at right angles provide more accurate solutions than intercepts that cross at acute or obtuse angles.
- A “track” page that displays the travel path of the receiver while it is turned on, along with the relative location of recorded points. Many GPS models have a “track-back” function that will guide the user on the same path back to the starting point
- A “navigation” page that displays instantaneous location and the real-time direction and velocity of travel. Some units provide two pages to display this information in different formats. Most units will report the overall “course

made good" (straight-line bearing and distance from the starting point) at any point.

- A "waypoint" page that allows users to "Go To" a created point or previously recorded point by providing a straight-line bearing and distance to the point. The information is instantaneously updated as the user moves along; some units display a pointing arrow that directs the user to the direction of travel. Be careful of go-to lines that lead through swamps or over cliffs – if you will be travelling in difficult terrain have a paper copy of the USGS quadrangle and a compass on hand for navigation.
- Signal strength degrades significantly next to buildings and underneath tree canopy. Most GPS receivers have an "averaging" function to improve the accuracy of shielded locations. GPS users can also improve precision by locating points three times, at different times of the day. Two of the solutions will generally be closer to each other than to the third and can be averaged for a more reliable fix.
- Most GPS receivers default to latitude and longitude, but data is more accurate and easier to input and when expressed in UTM coordinates to the nearest meter. The handheld GPS setup will have a function somewhere to change to UTM. Most of Connecticut is in UTM Zone 18 but the easternmost parts are in Zone 19.
- Consult "Corpscon" the datum translator available from the National Geodetic Survey website. Corpscon translates instantly from latitude/longitude to UTM coordinates to state plane coordinates and provides tools to identify UTM Zones. Also consult the Trimble, Garmin and Magellan websites for technological improvements and discussion of advanced techniques.

3. Limitations

- Handheld GPS receivers operating in unobstructed locations are currently reckoned to provide 2-5 meter accuracy, meaning that the true location of measured points lie within an "error ellipse" with axes of 2-5 meters centered on the measured location. In other words, even under the best of conditions a real-time GPS solution may be as much as 20 feet off the true horizontal location of a point.
- Due to geodetic restrictions, vertical locations (elevations) have less than half the accuracy of horizontal locations, meaning that even under the best of conditions, a surface elevation displayed on a handheld GPS receiver may be off by more than 50 feet.
- Horizontal and vertical data derived from handheld GPS receivers should never be considered more than relatively accurate, and this level of uncertainty should be identified in any discussion of positional tolerance.

4. References

Trimble Website: .trimble.com
Garmin Website: .garmin.com

Magellan Website: .**magellan**gps.com
National Geodetic Survey: ://www.ngs.noaa.gov/

5. Contact

Doug Bonoff, PLS

Section 5

Drilling Methods (DM)

STANDARD OPERATING PROCEDURES

DM-001 General Guidance on Determination of Appropriate Drilling Methods

1. Objective

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

The following text describes different methods of drilling with considerations for their use to collect groundwater and/or subsurface soil samples. Profiles of subsurface conditions encountered and well installation details must be recorded on logs. Procedures for field documentation are provided in Section 4 - Field Documentation.

2. Hollow-Stem Augers (HSAs)

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

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

A disadvantage of the method is that HSAs cannot be used to drill into competent bedrock or through large boulders. Also, "heaving or running sands" can be forced up inside the augers as a result of strong vertical groundwater gradients, which can hamper efforts to collect soil samples or complete well installation. Furthermore, the maximum depth achievable using HSAs, which is generally shallower than other methods, is dependent not only on the ability of the rig (e.g., horsepower, rig-torque, weight of augers etc.), but also the lithology of the material drilled.

3. Rotary Drilling

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

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

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

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

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

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

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

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

4. Sonic Drilling

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

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

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

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

5. GeoProbe®-Direct Push

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

Advantages of the direct-push method include the relatively quick collection of groundwater samples and, when used along with a mobile laboratory, collection of data in "real" time. The method allows for collection of multiple samples in a day with the potential for achieving contaminant delineation in one mobilization of the field equipment. The data can also be used to select locations of permanent monitor wells.

Disadvantages of the method include the fact that the data quality achieved is often suitable only for screening purposes. Direct-push methods typically result in very turbid samples since an oversize borehole is not produced and a filter pack is not used. Turbid samples can produce higher metal concentrations in groundwater samples since metals are typically adsorbed onto soil particles. Use of direct-push methods can also cause cross-contamination since contamination from shallow zones may be driven down to deeper zones. Due to the narrow diameter of the direct-push rods, samples are often collected with peristaltic pumps. When samples are collected for volatile organic compounds (VOCs) using peristaltic pumps, some of the volatiles may be lost due to the pressure drop produced by the suction lift. In such cases, the VOC data must be qualified accordingly. For this reason, use of the peristaltic pump for collecting groundwater samples for VOC analysis is not recommended and approval for its use should first be obtained from the project manager or geologist.

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

6. Contact

Gary Fuerstenberg

STANDARD OPERATING PROCEDURE
DM-002 Hollow-Stem Auger

1. Objective

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

2. Execution

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

- If a monitoring well will be installed, refer to SOP DM-007.
- Complete boring log and, if necessary, well installation logs (SOP SM-003, *Soil Classification*).
- Record boring locations on a site map and in a field notebook sketch. If the boring location will not be surveyed, measure each location from on-site reference points and record the information in the field notebook so that the location can be plotted on site figures.

3. Limitations

- In areas of significant soil contamination, hollow-stem augers may cross-contaminate upper soil layers as contaminated cuttings move up the auger flights. The potential also exists for contaminated augers to carry contamination to deeper soil strata
- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and evaluate health and safety conditions. If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see SOP DM-008 *Monitoring Well Telescoping Techniques*) to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of “running sands” or “blow in” to occur. Frequent measurements inside the hollow-stem augers after the drill bit/plug is removed will indicate if running sands are present. If sands start to flow into the auger, pour clean water into the augers and keep the augers filled during sampling.
- If necessary, arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site. Containers should be labeled.
- Plan the drilling program to drill borings from the least- to most-contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. Alternative locations will need to have utility clearance.
- Down-hole drilling equipment should be steam cleaned or pressure-washed between holes unless otherwise directed by the project manager.
- Record when standard operating procedures are deviated from. The drilling inspector should also record any detected odor from the boring and depth encountered.

4. References

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

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

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

5. Attachments

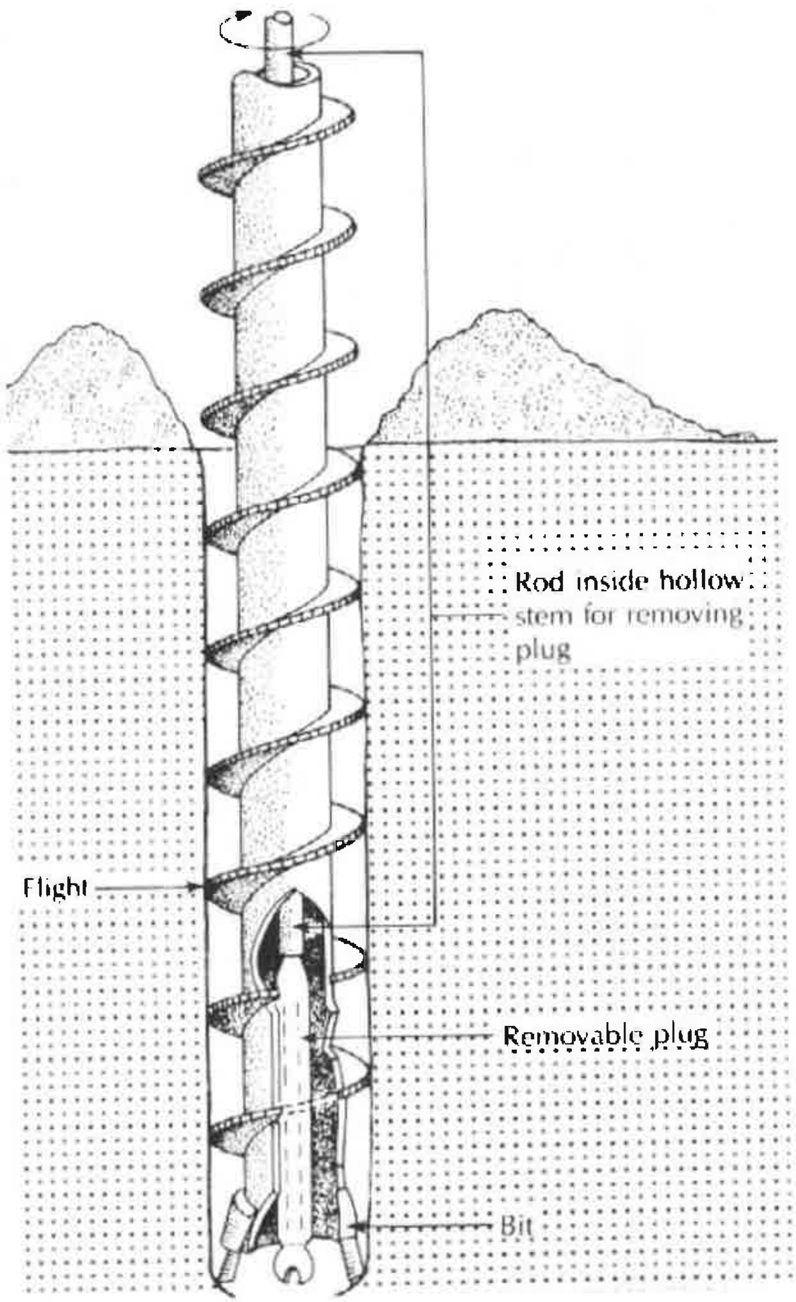
Attachment A – Hollow-Stem Auger

6. Contact

Gary Fuerstenberg
Cathy Johnson

SOP DM-002

Attachment A – Hollow Stem Auger



GEI Consultants

STANDARD OPERATING PROCEDURE

DM-003 Air Rotary Drilling with Casing

1. Objective

Describe standard operating procedures (SOP) for drilling of soil borings using casing by either the rotary method or air method.

2. Execution

- Confirm that appropriate measures have been taken for clearance of potential subsurface utilities. The responsibility for clearance may vary, depending on the client.
- Inspect the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned or pressure-washed. Record condition of down-hole drilling equipment. Record all observations in the field notebook (See SOP FD-001).
- Confirm that the casing (i.e., the borehole) is vertical when the first section of casing is advanced into the ground.
- For all soil samples, use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOP SM-001 *Split-Spoon Sampling* and SOP SM-003 *Soil Classification*–for details). Count and record the number of blows per 6-inch increments, confirming blow counts with driller if necessary.
- Decontaminate the split-spoon sampler after each use (see SOP QA-001 *Equipment Decontamination).*
- Advance the casing with the drive hammer and periodically clean out cuttings using a pneumatic hammer. A water spray and shield may be used for dust control and to control rock chips.
- Potable water should be used as the drilling fluid. If subsurface soil is sufficiently permeable to require a thicker fluid, drilling mud may be used to increase fluid viscosity, with prior approval from the project manager.
- To continue advancing the boring, additional lengths of casing are added one at a time, repeating this sequence until the required depth is reached.
- If an obstruction is encountered, the driller should attempt to penetrate the obstruction with a pneumatic hammer.
- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout or properly-tamped and hydrated bentonite. Check with Project Manager before using drill cuttings to backfill the boring.
- If a monitoring well will be installed, follow SOP DM-007.

- If the boring location is not going to be surveyed, measure each location from on-site reference points in the field notebook so that it can be relocated and plotted on figures.

3. Limitations

- To advance the boring, it may be necessary to use casing to maintain air pressure. Additional lengths of casing are then added one at a time, repeating this sequence until the required depth is reached.
- If unanticipated contamination is encountered, stop drilling to confer with the project manager and evaluate health and safety conditions.
- If the borehole is to be advanced below the contaminated strata, use telescoping techniques (see DM-008 Monitoring Well Telescoping *Techniques)* to avoid cross-contaminating underlying geologic strata.
- When drilling below the groundwater table in fine to medium sands, the potential exists for the phenomenon of "running sands" to occur. A head should be kept on the borehole at all times.
- Arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site (see SOP SC-003, *Investigation Derived Waste Management*).
- Plan the drilling program to drill borings from the least to most contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at each planned soil boring location. These locations must also have been cleared by the state utility service prior to drilling.
- Document variations from standard operating procedures.

4. References

ASTM D 5782 – Guide for Use of Direct Air Rotary Drilling for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices

5. Contact

Gary Fuerstenberg
Cathy Johnson

STANDARD OPERATING PROCEDURE
DM-004 Sonic Drilling

1. Objective

Describe common sonic drilling procedures.

Prior to drilling confirm that utility clearance has been completed and that the drilling rig has been appropriately decontaminated.

2. Execution

- Collect soil cores in runs of 5 to 10 feet. Some sonic rigs can collect a 20 foot sample, but the process generates a significant amount of heat that may degrade sample quality.
- Classify and sample the soil located within the liner.
- Excess soil should be placed in a 55-gallon drum for disposal.
- The core barrel should be cleaned with tap water following each use.
- The core barrel is then advanced within the isolation casing to collect the next soil core interval.
- Add water between the inner core barrel and the outer override casing. This will reduce friction between the casings and adsorb heat.
- Maximize drilling advance rate. The faster the core barrel is advanced, the less likely the core barrel will heat up. Drilling with a 3-inch diameter core barrel and a 5-inch diameter override casing, instead of the standard 4-inch core barrel and 6-inch over-ride casing, may increase advance rates and reduce the potential for soil core heating.
- If a significant decrease in drilling advance rate is observed, stop drilling and remove soil that has accumulated in the core barrel. Resume drilling through the resistant material (gravel, boulder, hard clay, etc.). When the resistant material has been penetrated and the drilling advance rate increases, stop drilling and remove what material has accumulated in the core barrel.
- Wash down the core barrel with cool water to cool the core barrel and associated casing, and resume drilling.
- If a well is to be installed in the borehole, the sandpack and grout are placed as the core-barrel and over-ride casing(s) are selectively vibrated out of the ground. The vibratory action should facilitate settlement of the sandpack and grout. Upon completion, no casing is left in the ground other than the well casing and screen.

3. Limitations

- Disturbance of the soil core is most likely to occur during removal of the soil core from the core barrel. The soil cores are usually vibrated out of the core barrel into plastic bags approximately 5 feet in length. As the plastic bags are a little larger than the soil core itself, fragmentation of the soil core may occur as the core is extruded into the bag or while the bagged core is being moved in an unsupported manner. Soil conditions that are prone to disturbance include wet or dry zones that contain little or no fines, and well graded sands that contain significant volumes of water.

- If integrity of the soil core is of concern, the following procedures should be implemented:
  - Measures should be taken to ensure that the core, from the time it is extruded from the core barrel, is rigidly supported through the use of some type of cradle or carrying device.
  - The core should not be removed from its cradle until all sampling of the core has been completed. Acrylic liners are available for some core sizes and can be used to hold the core together upon removal from the core barrel.
  - If the soil is to be sampled for volatile organic compounds (VOCs), acrylic liners must be used.
  - Sampling of the soil core for VOCs or semi-volatile organic compounds (SVOCs) must be approved on a case by case basis. Proposals for VOC or SVOC soil core sampling must include provisions to minimize core fragmentation and heat generation, such as:
    - Acetate liners in the core barrel so that the soil core does not have to be extruded out of the core barrel.
    - Limit the length of soil core generated during a given downhole run.
    - Implement practices to reduce the residence time of the soil core in the core barrel.
- For the analysis of SVOCs, the use of the acetate liners is not required.
- The large diameter of the core barrel enables ground water sampling equipment to be placed inside the core barrel so that discrete depth groundwater samples can be collected during borehole advancement.

4. References

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

5. Contact

Melissa Felter

STANDARD OPERATING PROCEDURE

DM-005 Drive and Wash

1. Objective

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

2. Execution

- Contact the owner to determine the locations of underground utilities/obstructions. Verify with the contractor that the utility clearance service in the particular state has been contacted. Ask subcontractor to provide a utility clearance authorization number and record the number in the fieldbook (See SOP PM-001 Utility Markout).
- Steam cleaning may be performed by drillers either on site or prior to site mobilization. If performed prior to site mobilization, observe the drilling rig to make sure it is clean and that the down-hole equipment has been steam-cleaned. Check that the steam-cleaner is working properly (i.e., that steam is being produced). Measure and record lengths of all down-hole drilling equipment, including the drive shoes and miscellaneous rods and attachments. Record all observations and measurements in the field notebook (See SOP FD-001).
- If a surface-soil sample is desired, collect this sample with a split-spoon sampler prior to setting the casing up over the borehole. For all soil samples, use a 140-lb hammer to drive the sampler, unless conditions necessitate using a 300-lb hammer (see SOP SM-001 *Split-Spoon Sampling* and SOP SM-003 *Soil Classification* for details). Count and record the number of blow counts per 6-inch increments, confirming blow counts with driller if necessary.
- Decontaminate the split-spoon sampler after each use (see SOP QA-001 *Equipment Decontamination).*
- Instruct drillers to drill the borehole, either by pounding or spinning the casing, to the top of the next sampling interval.
- The wash water should be carefully observed for indications of a soil strata change with depth (i.e., change in soil color and particle size). Record the changes and depth of changes on the boring log. Make sure that the soils in the borehole have been fully removed by the rotary bit before sampling by measuring the depth of the borehole, or by measuring the length of stick-up of drill rods to verify that the driller has sufficiently cleaned out the boring.
- Monitor the return wash water and record water losses from around the borehole onto the ground surface.

- Follow steps 4-8 until the borehole has been drilled to the desired depth. If refusal is encountered, a 5-foot core of the rock (at a minimum) may be required to confirm the bedrock surface (see site-specific field sampling plan).
- If a monitoring well is not installed in the soil boring, fill the boring with either cement/bentonite grout, properly-tamped and hydrated bentonite, or other specified materials as indicated in the site-specific field sampling plan. Backfilling of the environmental borehole should not be completed with drill cuttings (see site-specific field plan for deviations).
- Complete boring log and, if necessary, well installation logs (see SM-006 *Rock Coring Log* SOP).
- Record boring locations on a site map. Measure each location from on-site reference points and record the information in the field book.

3. Limitations

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

4. References

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

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

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

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

5. Contact

Gary Fuerstenberg

STANDARD OPERATING PROCEDURE

DM-006 Geoprobe® Direct Push Boring

1. Objective

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

2. Execution

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

3. Limitations

- If significant unanticipated contamination is encountered during drilling, stop drilling to confer with the project manager and re-evaluate health and safety conditions.
- Arrange for the storage of contaminated soil cuttings and water in drums or other appropriate containers in a secure place at the site (see SOP SC-003, *Investigation Derived Waste Management*).
- If possible, plan the drilling program to drill borings from the least to most contaminated areas. Be prepared in advance and know where alternative drilling locations are in the event that problems are encountered at soil boring locations. These locations must also have been cleared by the state or local utility service prior to drilling.

4. References

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

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

5. Attachments

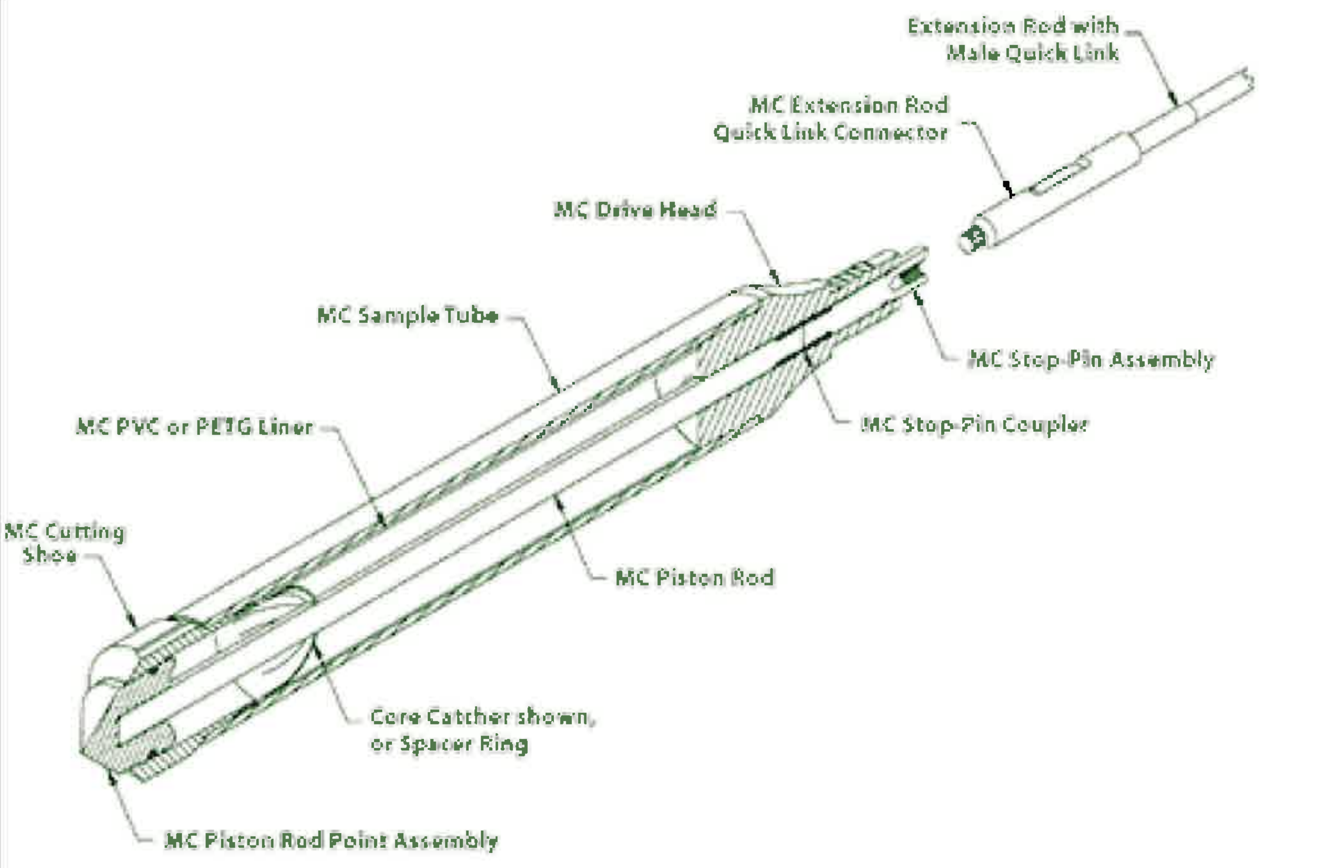
Attachment A – Geoprobe® with Macrocore® Sampler Assembly

6. Contact

Melissa Felter
Cathy Johnson

SOP DM-006

Attachment A – GeoProbe® with Macrocore® Sampler Assembly



Above: Diagram of a Macrocore® sampler

Right: A track-mounted GeoProbe ® Rig

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STANDARD OPERATING PROCEDURE

DM-007 Monitoring Well Construction and Installation

1. Objective

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

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

2. Execution

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

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

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

- Prevent well materials from contacting foreign substances during installation. Precautions may include requiring the driller to wear clean gloves while handling well materials and requiring that well materials not be placed onto the ground or pavement without a protective barrier such as polyethylene sheeting being present
- Confirm that the driller installs a minimum one-inch sump with a bottom cap to the bottom of the well screen. See the Work Plan for locations that may require larger sumps.
- Monitoring wells can be constructed of either 1, 1.5, 2 or 4 inch inner diameter (ID) Schedule 40 threaded flush-jointed PVC. Refer to the work plan for the site-specific requirements. Flush-threaded well materials should be used. Do not allow the driller to use glues, as they typically contain solvents that could affect on groundwater quality.
- Stainless steel well materials may be used if required in the Work Plan. Select slot size based on grain size of the formation and on requirements in the Work Plan.
- Confirm that the driller places at least 12 inches of clean uniformly graded medium quartz filter sand pack into the base of the borehole, if required in the Work Plan.
- The driller should remove the drilling casing/augers from the borehole slowly, at a maximum of 2-foot intervals, at the same time that filter sand is added. The drillers should take frequent measurements of the depth to sand.
- Confirm that the driller has added adequate sand to surround the area around the slotted section. The filter sand should extend at least 2 feet above the top of the slotted section.
- The driller should place a bentonite seal above the filter pack. If the seal is above the water table, use at least 5-gallons of potable water to hydrate the bentonite before grouting the remaining annular space, or otherwise backfilling the remaining annular space as discussed with the Project Manager. Tamp seal. It should extend 1 to 2 feet above the filter sand.
- If required by the Work Plan, the driller should use bentonite-cement and grout the annular space from the top of the bentonite seal to the ground surface. Bentonite cement grout should be placed using tremie methods. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using a pump (such as one on the rig) to ensure proper mixing.
- The drillers should cut the monitoring well riser at an angle or make "V"-notch in the riser pipe as a benchmark for surveying and groundwater measurements. The driller should cut the well riser so that the top of the well will be approximately 3 inches below the top of protective casing. The top of

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

- The protective surface casing is either a flush-mounted roadbox or a steel "stick up" pipe. The base of either type of casing should extend at least 1 foot into the grout below the ground surface (below the frost line) whenever possible.
- The protective casing should be set by placing cement in the annular space between the protective casing and the borehole up to the ground surface. If possible, the driller should slope the cement radially away from the protective casing at the ground surface to promote surface water runoff.
- In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the roadbox flush with the ground surface to avoid damage to the well.
- If the well is installed in a high-traffic area and is completed with a steel "stick up" pipe, additional protection such as steel pole bumpers around the steel "stick up" pipe may be necessary.
- If possible a locking cap should be placed on the steel "stick up" pipe. If the surface casing is flush mounted, a locking expansion plug should be placed, if possible, inside the top of the well riser pipe.
- All well locations should be photodocumented in accordance with SOP FD-004 Photodocumentation.
- Label the outside of the protective well casing with a paint pen. If the well is not going to be surveyed, measure the location to nearby landmarks so that the well may be located in the future and plotted on figures. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the well.
- Develop the well (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- Do not screen across different hydrostratigraphic units (for example, outwash sands, confining layers or till) unless specified in the Work Plan or approved by the Project Manager.

- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand should be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times.

- Do not use drill cuttings to backfill during monitoring well installation unless specified by the work plan or project manager.

4. References

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

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

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

5. Attachments

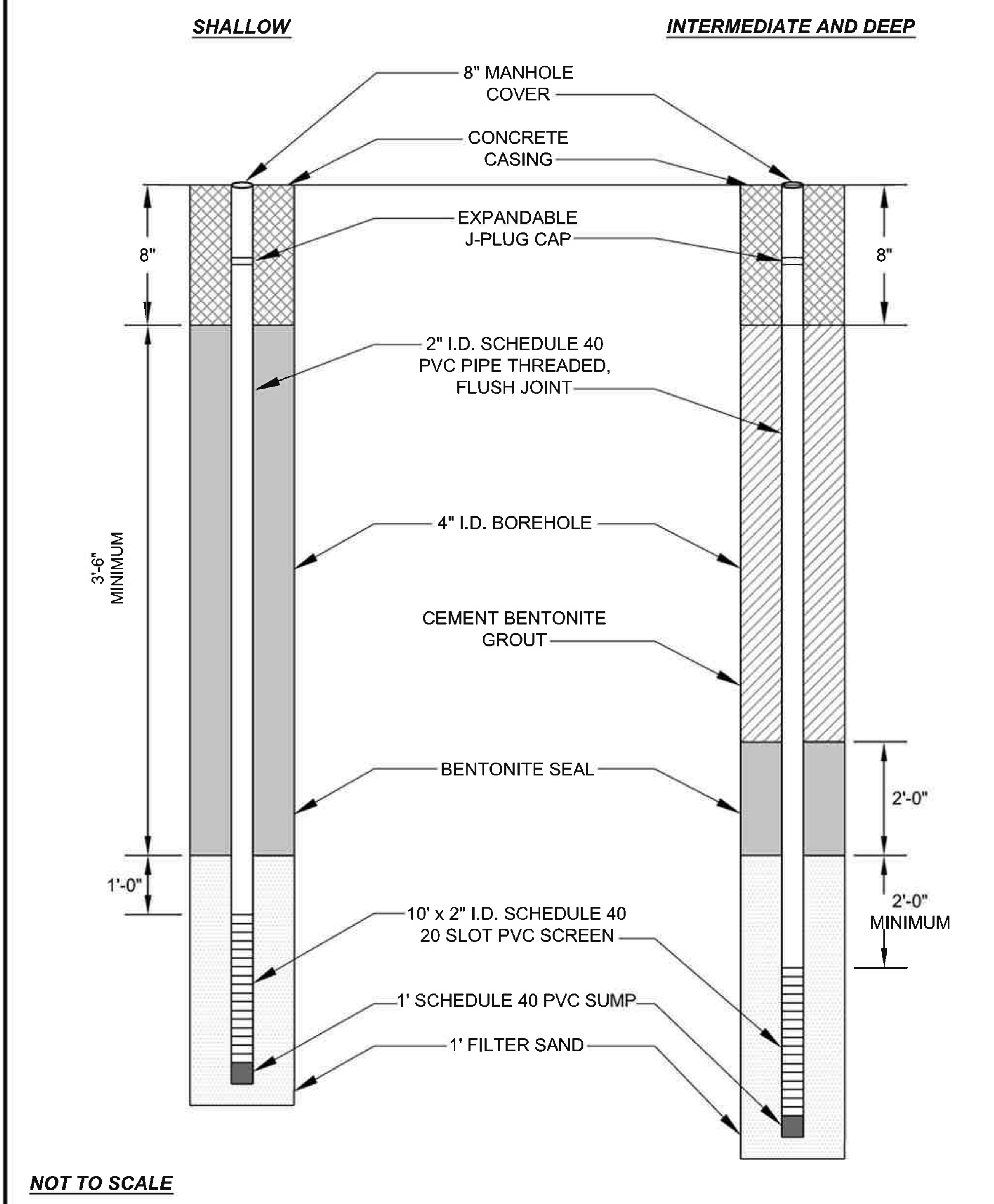
Attachment A – Typical Shallow, Intermediate, and Deep Groundwater Monitoring Well Construction Detail

Attachment B – Groundwater Monitoring Well Installation Log

6. Contact

David Terry
Anne Leifer

Attachment A - Well Detail



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TYPICAL SHALLOW, INTERMEDIATE AND DEEP GROUNDWATER MONITORING WELL CONSTRUCTION DETAIL

June 2008

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Attachment B - Groundwater Monitoring Well Installation Log

Groundwater Well Installation Log	**Well ID**

Project		**GEI Proj. No.**	
City / Town		**Location**	
Client		N	
Contractor		E	
Driller	**GEI Rep.**	**Install Date**	

Survey Datum:

Ground Elevation:

General Soil Conditions (Not to Scale)

depth

Fill

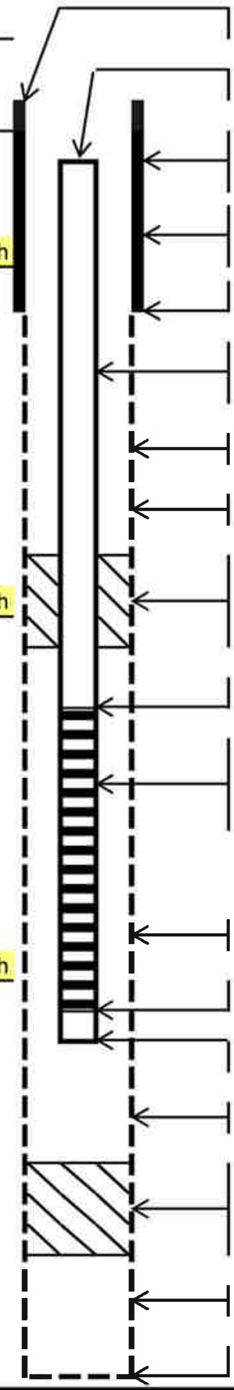
depth

Sand

depth

Till

Date	Time	Distance to ▼ below top of riser pipe



- Length of Surface Casing above Ground
- Dist. Top of Surf. Casing to Top of Riser Pipe
- Type and Thickness of Seal around Surface Casing
- ID of Surface Casing
- Type of Surface Casing
- Depth Bottom of Surface Casing
- ID and OD of Riser Pipe
- Type of Riser Pipe
- Type of Backfill around Riser Pipe
- Diameter of Borehole
- Depth Top of Seal
- Type of Seal
- Depth Bottom of Seal
- Depth Top of Screened Section
- Type of Screen
- Description of Screen Openings
- ID and OD of Screened Section
- Type of Filter Material
- Depth Bottom of Screened Section
- Depth Bottom of Silt Trap
- Depth Bottom of Filter Material
- Depth Top of Seal
- Type of Seal
- Depth Bottom of Seal
- Type of Backfill below Filter Material
- Bottom of Borehole

Notes:

GEI Consultants

STANDARD OPERATING PROCEDURE

DM-008 Telescoped Drilling

1. Objective

Describe telescoped drilling used to prevent the connection of two stratigraphic layers during boring advancement and/or monitoring well installation. This type of drilling is commonly used to prevent higher density contaminants (such as in coal tar or chlorinated solvents) from migrating downward in a boring.

Telescoped drilling is used with air rotary drilling (SOP DM-003) and drive-and-wash drilling (SOP DM-005). Refer to these SOPs for procedures to be performed prior to installing casing.

2. Execution

- Confirm that drilling tools have been appropriately decontaminated.
- Drill or core at least four feet into the stratigraphic unit (bedrock, till, etc.) to confirm the unit and provide a "socket" into which permanent casing can be grouted.
- The socket diameter should be at least two inches larger that the casing to be installed.
- The casing that will be installed should be large enough to allow smaller diameter drilling tools inside it to advance deeper, without the possibility of cross-contamination or hydraulic connection between the shallower and deeper units. For example, a six-inch casing is large enough for use of 4-inch tools inside it.
- Freshly mixed grout is required to set the large-diameter casing into the unit to be isolated. Depending on application, a mixture of Portland cement and bentonite meets most grouting requirements. For proper consistency, use no more than 6 gallons of water per 94-pound sack of cement. Add a few pounds of bentonite or hydrated lime per sack of cement for better flow.
- The driller should use a tremie pipe to deliver grouting outside the casing. Follow these steps to complete grouting using this method:
    - i. Lower the casing to the bottom of the borehole. Make sure that the lower end of the casing is tightly seated at the bottom.
    - ii. Mix a sufficient quantity of grout and pump it through the tremie pipe. As the grout is placed, lift the tremie pipe slowly, but keep the lower end submerged in the grout.
    - iii. Fill the casing with water as the grout is placed to balance the fluid pressure inside and outside the casing. Doing so prevents grout from leaking under the bottom of the casing.

iv. Allow the grout to set for a minimum of 24 hours. Some regulatory agencies require 48 hours.
v. Using smaller diameter drilling tools, advance through the existing casing into the underlying unit to continue investigation. Install additional casing or PVC into the unit, or leave it as an open borehole.

3. Limitations

- If dense non-aqueous phase liquid (DNAPL) and/or dissolved contamination is suspected in the shallow (weathered) bedrock, then installation of casing in the rock may not be wise. It could hide the DNAPL from detection and/or result in cross-contamination of deeper rock. A shallow bedrock well may be called for to characterize the impacts. Consult with the Project Manager.
- Other casing installation methods, such as pressure-grouting may be more appropriate. Consult with the Project Manager.

4. References

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

5. Contact

Gary Fuerstenburg
Catherine Johnson

STANDARD OPERATING PROCEDURE

DM-009 Monitoring Well Development

1. Objective

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

2. Execution

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

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

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

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

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

- Calculate or estimate the amount of water introduced to the borehole during drilling. At a minimum, this is the amount of water that should be removed during development. Removing less water than was introduced and allowing additional time for the surrounding formation to clear of injected drilling fluids may be considered as an alternative if the volume of introduced water was large.

- Record the volume of water purged in the field notebook or on the Monitoring Well Sampling Form (Attachment A).

- Collect a sample of water from the monitoring well with the selected submersible pump (e.g. 12-volt whale pump or Grundfos pump), a bailer, or a

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

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

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

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

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

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

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

3. Limitations

Always remove groundwater with fine particles from the well before surging. The fine particles may be forced into the well screen by the surging action. They may also damage the pump.

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

If the soils around the well screen are composed of fine-grained silts and clays, over-pumping and mechanical surging is not recommended since these more vigorous techniques can cause mixing of the fines into the filter pack. To develop these wells, use of a bailer is recommended.

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

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

4. References

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

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

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

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

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

5. Attachments

Attachment A - Monitoring Well Sampling Form

6. Contact

Gary Fuerstenberg
Anne Leifer

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________________ Job Name ____

Job Number ____________________ By ____________________ Date ________________

Location ____________________ Measurement Datum ______________________________

Well Number ____________________

Pre-Development Information Time (start) ______________________________

Water Level ____________________ Total Depth of Well ______________________________

One Purge Vol ____________________ Three Well Volume ______________________________

Water Characteristics

Color ____________________ ________ Clear _____ Cloudy

Odor _____ None _____ Weak ________ Moderate _____ Strong

Any films or immiscible material ____

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

Total Volume Removed (gal) _______________ pH _____________

Temperature (°C) _______________ Specific Conductance (µS/cm) _____________

DO Concentration (mg/L) _______________ ORP (mV) _____________

TDS _____________

Post Development Information Time (Finished) _____________

Water Level _______________ Total Depth of Well _____________

Approximate Volume Removed (gal) ___________________________________

Water Characteristics

Color _________________________ _____ Clear ______ Cloudy

Odor ______ None _____ Weak _____ Moderate ______ Strong

Any films or immiscible material ____

Comments

STANDARD OPERATING PROCEDURE

DM-010 General Guidance on Monitoring Well Abandonment

1. Objective

Describe methods to abandon a monitoring well.

The goal of monitoring well abandonment is to seal the borehole so it cannot act as a conduit for movement of contaminants or liquids from the ground surface to the water table or between aquifers.

General procedures for well abandonment are provided below but do not supersede state or local regulations. Make sure all well abandonment procedures adhere to appropriate regulations.

2. Execution

The following methods for abandoning unconsolidated (overburden) and consolidated (bedrock) monitoring wells should be performed by a licensed drilling contractor, if required by law or regulatory authorities. The following listed methods are general guidance for abandoning monitoring wells. The Work Plan and state and local requirements should be reviewed for additional requirements.

2.1 Unconsolidated (overburden) Monitoring Wells

Unconsolidated (overburden) monitoring wells should be abandoned in the following manner, see the Work Plan for additional requirements:

- Remove the protective casing and concrete pad.
- If possible, overdrill the monitoring well casing and sand pack using hollow-stem augers or casing to at least one foot below the depth of the boring/well as indicated in the soil boring log.
- If possible, remove the monitoring well riser, sand pack, bentonite seals and grout.
- Once the well materials have been removed, add cement/bentonite grout using tremie methods starting at from the bottom of the borehole as the augers or casing are removed.
- If the well materials cannot be removed by overdrilling, the riser should be cut off at a depth of between two and five feet below the ground surface and the remaining well materials may be filled with grout using tremie methods. The grout mixture will be as specified for the well installation (see SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods)
- Add grout to the point where the riser was cut off or to a depth of approximately two feet below the ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

2.2 Consolidated (bedrock) Monitoring Wells

Consolidated (bedrock) monitoring wells or open holes will be abandoned in the following manner. See the Work Plan for additional requirements:

- Remove the protective casing and concrete pad;
- Remove the monitoring well materials from the hole. If the materials cannot be removed, cut off the well riser between two feet to five feet below grade. If feasible, cutting off the riser at five feet is optimal.
- Add cement/bentonite grout via tremie methods from the bottom of the well up to the ground surface. The grout mixture should be as specified for the well installation SOP DM-001 General Guidance on Determination of Appropriate Drilling Methods
- Add grout to the point where the riser was cut off or to a depth of approximately 2 feet below ground surface. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

3. References

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

Massachusetts Department of Environmental Protection, "313 CMR 3.00, Registration of Well Drillers and Filing of Well Completion Reports".

Massachusetts Department of Environmental Protection, "Standard References for Monitoring Wells, Section 4.6 Decommissioning of Monitoring Wells", January 1991

4. Contact

Gary Fuerstenberg
Anne Leifer

Section 6

Sample Collection and Field Screening (SC)

STANDARD OPERATING PROCEDURE

SC-001 Environmental Sample Types and Sampling Strategies

1. Objective

Describe types of samples and strategic approaches to sample locations.

Refer to Attachment A for guidance on compatible sampling materials.

2. Sample Types

Grab Samples

A grab (or discrete) sample is a single aliquot (part of the sampled media) collected from a single location at a specific time.

Surface soil samples are typically "grab" samples. Volatile organic samples are always grab samples because the least amount of sample disturbance is necessary.

Composite Samples

Composite samples are non-discrete samples composed of more than one aliquot collected from different sampling locations and/or at different points in time. Analysis of composite samples produces an average value.

Composite samples are frequently collected to characterize waste soil that has been stockpiled for eventual disposal. Several grab samples are collected from the stockpile and are blended together into a single sample.

Screening Samples

Screening samples may be grab or composite in nature. However, they offer potential advantages such as rapid results and low cost. The trade-off is that they may only provide results within a range and/or they may have elevated detection limits. Screening samples are most often used to evaluate presence/absence and/or indications of the potential magnitude of impacts.

3. Sampling Strategies

Generally, there are three sampling strategies: random, systematic, and judgmental sampling.

- Random sampling involves collection of samples in a non-systematic fashion from the entire site or a specific portion of a site.
- Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established.
- Judgmental sampling is the collection of all other samples. This sampling might be from areas most likely to be contaminated, areas most likely to be clean, or areas where information is lacking.

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

4. Attachments

Attachment A - General Guidelines for selecting equipment

5. Contacts

Jerry Zak
Ryan Hoffman

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE

SC-002 Environmental Sample Handling

1. Objective

Describe appropriate environmental sample handling procedures.

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

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

2. Execution

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

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

3. Limitations

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

- Field personnel should be aware of analyses which have short hold times and schedule sampling events and shipping accordingly. Shipment of samples for analyses with short hold times must be arranged for in advance. Refer to the project work plan, quality assurance project plan, or state/federal regulations for holding time and preservative information. Contact the laboratory ahead of time when shipping samples with short hold time to ensure the lab is prepared for these analyses.
- For glassware containing preservatives (e.g., HCl, HNO_3), take care not to overfill the container, thus flushing the preservative out of the bottle.
- Never composite samples for VOCs in the field. Collect individual aliquots and direct the laboratory to perform compositing, if needed.
- Collection of aqueous samples should not be performed over the opening of a monitoring well. Preservatives from overfilling, a marker pen or other objects could fall into the well.
- If the recharge volume for a monitoring well is low, completely fill all volatile vials and then collect the minimum sample volume required for each remaining analysis.
- During subsurface soil sampling, if the recovery from the split-spoon sample is inadequate, if appropriate, resample the bottom of the borehole to obtain proper sample volume.
- Laboratories will homogenize and test the contents of the sample container, unless directed otherwise. Samples should not contain rocks, twigs, leaves, etc… unless these materials are of interest.

4. References

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

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

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

5. Contacts

Jennifer Belonsoff
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-003 Investigation Derived Waste

1. Objective

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

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

2. Execution

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

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

2.1. Test Pit Excavation

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

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

2.2. Boring/Monitoring Well Installation

- For auger borings, segregate contaminated soil (determined by visual and/or field screening methods) from uncontaminated soil during drilling. Segregate residual contaminated soil from split-spoon sampling.
- Auger cuttings or sediment generated by drive and wash may be spread around the ground surface at the boring location if it is acceptable to the client and the governing regulatory agency. If not, IDW may be placed in an appropriate area or container pending characterization and appropriate disposal. (A useful rule of thumb is to assume generation of one 55-gallon drum of cuttings for each 20 feet drilled with 7-¼-inch-I.D. augers).
- Segregate contaminated drilling fluid from uncontaminated fluid for rotary wash borings.
- Drilling fluid management options include pouring the drilling fluid on the ground near the boring location, if acceptable to the client and governing regulatory agency, or containerizing the fluid in drums or tanks.

2.3. Well Development/Sampling

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

2.4. Decontamination Fluids

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

2.5. Disposable Personal Protective Equipment

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

3. Limitations

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

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

4. References

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

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

5. Attachments

Attachment A - Summary of Investigation Derived Waste Management Options
Attachment B - CTDEP Waste Guidance

6. Contacts

David Terry
Leslie Lombardo

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

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

Attachment A: - SUMMARY OF IDW MANAGEMENT OPTIONS
GEI Consultants, Inc. Standard Operating Procedures
Management of Investigation - Derived Waste

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

Notes:

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

Connecticut Department of Environmental Protection

Connecticut's RCRA "Contained-In" Policy

Characterization of Contaminated Soil and Groundwater

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

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

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

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

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

STANDARD OPERATING PROCEDURE
SC-004 Headspace VOC Screening

1. Objective

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

This information can be used for several purposes:

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

2. Execution

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

3. Limitations

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

- Prevent water and soil particles from entering the tip of the instrument probe. Use a filter on the instrument's probe.
- Measure background VOC conditions and perform JHS screening away from non-site-related VOC sources, such as vehicle and heavy equipment exhaust.
- The VOC concentration on the instrument's display may vary when the air contains high VOC concentrations or high moisture.
- JHS screening is a guide that helps the screener to segregate soils into broadly defined categories. JHS screening results may differ by orders of magnitude from laboratory testing results.
- Note that states may have specific procedures for field monitoring. In Massachusetts, the Massachusetts Department of Environmental Protection (DEP) requires that screening of gasoline-contaminated soil be performed in accordance with Attachment II of the DEP's policy #WSC-94-400 Interim Remediation Waste Management Policy for Petroleum Contaminated Soils. Consult this procedure or any relevant guidance documents for assistance.

4. References

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

5. Contacts

Lynn Willey
Leslie Lombardo

STANDARD OPERATING PROCEDURE

SC-005 Ultraviolet Fluorescence (UVF) Detection Method

1. Objective

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

2. Background

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

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

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

3. Execution

- Upon receipt of the instrument, inspect all shipping cartons to ensure that all components have been received and verify that the unit is operational.
- On site, assemble the unit according to the manufacturer's instructions. Install the UVF-3100 software onto the field laptop computer.
- The UVF-3100 is equipped with an internal battery. However, the AC adapter may be needed for extended operation. Be prepared to switch to AC power if necessary.

- Operate the UVF-3100 for 20 minutes prior to use to ensure that the instrument is operating at full performance.
- Select the applicable standards based on the target hydrocarbon range (i.e., BTEX, PAHs, etc.).
- Calibrate the UVF-3100 in accordance with the instructions provided with the appropriate calibration kit. Proper calibration of the instrument is critical.
- For optimal use of the UVF-3100, approximately 20 samples (maximum of 20 samples) should be screened during each run.
- Extract samples using the SiteLAB™ UVF Analytical Test Kit (Product Number EXTR010-20).
- Sample extracts can be stored for up to 3 months if kept refrigerated.
- Field personnel should be familiar with both the sample extraction and the calibration procedure before attempting to record data.
- Operate instrument as per manufacturer's instructions:

  i. Select the appropriate optical filter for the specific test to be run.
  ii. Select the proper wavelength for the specific test to be run.
  iii. Perform the 5-point calibration using the appropriate standards.
  iv. Perform the sample extraction procedure.
  v. Make any necessary dilutions.
  vi. Analyze the samples and record the results on the record sheet included with the extraction kit. Include test run number, Sample ID, Fluorescence, Sample Concentration, and Dilution Factor on the sheet.
  vii. Calculate result by multiplying the sample result by the dilution factor.
  viii. Repeat for each sample. Make addition dilutions if necessary.

- **Sample dilution -** Samples exhibiting a yellowish color should be diluted until a minimal yellow tint is observed. Analyze both the diluted sample and the undiluted sample for comparison. Follow dilution procedure outlined in the manual. Addition methanol may be necessary for further dilution.

- **Field duplicate** – a duplicate sample should be collected from a sample location suspected of being contaminated with the target hydrocarbon and extracted in a manner identical to the original sample. Field duplicates should be taken at a frequency of one per twenty samples or one per weekly sampling whichever is the greater.

4. Contacts

Brian Conte
Leslie Lombardo

Section 7

Solid Matrix Sampling (SM)

STANDARD OPERATING PROCEDURE

SM-001 Soil Sampling Techniques Including Split-Spoon

1. Objective

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

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

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

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

2. Execution

2.1. Surface Soil Sampling

Collection of surface soil samples can be accomplished with tools such as spades, shovels, trowels, scoops, etc. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required.

- Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- Using a decontaminated stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- If volatile organic compound (VOC) analysis is to be performed, transfer the sample directly into an appropriate labeled sample container with a stainless steel lab spoon, small diameter core device, or equivalent and secure the cap tightly.
- Place the remainder of the sample into a decontaminated stainless steel, plastic, or other appropriate container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval.
- Either place the sample into appropriate labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the container and mix thoroughly.
- When compositing is complete, place the sample into appropriate labeled containers and secure the caps tightly.

2.2. Sampling with Hand Augers and Thin Wall Tube Samplers

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

2.2.1 Auger Sampling

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

2.2.2 Thin-Walled Core Sampling

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

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

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

Place the remainder of the sample into a stainless steel, plastic, or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the container and mix thoroughly.

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

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

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

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

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

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

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

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

3. Limitations

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

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

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

4. References

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

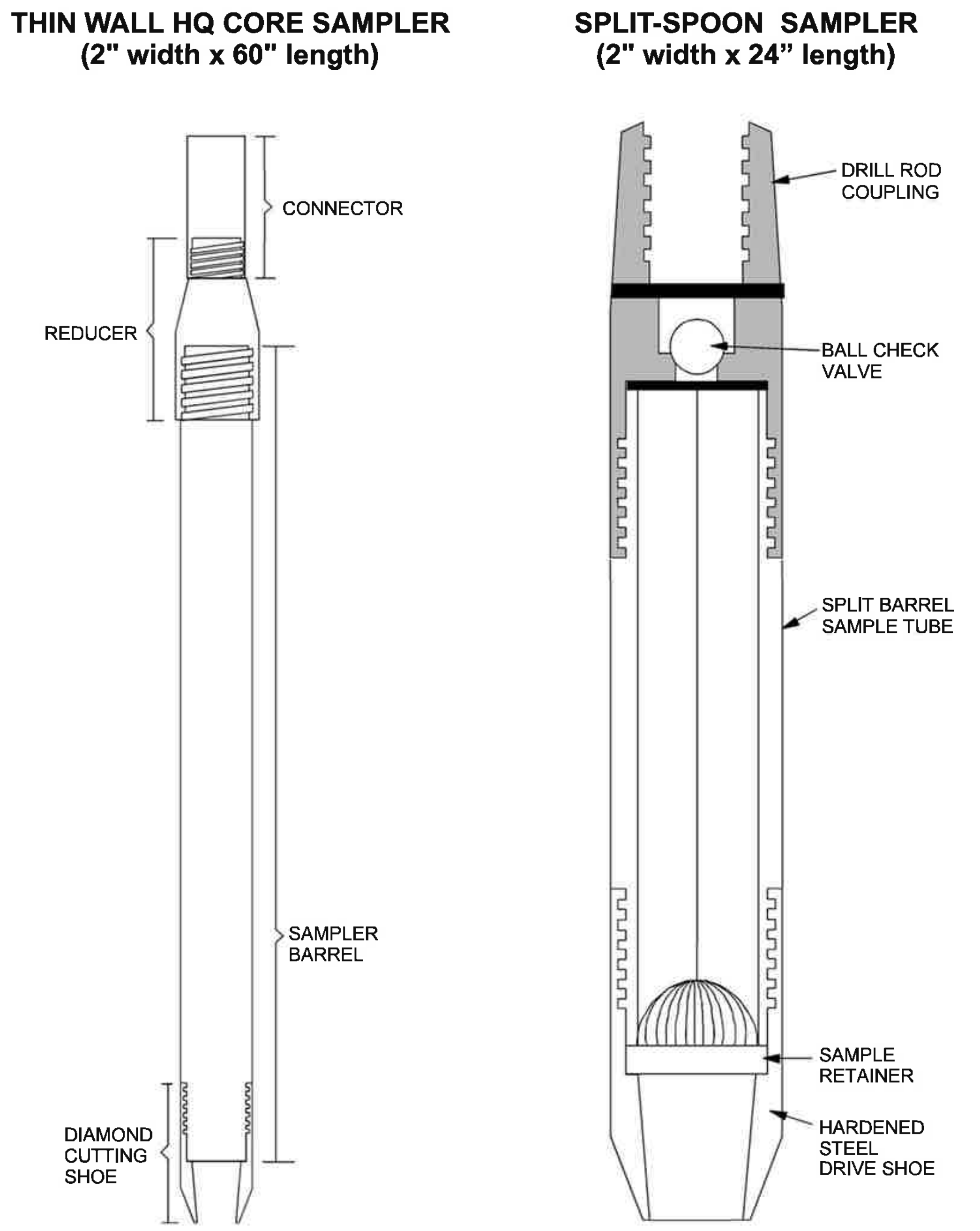
United States Environmental Protection Agency, SOP 2012 "Soil Sampling", Revision 0.0, February 18, 2000.

5. Attachments

Attachment A - Sampler Design Assembly

6. Contacts

Gary Fuerstenberg
Mark Ensign



STANDARD OPERATING PROCEDURES SM-001	GEI Consultants	**THIN WALL AND SPLIT-SPOON SAMPLERS**
NEW ENGLAND AND ATLANTIC REGIONS	June 2011	Attachment A

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STANDARD OPERATING PROCEDURE

SM-002 VOC Soil Sample Collection and Preservation Method

1. Objective

Describe methods to collect and preserve soil samples for analysis of Volatile Organic Compounds (VOCs) in accordance with the U.S. Environmental Protection Agency (EPA) Method 5035.

Some states have adopted soil sampling and preservation methods that vary from the procedures presented herein. Confirm that this method is appropriate for your project.

2. Execution

VOCs evaporate readily at normal temperatures and pressures. Care should be taken during sampling and preservation to limit the potential for VOCs to off-gas from the soil sample prior to being analyzed by the laboratory.

Soil samples should be obtained utilizing a small diameter core sampler such as a 10 milliliter (ml) plastic disposable syringe, an EnCore® sampler, an EasyDraw Syringe®. The EnCore® sampler is the only EPA-approved small diameter core sampler that can be used to collect the sample, store the sample, and transport the sample to the lab.

A separate soil sample must be collected and submitted to the laboratory for percent solids testing. At least approximately 20 grams of soil must be collected in a separate glass or plastic sampling container.

2.1. Collection and Preservation of Soil Samples

Three types of soil samples may be collected for VOCs analysis:

- High (typically >200 µg/kg) VOC concentration soil sample (Section 2.2 below)
- Low (typically 0.05-200 µg/kg) VOC concentration soil sample (Section 2.3 below)
- Synthetic Precipitation Leaching Procedure/Toxicity Characteristic Leaching Procedure (SPLP/TCLP) soil sample (Section 2.4 below)

2.2. Collection and Preservation of a Soil Sample with "High" Concentrations of VOCs (typically >200 µg/kg)

2.2.1. Option 1 – Methanol Preservation Method

Supplies include: an electronic field balance (in some cases), two VOC vials (per sample) with 10 ml methanol (the number of vials and amount of methanol might vary among labs), and a small diameter core sampler to collect an approximately 10 gram soil sample. Some labs, and EPA method 5035, specify a 5 gram soil sample. Check with the lab or project manager for the amount to collect.

Sampling Procedure:

- Weigh the VOC vials containing the methanol and record the weight. Some laboratories provide pre-weighed VOC vials.
- If you are weighing your samples, take a test sample with the sampler and weigh it to evaluate how close you are to the appropriate sample weight. If the laboratory VOC vial is pre-marked with a line, then you do not need to weigh the soil, just fill the VOC vial with soil until the methanol and soil mixture reaches the line.
- Collect the sample using the sampling device and extrude the sample into the preserved VOC vial. Be sure that the VOC vial and cap threads are free of soil, and then screw the cap tightly onto the VOC vial. Gently swirl the methanol in the VOC vial to coat the soil sample. Do not vigorously shake the vial.
- If necessary, weigh the VOC vial and record the weight. Some laboratories will weigh the vials at the lab, and it is not required in the field.
- Collect separate soil samples from the same area for percent solids and head space sampling.
- Samples must be frozen or analyzed within 14 days.

2.2.2. Option 2 – EnCore® Sampling Method

Supplies needed: One 5 or 10 ml EnCore® sampler.

Sampling Procedure:

- Label the EnCore® sampling container.
- Collect the soil sample quickly, wipe the sampler free of soil, and seal the sampler.
- Place sampler in a clean ziplock bag and place on ice in a cooler.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen, or preserved, or analyzed within 48 hours (requires coordination with the laboratory).

2.3. Collection and Preservation of a Soil Sample with "Low" Concentrations of VOCs (typically 0.5 to 200 µg/kg)

2.3.1. Option 1 – Water Preservation Method

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

Sampling Procedure:

- Use a small diameter core sampler to collect two soil samples (5 grams each) into pre-weighed 40 ml VOC vials with 5 ml of water and a magnetic stirrer. Wipe threads and cap and seal the VOC vial. Repeat for the second VOC vial.
- Weigh the VOC vials and record the weights.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen or analyzed within 14 days.

2.3.2. Option 2 – Collection into Unpreserved VOC Vials

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

Sampling Procedure:

- Collect the sample using the sampling device and extrude the sample into the VOC vial. Be sure that the threads are free of soil, and cap and seal the VOC vial. Repeat for the second vial.
- Weigh the VOC vials and record the weights.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen or analyzed within 48 hours (requires coordination with the laboratory).

2.3.3. Option 3 – Collection in VOC Vials Preserved with Sodium Bisulfate

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

Sampling Procedure:

- Collect the sample using the sampling device and extrude a 5 gram sample into the VOC vial containing the sodium bisulfate. Wipe threads and cap and seal the VOC vial. Repeat for the second VOC vial.
- Weigh the VOC vials and record the weights.

- Collect separate samples in separate containers for percent solids and head space sampling.
- Samples must be frozen or analyzed within 14 days.

2.3.4. Option 4 –EnCore® Sampling Method

Supplies required: two 5 gram EnCore® samplers.

Sampling Procedure:

- Label the EnCore® sampling container.
- Collect the soil sample quickly, wipe the sampler free of soil, and seal the sampler.
- Place sampler in a clean ziplock bag and place on ice in a cooler.
- Collect separate samples in separate containers for percent solids and head space sampling.
- Repeat previous steps with the second EnCore® device.
  Samples must be frozen, or preserved, or analyzed within 48 hours (requires coordination with the laboratory).

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

Sampling methods for TCLP or SPLP are similar to the methods presented above. The appropriate method is determined by local regulations. If using an EnCore® sampler, a 25 gram sampler should be used.

3. General Guidance

- Each state and federal regulatory agency has unique soil preservation requirements. Always verify collection and preservation methods with governing bodies.
- Verify preservation techniques with laboratory prior to sample collection.

4. Contacts

Lynn Willey
Mark Ensign

STANDARD OPERATING PROCEDURE

SM-003 Classification of Soil Samples in the Field

1. Objective

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

2. Execution

- Describe soil samples according to *ASTM D2488-09a, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)* and Attachments A and B. This standard is the basis for the Unified oil Classification System.
- Identify and record the soil in terms of the major and minor constituents (i.e., sand gravel, silt, clay), Unified Soil Classification Symbol, sample structure, plasticity and dilatancy for fine-grained soils, color, local or geologic name if known (e.g., Boston Blue Clay or glacial till), odor, presence of iron or other staining, and presence of organic matter, shells, debris, or other unusual characteristics of the same.
- If a soil split-spoon sample contains more than one soil type (for example, the upper portion is silty sand and the lower portion is clay) describe each type separately.
- Record sampler type, blow counts, soil description, etc. on the boring log (see Attachment C).
- GEI consistently applies one modification to the ASTM standard: Use "widely graded" and "narrowly graded" instead of "well-graded" and "poorly graded," respectively.

3. Limitations

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

- “and” = 35-50%
- “some” = 20-35%
- “little” = 10-20%
- “trace” = 1-10%

- Describing soil samples is often difficult during cold or wet weather. Make sure your field notes describe these conditions. When possible, collect archive samples and verify sample descriptions in the office.

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

4. References

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

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

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

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

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

5. Attachments

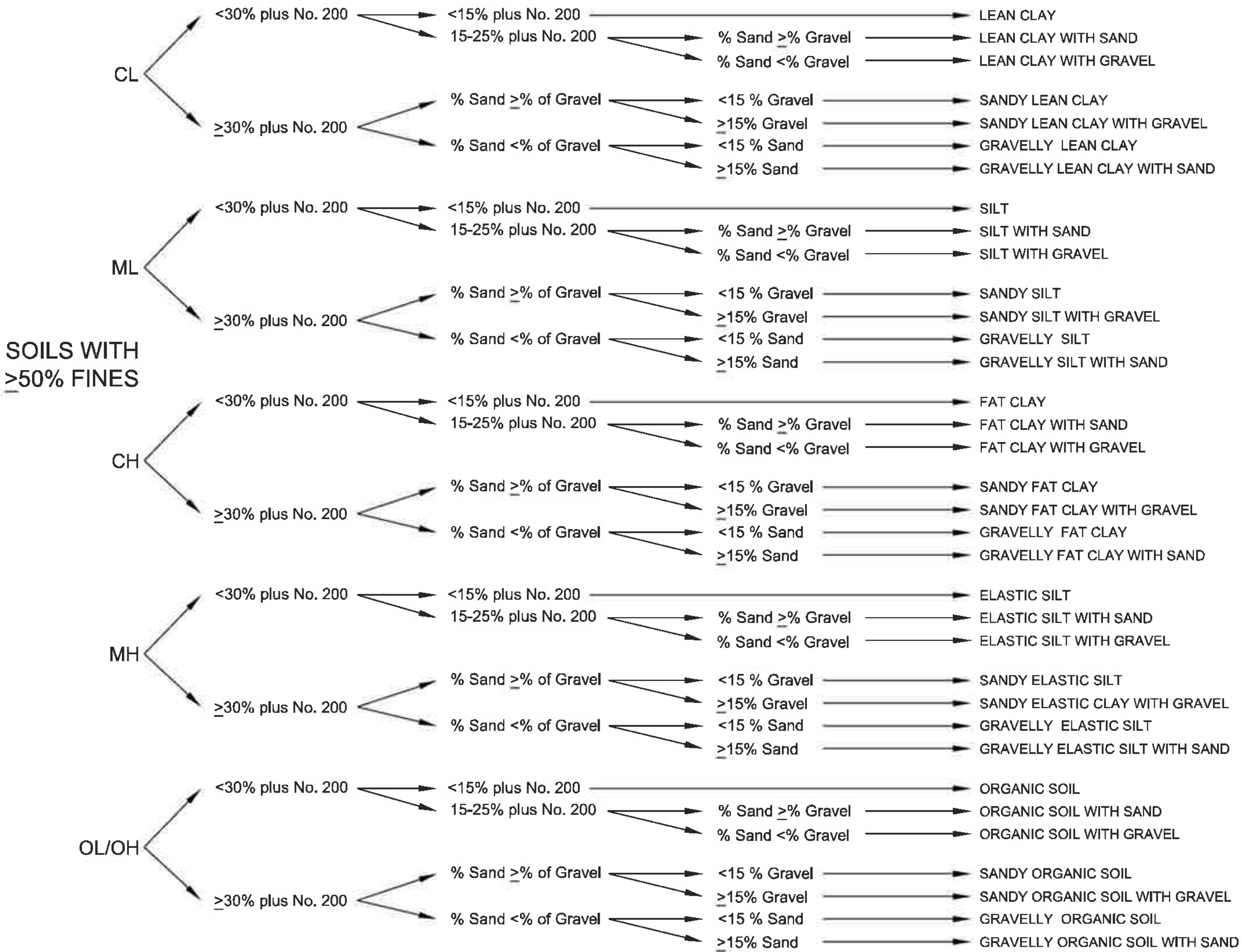
Attachment A – GEI Soil Description Charts (2007)
Attachment B – Visual Manual Descriptions with example boring log
Attachment C – Describing the Plasticity of Soil Samples

6. Contacts

Lynn Willey
Cathy Johnson

GEI Consultants

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

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

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

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

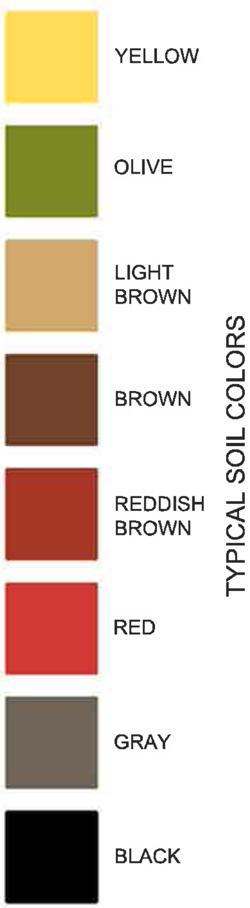
CRITERIA FOR DESCRIBING PLASTICITY

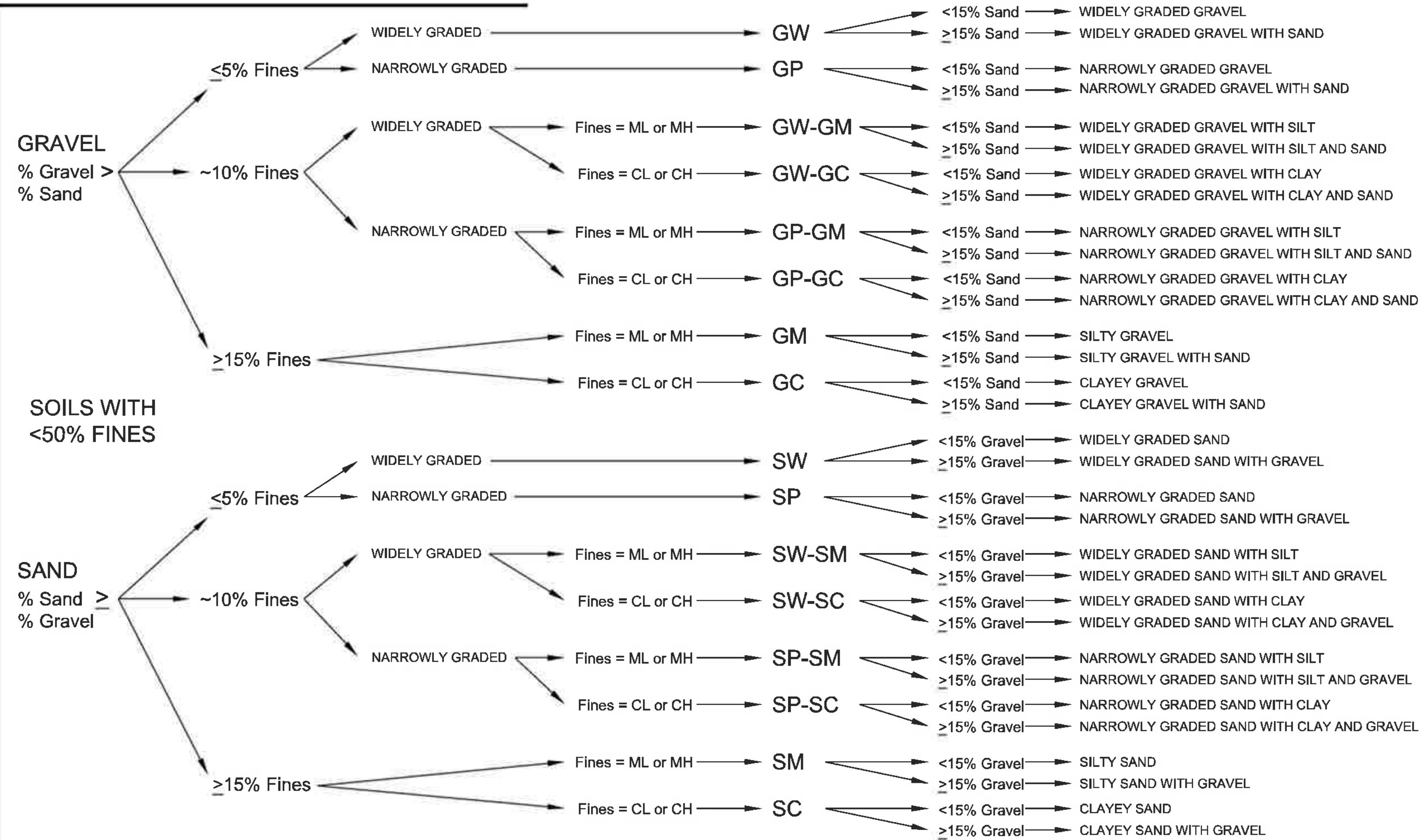
Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to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

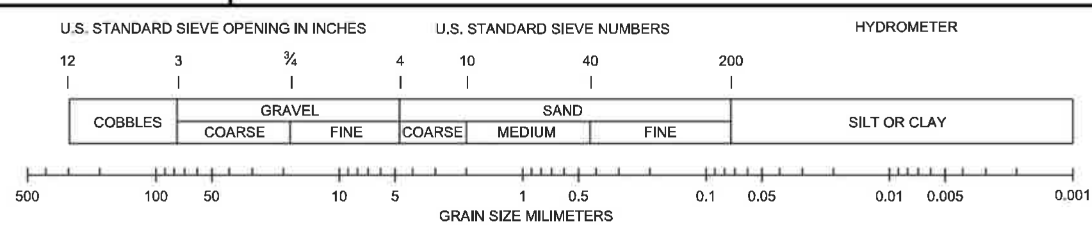
* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

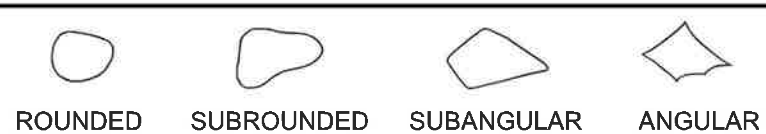
COARSE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS









1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

Describing the Plasticity of Soil Samples
M. Paster – November 2008

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

GEI Practice for Boring and Test Pit Logs

Describe the fines as:

Non-plastic
Low plasticity (The GEI laminated sheets incorrectly use "slightly plastic" for "low plasticity.")
Medium plasticity
High plasticity

Example: ~25% low plasticity fines

Toughness and dry strength:

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

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

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

For example, the end of a silty sand description might be:
. . . ~25% fines, ~10% gravel max size ½ inch, gray. PL=23, LL=35.

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

Hints:

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

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

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

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

Non-plastic vs. low plasticity:

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

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

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

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

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

BORING LOCATION Maple Ave Sidewalk

GROUND ELEVATION (NGVD)

GROUNDWATER EL. DATE

DATE START/FINISH 2/14/07 - 2/15/07

DRILLED BY Geologic: M. Costigan

LOGGED BY T. Kahl/M. Yako TOTAL DEPTH (FT) 25

B101

PG. 1 OF 1

EL. FT.	DEPTH FT.	SAMPLE TYPE and NO.	BLOWS PER 6 IN.	PEN IN.	REC IN.	PID JAR HS / REMARKS	GRAPHIC LOG	SOIL AND ROCK DESCRIPTIONS
							FILL	4" pavement
		S1	13-9 17-14	24	0	0.5 ppm	FILL	S1: Redrove 0.5 to 3.5 ft. Recovery 11": WIDELY GRADED SAND (SW) ~85% sand, ~10% gravel to 1", <5% nonplastic fines, brown. Contains brick fragments and ash. Fill.
	2.5					hard drilling 3 to 4 ft, possible boulder	FILL	
	5	S2	7-7 11-13	24	8	2.0 ppm	FILL	S2: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) ~65% mostly fine sand, ~25% gravel to 3/4 inch ~10% non-plastic fines, brown. Fill.
	7.5	S3	9-10 2-1	24	16	0.0 ppm	FILL	S3 (0-10"): Similar to S2.
	10						ORGANICS	S3 (10"-16")": ORGANIC SILT (OL) ~100% slightly plastic fines, dark gray, organic odor, contains white shell fragments.
	12.5	S4	WOH 1-2 1	24	15	0.0 ppm	ORGANICS	
	15					hard drilling at 15.5 ft	ORGANICS	S4: Similar to S3, bot 6".
	17.5	S5	20-35 50/3"	15	8	Top of rock ~19 ft. Roller bit to 20 ft.	TILL	S5: SILTY SAND WITH GRAVEL (SM) ~60% mostly fine sand, ~25% slightly plastic fines, ~15% gravel to 1/2 inch, olive. Glacial Till.
	20						ROCK	C1: SCHIST, hard, slight weathering at joint surfaces, joints at ~30 degrees from horizontal and generally parallel to foliation, gray. Marlborough Formation.
	22.5	C1	RQD 70%	60	54	lost ~10 gallons drill fluid from 23 to 25 ft	ROCK	
	25							Bottom of Boring 25 ft Truck-mounted drill rig. 4-inch casing to 19 ft. Safety-hammer with rope and cathead for SPT. Backfilled with drill cuttings.
	27.5							
	30							

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

NOTES:
1: Groundwater at 10 ft depth at start of day 2/15/07.

PROJECT 07999-0

DATE

GEI Consultants

EXAMPLE SOIL DESCRIPTIONS

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

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

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

EXAMPLE ROCK DESCRIPTIONS

(0-9"): GRANITE, hard, one piece, joint surface slightly weathered, pink.
(6-60"): PHYLLITE, joints ~ 45° generally parallel to foliation, 9" to 44" moderate to severe jointing and joint weathering. 44" to 60" single piece, green-gray.

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

GEOPROBE AND ROTOSONIC

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

CRITERIA FOR DESCRIBING DILATANCY OF FINE-GRAINED SOILS

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

SPT: Standard Penetration Test

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

ENV'L TERMINOLOGY FOR SOIL DESCRIPTIONS

- **Ash -** Typically silt-size to medium sand-size.
- Do not use the term "cinders." This is not a technical term. Instead, use "ash," "burnt wood," "burnt material," or a similar term.
- **Coal-like material** - If it looks like coal but you aren't sure.
- **Clinker** - Vitrified (glass-like) or heat-fused material. Often burned impurities in coal. Often looks like pumice, but heavier.
- **Slag** - Similar to clinker, but normally refers to residue from metal ore processing.

- **Sheen -** Iridescent petroleum-like sheen. Not to be used for a "bacterial sheen," which can be distinguished by its tendency to break up on the water surface at angles. Petroleum sheen will be continuous and will not break up.
- **Stained -** Use with a color ("brown-stained") to indicate that the soil is stained a color other than its natural (unimpacted) color.
- **Coated -** Soil grains are coated with NAPL (oil, tar, etc.). There is not enough NAPL to saturate the pore spaces. ("Split spoon sampler coated with brown oil." "Soil grains coated with gray substance with slight gasoline-like odor.")
- **Saturated -** The entire sample pore space is saturated with NAPL. If you use this term, be sure it is not water saturating the pore spaces. Depending on viscosity, the NAPL may drain from a soil sample. ("Sample saturated with green, sticky substance.")
- **Blebs -** Discrete sphericals of NAPL in a soil matrix that was not visibly coated or saturated. ("Occasional blebs of reddish-brown tar.")
- **Oil -** Exhibits a petroleum odor, different from MGP odors.
- **Tar -** Exhibits an MGP odor (e.g. naphthalene-like odor).

- **Odors -** Use terms such as "naphthalene-like odor" or "petroleum-like odor." Use modifiers (strong, moderate, slight) to indicate odor intensity.

STANDARD OPERATING PROCEDURE
SM-004 Test Pit Excavation

1. Objective

Describe methods for excavating test pits and documenting findings.

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

2. Execution

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

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

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

3. Limitations

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

4. References

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

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

5. Contacts

Douglas Bonoff
Mark Ensign

STANDARD OPERATING PROCEDURE

SM-005 Underground Storage Tank (UST) Removal and Closure Process

1. Objective

Describe a standardized approach for observing Underground Storage Tank (UST) removals and methods to manage environmental issues that may be encountered.

Consult state regulations and the work plan to ensure proper closure procedures in addition to this standard operating procedure (SOP).

Prior to excavation confirm that utility clearance has been completed.

2. Execution

- Verify that all appropriate parties (contractors, owner, fire department, etc.) have been contacted and notified regarding the intended UST removal(s). Verify, with the contractor or owner, that all necessary permits have been obtained by the appropriate parties prior to tank removal.

- Prepare a site diagram/sketch detailing location of tank(s), structures, the location of any known fill and vent pipes, adjacent properties, buildings, utilities (where known), and any adjacent surface water(s). Record information in the field notebook (see SOP FD-001 Field Notebook).

- Record the removal contractor's activities in the field notebook.

- Confirm with the removal contractor that all liquids have been removed from the tank and associated piping.

- Confirm that exposed product lines are drained, disconnected, and capped with sorbent padding to catch any leakage.

- Confirm with the removal contractor that proper steps have been taken to inert remaining vapors in the UST.

- Request that any pavement or blacktop on top of the tank area is removed and segregated away from excavation and soil stockpile areas.

- Observe soil as it is being removed from excavation and perform soil screening (see SOP SC-004 Head Space Screening). If contaminated soil is observed notify the project manager and initiate soil segregation procedures (see SOP SM-004 Test Pit Excavation and the Work Plan).

- Once the tank is exposed, observe the tank, piping, and other tank features for corrosion, holes, etc. Photograph tank, piping, and excavation in accordance with SOP FD-004 Photodocumentation.

- If contaminated soil is excavated, it should be stockpiled on and covered with polyethylene sheeting. See the Work Plan for further detail on managing contaminated soils encountered during UST removal.

- If contaminated soil has been identified manage the impacted soil in accordance with the Work Plan and/or directions provided by the Project Manager. If appropriate, once the extent of contaminated soil has been defined (based on visual observation and headspace readings), collect sidewall and bottom samples for confirmatory analysis. Note the location, depth, and description of the samples in the field notebook.

- If groundwater is encountered, note any sheen or separate phase product observed on the surface of the groundwater table.

- A Tank Removal Checklist is in Attachment A. Consult state regulations and policies, and the Work Plan to ensure proper closure procedures. A list of applicable state regulations is provided n Section 4.

- Backfill excavation according to the Work Plan guidelines and/or applicable state requirements (clean backfill, excavated materials).

- If contaminated soil is excavated, it should be stockpiled on and covered with polyethylene sheeting. See the Work Plan for further detail on managing contaminated soils encountered during UST removal.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health & Safety Plan.
- Note that excavation does not undermine adjacent structures, footings, etc.
- Trucks pumping flammable liquids should always be properly grounded to eliminate any spark hazard.
- No GEI personnel may ever enter the UST.

- Contractors must have appropriate Health and Safety and confined space entry training.
- The Field Plan should specify the responsibilities of GEI, the client, and the contractor.

4. References

GEI Technical Manual, dated July, 1987.

Removal and Disposal of Used Underground Storage Tanks, API.

Commonwealth of Massachusetts Underground Storage Tank Closure Assessment Manual,(1996) Massachusetts Department of Environmental Protection Policy # WSC-402-96.

Sampling and Analytical Methods for Underground Storage Tank Closure State of Connecticut Department of Environmental Protection, update December 7, 2006.

Recommended Practice 1604 (1987), American Petroleum Institute, Washington, D.C.

Tanks and Containers (1989), Massachusetts Board of Fire Prevention, 527 CMR 9.00.

Management Procedures for Excavated Soils Contaminated With Virgin Petroleum Oils (1989), Massachusetts DEP BWSC, Policy #WSC-400-89.

State of Vermont Guidelines for Performing a Site Assessment at Petroleum UST Closure Sites (undated).

5. Attachment

Attachment A - GEI Tank Removal Checklist

6. Contact

Brian Conte
Bill Simons

GEI

TANK REMOVAL CHECKLIST (SM-005)

GENERAL INFORMATION

Facility Name and Address ______

Removal Date ______

Weather Conditions ______

Removal Contractor ______

PERMIT INFORMATION

Fire Department Identification No. (FDID) ______

Permit No. ______ Dig Safe No. ______

Date of Issuance ______

Tank Contents ______

Tank Hauler Name and Address ______

______

Tank Disposal Facility Name and Address ______

______

Approved Disposal Facility No. ______

ON-SITE PERSONNEL

GEI ______

State/Local ______

Contactor ______

______

______

Other ______

TANK INFORMATION

Age of Tank ______ Size (Capacity) ______

Dimensions ______ Material ______

Construction ______ Coatings ______

Interstial Monitoring ______ Cathodic Protection ______

PIPING

Supply and Return Line Material

Secondary Containment Material

Vent Line Material

Removed from Excavation (if no why?)

ANTI-FLOTATION DEVICE

Hold Down Straps (type and material)

Concrete Pad or Deadman Anchors

TANK REMOVAL

Time **Tank Disposal Receipt No.**

Removal Method and Equipment

Condition of Tank

Condition of Piping

Cleaning Procedure T

O_2/LEL Reading

Items Abandoned in Place and Why?

MANIFEST INFORMATION

Amount of Sludge and Waste Removed

State Manifest and Document No.

EXCAVATION INFORMATION

Dimensions

Free Product/Staining on Soils and Locations (if any)

Suspected Source of Release

Odor (location and description)

Description of Soils Stockpiled

Estimated Volume (yd^3)

Side Wall Geologic Composition/Adjacent Buildings

Was Shoring of the Excavation Necessary?

Description of Desired/Required Restoration to be Performed

GROUNDWATER INFORMATION

Presence of Groundwater

Depth from Surface	**Odor**
Sheen/Oil on Water	**Dewatering Necessary**

Sample Name and Location

SOIL ANALYSIS

Equipment Used for Field Screening (make/model/GEI No.)

Field/Office Calibration Performed		**Date**
Calibrant	**Reading**	**Span**

CONFIRMATORY SAMPLES **SEE SKETCH:**

Sample No.	**Sample Location***	**Headspace**
Sample No.	**Sample Location***	**Headspace**
Sample No.	**Sample Location***	**Headspace**
Sample No.	**Sample Location***	**Headspace**
Sample No.	**Sample Location***	**Headspace**
Sample No.	**Sample Location***	**Headspace**
Sample No. **(*=N,S,E,W, Sidewall, Bottom)**	**Sample Location** **(soil stockpile)**	**Headspace**

SAMPLE INFORMATION

Laboratory Name and Address NA

Date Submitted **No. of Samples**

Composite Sample Locations

Analysis

General Soil Description

Dry/Wet **Odor**

Staining/Color

SITE SKETCH

Include tank location, excavation location, sample locations, buildings, streets, north arrow, and any schools, supply wells, or sensitive environmental receptors within 500 feet of tank location (and any sensitive environmental receptors).

Attached Site Plan (depicting location of tank(s), streets, etc.)

Pictures Attached and Labeled

Report Prepared by **Date**

STANDARD OPERATING PROCEDURE

SM-006 – Rock Core Logging

1. Objective

Describe bedrock coring procedures and rock core logging.

2. Execution

2.1 Rock Coring and Logging

Prior to beginning drilling activities, complete the header of the boring log to the extent possible. Record the names of the driller and assistant and the types of drilling equipment used for each boring/rock core.

Use double- or triple-tube, swivel-type, split-inner-barrel or solid-inner-barrel core barrels that provide a minimum rock core diameter of 1.75 inches. Wireline equipment is acceptable. Consider whether borehole geophysics may be necessary for bedrock characterization. If so, ensure that the outer diameter of coring tools leaves an adequate diameter bedrock hole to accommodate geophysical tools.

The first core run in each boring should be no longer than 5 feet to help assure optimal recovery. Individual core runs may be increased to as much as 10 feet depending on the recovery and quality of the cored rock, and the difficulty in advancing the core barrel.

If coring progress indicates that a weak or soil-filled zone has been encountered, pull the core barrel and attempt to obtain a split spoon sample in accordance with GEI soil sampling procedure.

Stop coring and pull the core barrel if the barrel appears to be jammed or the normal flow of drill fluid is blocked.

Pack and label cores in boxes in accordance with GEI procedure for Packing and Labeling of Rock Cores.

Measurements of the lengths of drilling tools and core barrels should be made to the nearest 1 inch or 0.10 feet or less. Measurements or calculations of the depth of the borehole and depth of coring intervals should be made to the nearest one foot or less. Measurements of the length of individual core runs and the length of rock core recovered should be made to the nearest 1 inch or 0.1 feet or less.

For each boring, record on the boring log the following:

- Type and size of core barrel used.
- Type and size of casing used through soil.
- Type of drill fluid used if other than plain water.

During coring, record the following information on the log, as applicable.

- Time, in minutes, to advance the core each foot.
- Depth intervals over which some or all drill fluid does not return to the ground surface.
- Observations of unusually hard coring.
- Observations of unusually easy coring, rod drops, possible cavities, etc.

For each core run, record on the field log, as a minimum, the following:

- Core run number (C1, C2, etc.)
- Depth to top of core run
- Length of core run
- Length of rock recovered
- RQD, %. (RQD is the rock quality designation, and is equal to the total length of intact pieces of rock core longer than 4 inches divided by the core barrel penetration)
- Description of rock, including, as appropriate, approximate joint angles, presence of soil filled seams or cavities, color

Complete the log concurrently with drilling procedures (i.e., do not let the driller work faster than your ability to accurately represent the subsurface conditions).

In the appropriate column, record all observations with regard to environmental conditions, including staining, odors, foreign material, and presence of free product.

Information regarding rock coring procedures, including the length of the core run, recovered core length, rock quality designation, and fracture zones should be recorded on the rock core log. Provide rock descriptions, including rock type, hardness, grain size, structure, weathering, and color. Rock core logs should be completed for each core run.

Record relevant drilling observations such as advance rate (minutes per foot), water levels, drilling difficulties, changes in drilling method or equipment, amounts and types of any drilling fluids, running sands, and borehole stability.

Record the procedures and material used to abandon or seal each borehole upon completion. If the borehole is completed as a monitoring well, record the well construction details in accordance with SOP DM-007 Monitoring Well Construction and Installation.

Using the guidance in Attachment A, rock core logs should address:

- Rock Type: Igneous, metamorphic or sedimentary. Consult previous geologic maps published by USGS or State Geological Survey for formation name and general description.
- Rock Color: Use standard color wording; a color chart may be consulted (e.g. Munsell Color Chart).
- Field Hardness: Hard, medium, or soft based on scratch test with steel blade or nail.
- Bedding in Sedimentary Rock: Describe bedding presence, orientation, and type.
- Foliation in Metamorphic Rock: Describe foliation presence, orientation, and type.
- Grain Size Characteristics and Distribution : grain size. Sorting and angularity for sedimentary rocks.
- Weathering: General weathered state of the rock, differentiated from weathering on fractures. In particular, weathering or physical or chemical alteration which may be relevant to shearing or faulting should be thoroughly described.
- Fracturing: Fracture type, as applicable, and fracture surface character. In particular, fractures with features possibly relevant to shearing or faulting should be thoroughly described.
- Special Features: include fossils, marker bed features, vugs, unusual weathering features.
- RQD: as described in Attachments B and C.
- Bedrock Formation Name: As identifiable from geologic literature.
- Depths or depth ranges of any distinctive features should be specified on the log.

2.2 Rock Quality Designation (RQD)

In general, RQD is a modified core recovery percentage in which all the pieces of core which are over 4.0 in. long, are hard and sound, and are counted as recovery and expressed as a percent of the length of core drilled. Since RQD is an interpretive measure of rock quality, there are several factors, such as those listed below, which must be properly evaluated in order for RQD to provide reliable results.

Core Barrel size and Type: RQD is most frequently calculated for N size core or larger, obtained with double-tube core barrels. Smaller diameter cores and single-tube core barrels can reduce apparent rock core quality. RQD should not be calculated for core barrels smaller than N size (1.875 in. diameter). Size and type of core barrels and bits should always be recorded on core boring logs.

Soundness: Pieces of rock core that are not hard and sound should not be counted for the RQD, even if they meet the 4 in. length requirement.

Rock judged to be fresh or slightly weathered is to be included in the RQD count; moderately weathered rock is to be included also, but completely weathered and residual soil is to be disregarded in the RQD count.

Core Recovery: Reliable RQD measurements result when coring is done well and core recovery is at or near 100 percent. As core recovery varies from 100 percent, explanatory notes should be included in order to describe the reason for the variation and the effect on RQD.

Calculating RQD for Portion of Run: RQD is most frequently determined per core run. If the core runs vary greatly in length, RQD can also vary without significant changes in core quality. For instance, if 6.0 in. of poor rock is recovered in a 2.0 ft. core run, the RQD would be 75 percent. If the core run was extended to 5 ft. without encountering additional poor rock, the RQD would be 90 percent. In general, RQD should be based on consistent 5-ft. or 10-ft. long core runs as the Project Manager requests.

Discontinuities: Only natural discontinuities such as joints or shears should be considered when calculating RQD. Breaks in the core which are judged to be due to drilling and handling must be discounted in RQD considerations. Natural discontinuities, nearly parallel to the boring (e.g., vertical joints in a vertical boring) are not counted, if the rock is otherwise good.

3. Limitations

- A separate Field Observation Report should be completed after each day of drilling (see SOP FD-002 Field Observation Report), if requested by the Project Manager.

- Keep boring logs and rock core logs focused on actual observations. Record only factual information on the logs.
- The boring logs should be returned to GEI from the field in a legible form that can be used in a report directly or allow for typed logs in the same format if required for specific projects.

4. References

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ASTM D2113-08, Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation, 2008

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Hunt, R.E., Geotechnical Engineering Investigation Handbook, Second Edition, Taylor & Francis Group, LLC, 2005.

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Walker, J. D. and Cohen, H.A., The Geoscience Handbook, AGI Data Sheets, Fourth Edition, 2006.

5. Attachments

Attachment A – Guidelines for Rock Description
Attachment B – Guidance for Computation of Rock Quality Designation Soil and Rock Core Log
Attachment C – ASTM D6032-08 Standard Test Method For Determining Rock Quality Designation (RQD) of Rock Core

6. Contact

Melissa Felter
Cathy Johnson

ROCK CLASSIFICATION

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ROCK DESCRIPTION FORMAT	DESCRIPTIVE TERMS		STANDARD DEFINITION
ROCK TYPE	Refer to Quarterly of the Colorado School of Mines, Volume 50, Number 1		
HARDNESS	VERY HARD		Can not be scratched with knife or sharp pick; breaking of hand specimens requires several hard blows of a geologist's hammer.
	HARD		Can be scratched with knife or pick only with difficulty; hard blow(s) of hammer required to break hand specimen
	MEDIUM HARD		Can be scratched with knife or pick up to 1/16 in. deep; hand specimens can be broken with moderate blow with hammer.
	SOFT		Can be readiy gouged or grooved with knife or geologist's pick; can be excavated in chips to pieces several inches in size by moderate blows of a pick point; small thin piece can be broken by finger pressure.
	VERY SOFT		Can be carved with knife; can be excavated readily with point of pick; pieces one inch or more in thickness can be broken by finger pressure; can be readily scratched by finger nail.
GRAIN SIZE AND RANGE	IGNEOUS	FINE-GRAINED	Less than 1 mm (f-med sand range)
	METAMORHIC	MEDIUM-GRAINE	1mm to 5mm (med-coarse sand range)
	CRYSTALLINE SED.	COARSE-GRAIN	5mm and greater (fine gravel and larger)
	SEDIMENTARY		Use soil grain size
WEATHERING	FRESH OR UNWEATHERED		Rock fresh, crytals bright, few joints may show staining. Rock rings under hammer if crystalline.
	SLIGHTLY WEATHERED		Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in.(in outcrops). Joints may contain clay. In granitoid rocks, some occ. feldspar crysta are dull and discolored; crystalline rocks ring if struck with hammer.
	MODERATELY WEATHERED		Except for quartz, most of the rock mass shows discoloration and weathering effects; Rock has a dull sound under hammer and shows significant loss of strength as compared with fresh rock.
	SEVERELY WEATHERED		All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. Some fragments of stronger rock are usually left.
	COMPLETELY WEATHERED		Rock is decomposed to a soil. Rock fabric may not be descernible except in scattered locations. Quartz may be present as dikes or stringers.
DISCONTINUITIES (Nature, thickness, and spacing of rock mass defects)	JOINTS		Describe type, openness, spacing, dip angle, weathering
	SPACING		
	VERY CLOSE		Less than 2 inches
	CLOSE		2 inches to1 foot
	MODERATELY CLOSE		1 to 3 feet
	WIDE		3 to 10 feet
	VERY WIDE		Greater than 10 eet
	OTHER COMMON DISCONTINUITIES		
	SHEAR ZONES		
	WEATHERED ZONES		
	INFILLINGS		
	SLICKENSIDES		
	HYDROTHERMAL ALTERATION		
	CAVITIES,VOIDS, VESCICLES		
OTHER	FIELD STRENGH OR HARDNESS TESTS		Schmidt Hammer Tests; Point Load Tests
	ENGINEERING COMMENTS		
	MINERALOGICAL COMPOSITION		
	REACTION TO HCl		
	ROCK QUALITY DESIGNATION		
	ROCK MASS RATING		
STANDARD DEFINITIONS	ROCK QUALITY DESIGNATION (RQD)		RQD is the ratio of the cumulative length of pieces of sou core 4 inches or longer to the total penetration length of the core run. If the core is broken by handling or drilling, (i.e., the fracture surfaces are fresh and/or irregular rather than natural joint surfaces), the broken pieces are fitted together and counted as one piece provide they forn the requisite length of 4 inches.

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ROCK DESCRIPTION FORMAT	DESCRIPTIVE TERMS (See opposite side for definitions)	EXAMPLE DESCRIPTIONS		
		IGNEOUS	SEDIMENTARY	METAMORPHIC
1.ROCK TYPE (CAPITAL LETTERS) (Include definitive adjectives)	(See opposite side)	VESICULAR BASALT	CALCAREOUS SANDSTONE	BIOTITE SCHIST
2.HARDNESS	VERY HARD HARD MEDIUM HARD SOFT VERY SOFT	V. HARD	HARD	MEDIUM HARD TO SOFT
3.GRAIN SIZE AND RANGE (texture, fabric, angularity)	IGNEOUS - FINE, MED.,COARSE SEDIMENTARY - USE SOIL GRAIN SIZE (describe angularity of sedimentary particles)	APHANITIC	FINE GRAINED	FINE TO MED. GRAINED
4. STRUCTURE	FOLIATED STRATIFIED OR BEDDED SCHISTOSE MASSIVE LENSED BANDING LINEATION MICROFOLDING	MASSIVE	ALTERNATING 1 TO 2" THICK LAMINA OF FINE GRAINED, QUARZITIC SANDSTONE AND SANDY SILTSTONE. BEDDING DIPS UNIFORMLY AT 20-25 DEGREES.	WELL DEVELOPED SCHISTOSE TEXTURE; FOLIATION DIPS 25-30 DEGREES.
5.WEATHERING	FRESH OR UNWEATHERED SLIGHTLY WEATHERED MODERATELY WEATHERED SEVERELY WEATHERED COMPLETELY WEATHERED	FRESH	SL. WEATHERED THROUGHOUT.	MOD. WEATHERED CONTAINING 1-2" THICK SEVERELY WEATHERED ZONES
6. DISCONTINUITIES (Nature, thickness, and spacing of rock mass defects)	JOINTS (type,openess,spacing,weathering) SHEAR ZONES INFILLINGS WEATHERED ZONES SLICKENSIDES CAVITIES,VOIDS HYDROTHERMAL ALTERATION	GENERALLY INTACT WITH OCC. RANDOMLY ORIENTED, ROUGH, IRREGULAR JOINTS. SEVERAL SMALL 1/16-1/8" VESCICLES.	MOST JOINTS OCCUR AS SMOOTH, TIGHT, PLANAR, SURFACES ALONG BEDDING AT 2-14" SPACING,DIPPING 20-25 DEGREES. MINOR RUSTY WEATHERING EFFECTS ON JOINT SURFACES.	NUMEROUS OPEN, PLANAR JOINTS ALONG BIOTITE CONCENTATIONS; SPACED 1-3" APART. 1/2 -1" THICK ZONES ABOVE AND BELOW JOINTS WEATHERED TO OR NEARLY TO A SOIL (Silty Sand).
7. COLOR AND RANGE	*******	BLACK	ALTERNATING BROWN AND REDDISH-BROWN LAYERS	GRAY-moderately weathered YELLOW BROWN- severely weathered
8. LOCAL OR GEOLOGIC NAME	(Refer to geologic maps and reports)	HAMPDEN FORMATION	TRIASSIC RED BEDS	HARTLAND FORMATION
9.OTHER	FIELD STRENGH OR HARDNESS TESTS ENGINEERING COMMENTS MINERALOGICAL COMPOSITION REACTION TO HCl ROCK QUALITY DESIGNATION ROCK MASS RATING	RQD = 88%	SL. REACTION TO HCl	SCHMIDT HAMMER REB. NO. = 14

Sample ID	Rock Name	Rock Type	Formation	Location	Distinguishing Features
1	Gneiss	Metamorphic	Unknown	Farmington, NH	compositional layering (alternating light and dark mineral bands), alignment of platy minerals such as mica (muscovite=white, biotite=black), looks like banded granite.
2	Amphibolite	Metamorphic	Marlboro Fm.	Danvers, MA	describes a wide range of metamorphic grades, often have a lot of hornblende and plagioclase, can be dark green in color
3	Mylonite-Phyllonite	Metamorphic	Unknown	Blue Ridge Mts.	phyllite is similar to slate, but has silky rather than dull cleavage surfaces, mylonite-phyllonite is a ductily sheared phyllite look for "smeared" grains in a dark background, often occurs in shear zones
4	Basal Glacial Till	Sedimentary	Unnamed	Prompton, PA	laid down by base of the glacier (a kind of lodgment till vs. ablation till which often implies deposition by melt water), when unlithified-very dense (high blow counts), fabric (slight alignment of grains) with subangular pebbles/cobbles
5	Calc-Silicate	Metamorphic	Patridge Formation	Oakham, MA	metamorphic carbonate with abundant Si, looks like marble, but with more quartz, more defined crystals, low grades can see foliation and bedding, higher grades=more massive crystals
6	Biotite Schist	Metamorphic	Fm. Unknown	Philadelphia, PA	Biotite is black mica, look for alignment of mineral grains in schists, but not necessarily in alt. light or dark layers like gneiss
7	Gray Granite	Igneous	Conway Granite	Conway, NH	interlocking coarse grains/crystals, approximately equal amounts of light and dark minerals, "salt and pepper"

Sample ID	Rock Name	Rock Type	Formation	Location	Distinguishing Features
8	Pink Granite	Igneous	Unnamed Formatio	Burlington, MA	"pink" = K-feldspar, vs. gray granite dominated by white/gray feldspar =plagioclase
9	Pegmatitic Granite	Igneous	Binary Granite	Farmington, NH	grains in excess of 1 cm, interlocking grains, looks like a coarse grained granite
10	Diorite	Igneous	Salem Gabbro-Dior	Woburn, MA	think darker granite, or higher percentage of darker minerals to lighter minerals, coarse grains, more pepper than salt
11	Basalt	Igneous	Dike Rock	Nashua, NH	fine-grained, no foliation or bedding (linear features), denser than sedimentary rocks, often found in dikes
12	Granodiorite	Igneous	Ayer granodiorite	N. Chelmsford, MA	interlocking coarse grains/crystals, larger percentage of lighter grains to darker grains in rock, more salt than pepper
13	Red Shale	Sedimentary	New Haven Arkose	Hartford, CT	pink or red sometimes from K feldspars, very fine grained, bedding sometimes, not esp. dense
14	Argillite	Metamorphic	Cambridge Argillite	South Boston	Slightly metamorphosed mud or siltstone, intermediate between a shale and a slate
15	Conglomerate	Sedimentary	Roxbury Conglome	Newton, MA	clastic instead of interlocking grains (this particular example is slightly metamorphic so it is hard to see the difference between clastic and interlocking or crystalline), large grains in a fine grained matrix
16	Quartzite	Metamorphic	Kittery Formation	Portsmouth, NH	dense, looks like quartz, but generally not as glassy, sometimes semi-concoidal fracture (breaks in a circular pattern)
17	Basalt	Igneous	Unnamed Dike	Kittery, ME	fine-grained, no foliation or bedding (linear features), denser than sedimentary rocks, often found in dikes

Sample ID	Rock Name	Rock Type	Formation	Location	Distinguishing Features
18	Sandstone	Sedimentary	Fm. Unknown	North Carolina	clastic instead of interlocking grains, bedding, harder and denser than shale and limestone
19	Kaolinized Argillite	Metamorphic	Cambridge Argillite	Boston, MA	Kaolinite is a sheet silicate that occurs in clay sized fraction of rocks, soils, sedimentary rocks, and weathered and altered rocks, in this case it is a weathered metamorphic rock, looks like chalk, the term argillaceous refers to rock or sediment containing a significant amount of clay minerals
20	Quartzite	Metamorphic	Berwick Formation	Lowell, MA	dense, looks like quartz, but generally not as glassy, sometimes semi-concoidal fracture (breaks in a circular pattern)
21	Gneiss	Metamorphic	Unknown	Farmington, NH	compositional layering (alternating light and dark mineral bands), alignment of platy minerals such as mica, looks like banded granite.
22	Granite Gneiss	Metamorphic	Collinsville Fm	Southbury, CT	compositional layering (alternating light and dark mineral bands), alignment of platy minerals such as mica, looks like banded granite.
23	Granite-Augen Gneiss	Metamorphic	Fm. Unnamed	Wareham, MA	blastomylonitic texture (smeared/sheared big crystals), larger grains in finer grained material, crystals are often alkali or plagioclase feldspar (light crystal grains in dark background), augen means "eye" in German
24	Muscovite Schist	Metamorphic	Hartland Fm.	Southbury, CT	Muscovite alignment
25	Rhyolite	Igneous	Lynn Volcanics	Lynn, MA	fine-grained, interlocking crystalline texture, often pink or purple, fine grained equivalent of granite

Sample ID	Rock Name	Rock Type	Formation	Location	Distinguishing Features
26	Melaphyre	Igneous	Brighton Melaphyre	Brighton, MA	dark porphyry with feldspar crystals (big light colored crystals in dark matrix), sometimes has funky purple and green hue to it
27	Limestone	Sedimentary	Trenton Group	Hinckley, NY	soft, reacts with HCl, fossils sometimes
28	Black Shale	Sedimentary	Rhode Island Fm.	Brayton Point, RI	less dense than basalt, clastic, bedding sometimes, fossils sometimes
29	Red Shale	Sedimentary	Portland Fm	Holyoke, MA	pink or red sometimes from K feldspars, very fine grained, bedding sometimes, not esp. dense
30	Anthracite Coal, Organic Shale	Sedimentary	Rhode Island Fm.	Brayton Point,RI	not dense, often black, slightly shiny, looks like graphite

Attachment B

Guidance for Computation of Rock Quality Designation

The RQD is equal to the ratio expressed in per cent of the cumulative length of pieces of sound core 4 inches or longer to the total length of the core run.

1. If the core is broken by handling or by the drilling process (i.e., the fracture surfaces are fresh irregular breaks rather than natural joint surfaces), the fresh broken pieces are fitted together and counted as one piece provided that they form the requisite length of 4 inches.

2. Measure all pieces of cores longer than 4 in. except in cases of rock with vertical or near-vertical foliation which splits the rock into two halves, where the RQD measurements shall be 50% of the length of such pieces.

3. Always measure from the center of the high or low angle foliation.

4. The method of measurements in the case of very few pieces of a run smaller than 4" is to try to measure fully the length of rock in each compartment of the box and then deduct from it the total length of the pieces smaller than 4" to obtain the cumulative length of sound core. Conversely, if there are very few pieces of the core longer than 4" in any run, just measure those and add to obtain the cumulative length of sound core.

Boring Information

Northing : 1,282,273 **Easting :** 544,173
Horizontal Datum : NAD27 NY Central Zone
Ground Surface Elev. (ft): 256
Vertical Datum : NGVD29
Rig Type/I.D: Dietrich / BL2

Date Start - End: 8/21/2007 - 8/30/2007
Driller Name: Paul Dickensen
Logged By : Chad Conti
Drilling Company : Boart Longyear
Total Depth (ft) : 195.0

Final Boring Log

Boring No.
B106(MW)

Drilling Information

Hammer Ident: SN I
Auger I.D: 4.25 inch
Auger Head Length: 6 inch
Casing I.D: 4 inch
Drill Rod O.D: 2.625 inch NW
Core Barrel Type: NQ2
Core Barrel I.D/O.D: 2 inch / 3 inch
Core Barrel Length: 13 ft
Drilling Method: 0-10.5 ft HSA, replace HSA with casing, 10.5 ft-195 ft coring (NQ2).

ABBREVIATIONS:

Blows per 6 in.: 140 lb hammer falling 30 inches to drive a 2 inch O.D. split spoon sampler.
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Length of Sound Cores>4 in / Pen.,%
HSA = Hollow-Stem Auger
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
NA, NM = Not Applicable, Not Measured
LL = Liquid Limit
PI = Plasticity Index
NV, NP = No value, Non-plastic

Elev. (ft)	Depth (ft)	Type	Sample No.	Rec./ Pen. (in)	Blows per 6 in. or RQD	Coring Time (min/ft)	Drilling Remarks and Engineering Geology Description of Rock Cores and Fractures	Fractures	Graphic Log	Soil-Sample Description Rock-Lithological Description
		S	S1	19/24	3-5-5-5	NA				S1: SILTY SAND (SM); ~65% sand, ~25% fines, ~10% fine gravel; non-plastic fines. Brown with streaks of light brown and yellow. TOPSOIL.
250		S	S2	24/24	1-3-4-5	NA				S2: (0-8") SILTY SAND (SM); ~65% sand, ~25% low plasticity fines, ~10% fine gravel. Brown with areas of rust colored oxidation. (8-24") SANDY LEAN CLAY (CL) 60% clayey fines (LL = 23, PI = 11), 31% mostly fine to medium sand, 9% fine gravel, gray with light brown, dark brown and reddish brown streaks. (Laboratory grain-size and Atterberg limit tests performed.) TOPSOIL. Approximate top of Oswego Sandstone at 8 ft.
	10									
		C	C1	46/54	60	3 3 3 3 3	Horizontal bedding-parallel fractures along siltstone beds.			C1: SANDSTONE WITH INTERBEDDED SILTSTONE, siltstone layers up to 3", fine-grained, planar fractures generally horizontal, some small cross-bedding in sandstone, fractures spaced 0.5-13", highly fractures zone of siltstone at 26-29.5".
240		C	C2	119/120	91	3 3 3 3 3 3 3 3 3 3	Crossbedding.			C2: SANDSTONE WITH INTERBEDDED SILTSTONE, predominantly sandstone with 5" layer of siltstone at 65" and uneven patches of siltstone throughout. Planar fractures spaced 1"-26", fine-grained, gray-green, hard sandstone, soft siltstone.
	20									
230		C	C3	121/120	98	3 3 3 4 3 3 3 3 3 3				C3: SANDSTONE WITH INTERBEDDED SILTSTONE, fractured zone of siltstone at 52-54", mottled segment 14-18", sandstone is gray-green, siltstone is gray. Planar fractures horizontal, 13-18" - zone of mottling (siltstone in sandstone).
	30									

Notes: Engineering geology description of rock cores and fractures by Stephen Potts.
Rock is hard, fresh, and unweathered unless otherwise noted.
Methane gas pocket at 130 ft.

Project Name: Nine Mile Point Site Characterization
City/State: Oswego, New York
GEI Project Number: 07223

DRAFT

GEI Consultants

Final Boring Log

Boring No.
B106(MW)

Ground Surface Elev. (ft): 256
Vertical Datum : NGVD29
Date Start / End: 8/21/2007 - 8/30/2007
Total Depth (ft) : 195.0

Elev. (ft)	Depth (ft)	Type	Sample No.	Rec./ Pen. (in)	Blows per 6 in. or RQD	Coring Time (min/ft)	Drilling Remarks and Engineering Geology Description of Rock Cores and Fractures	Fractures	Graphic Log	Soil-Sample Description Rock-Lithological Description
220	40		C4	120/120	97	3 3 3 3 3 4 3 3 3 3	Siltstone lenses in sandstone.			C4: SANDSTONE WITH INTERBEDDED SILTSTONE AND SHALE, planar fractures, some mottling at sandstone/siltstone contacts, sandstone is hard to medium (in areas of higher silt content), siltstone is soft. Gray-green, fine-grained sandstone; gray to dark gray siltstone, massive bedding in sandstone, fine lamination in siltstone.
210	50		C5	118/120	93	3 3 3 3 3 3 3 3 3 3				C5: SANDSTONE WITH INTERBEDDED SILTSTONE AND SHALE, mottling in top 10", core becomes predominantly siltstone and graywacke at 55" with mottling and possible storm event layers. 2 low angle fractures (~20° at 85"). Bottom 60" becomes siltstone with some shale. Top of Oswego Transition Zone at 55 ft.
200	60		C6	120/120	98	3 3 3 3 3 3 3 3 3 3	12-inch-thick shale layer. Cross-bedding.			C6: SILTSTONE WITH GRAYWACKE AND INTERBEDDED SHALE, top 5" silty shale bed. Possible marker bed. Hard to medium sandstones and graywackes, soft siltstone and shale, planar fractures spaced 3-24" and occurring at shale layers.
190	70		C7	121/120	95	3 3 3 3 3 4 4 4 4 4				C7: INTERBEDDED SANDSTONE, SHALE AND SILTSTONE, very disturbed layering with mottling and fossil layer of shell material/trace fossils. Thick sandstone bed at 97-113", otherwise all beds generally interbedded and <2". Sandstone is medium to hard, siltstone and shale are soft. Horizontal - low-angle planar fractures. Top of Pulaski Formation - Unit A at 71 ft.
180			C8	119/120	96	3 3 4 3	Bedding-parallel fractures.			C8: INTERBEDDED SANDSTONE AND SILTSTONE WITH SHALE (0-64") Mottling and trace fossils, predominantly siltstone. (64-119") Predominantly sandstone with siltstone and shale interbedded. Fractures planar and generally horizontal.

Notes: Engineering geology description of rock cores and fractures by Stephen Potts.
Rock is hard, fresh, and unweathered unless otherwise noted.
Methane gas pocket at 130 ft.

Project Name: Nine Mile Point Site Characterization
City/State: Oswego, New York
GEI Project Number: 07223

DRAFT

GEI Consultants

Ground Surface Elev. (ft): 256
Vertical Datum : NGVD29
Date Start / End: 8/21/2007 - 8/30/2007
Total Depth (ft) : 195.0

Elev. (ft)	Depth (ft)	Type	Sample No.	Rec./ Pen. (in)	Blows per 6 in. or RQD	Coring Time (min/ft)	Drilling Remarks and Engineering Geology Description of Rock Cores and Fractures	Fractures	Graphic Log	Soil-Sample Description Rock-Lithological Description
	80					3, 4, 4, 3, 3, 3	Well-lithified fossil shell debris.			
170	90		C9	119/120	95	4, 4, 4, 3, 4, 4, 4, 3, 3, 3				C9: Similar to C8. Fewer fossiliferous beds, interbedded sandstone, siltstone and shale throughout. Planar fractures, generally horizontal.
160	100		C10	121/120	99	3, 3, 3, 3, 4, 4, 3, 3, 3, 3	Mottled appearance due to clasts of siltstone and sandstone.			C10: ALTERNATING BEDS OF SANDSTONE AND SILTSTONE/SHALE, well-defined layers with mottling throughout, layers range from 2-12" thick, some fossils present, planar, horizontal fractures. Top of Pulaski Formation - Unit B at 102.5 ft.
150	110		C11	121/120	96	3, 3, 3, 3, 3, 3, 3, 3, 3, 3	Bedding-parallel fractures along siltstone and sandstone contacts. Quartz vug.			C11: Similar to C10, sandstone becomes predominantly at ~96", planar fractures horizontal, some trace fossils, mottling. Quartz vug at 45", may contain small amount of calcite.
140	120		C12	121/120	81	3, 3, 2, 2, 3, 3, 3, 3, 3	Laminated bedding in siltstone. Fractured intervals in shale, 2-3 inches thick. Sandstone clasts in siltstone.			C12: SANDSTONE WITH INTERBEDDED SILTSTONE AND SHALE from 0-61", siltstone with interbedded shale and sandstone from 61-121", planar fractures generally horizontal, highly fractured zones of shale at 9-11", 40-42", 73-74", 99-101". Top of Pulaski Formation - Unit C at 119.5 ft.

Notes: Engineering geology description of rock cores and fractures by Stephen Potts.
Rock is hard, fresh, and unweathered unless otherwise noted.
Methane gas pocket at 130 ft.

Project Name: Nine Mile Point Site Characterization
City/State: Oswego, New York
GEI Project Number: 07223

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NINE MILE POINT SITE CHARACTERIZATION 1 NMP GINT LOGS.GPJ GEI DATA TEMPLATE.GDT 3/6/08

Ground Surface Elev. (ft): 256	Date Start / End: 8/21/2007 - 8/30/2007	Final Boring Log
Vertical Datum : NGVD29	Total Depth (ft) : 195.0	Boring No. **B106(MW)**

Elev. (ft)	Depth (ft)	Type	Sample No.	Rec./Pen. (in)	Blows per 6 in. or RQD	Coring Time (min/ft)	Drilling Remarks and Engineering Geology Description of Rock Cores and Fractures	Fractures	Graphic Log	Soil-Sample Description Rock-Lithological Description
						3				
130	130		C13	110/120	82	3 3 3 3 3 3 4 4 4 3	Methane gas pocket at 130 ft. Water gushing out of casing, readings over 10% LEL. Circulating water brought LEL to safe levels.			C13: SILTSTONE AND SHALE WITH INTERBEDDED SANDSTONE, 20" sandstone bed at 69", planar fractures generally horizontal. One vertical fracture at 6" due to drilling.
120	140		C14	124/120	88	4 4 4 3 3 3 3 3 3 3	Fracture along moderately-dipping bedding plane.			C14: ALTERNATING BEDS OF SANDSTONE AND SILTSTONE/SHALE, beds are ~2-24" thick. Some irregular fractures, fractured zone at 99-103" and driller-created fracture zone at ~118". Fracture at 91" also shows irregular vertical fracture just below.
110	150		C15	121/120	87	3 3 3 4 4 4 3 3 3 3				C15: Similar to C14, planar fractures generally horizontal.
100	160		C16	121/120	100	3 3 3 3 3 3 4 4 4 4	Well-lithified fossil shell debris.			C16: INTERBEDDED SANDSTONE, SILTSTONE AND SHALE, predominantly sandstone, 51"-thick sandstone layer at 47", fossiliferous zones at 4" and 26", planar and horizontal fractures. Top of Whetstone Gulf Formation - Unit A at 165 ft.
90			C17	124/120	85	4 4 3				

Notes: Engineering geology description of rock cores and fractures by Stephen Potts.
Rock is hard, fresh, and unweathered unless otherwise noted.
Methane gas pocket at 130 ft.

Project Name: Nine Mile Point Site Characterization
City/State: Oswego, New York
GEI Project Number: 07223

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Form 150.2 rev. 1

NINE MILE POINT SITE CHARACTERIZATION 1 NMP GINT LOGS.GPJ GEI DATA TEMPLATE.GDT 3/6/08

Ground Surface Elev. (ft): 256	Date Start / End: 8/21/2007 - 8/30/2007	Final Boring Log
Vertical Datum : NGVD29	Total Depth (ft) : 195.0	Boring No. **B106(MW)**

Elev. (ft)	Depth (ft)	Sample Information: Type	Sample No.	Rec./ Pen. (in)	Blows per 6 in. or RQD	Coring Time (min/ft)	Drilling Remarks and Engineering Geology Description of Rock Cores and Fractures	Fractures	Graphic Log	Soil-Sample Description Rock-Lithological Description
	170					3 4 4 4 4 4 4	Slickensides on moderately-dipping fracture surfaces. Fractured interval - 1 ft thick. Bedding-parallel fractures.			C17: SILTSTONE WITH INTERBEDDED SHALE, predominantly siltstone with interbedded shale and very little interbedded sandstone, highly fractured zone at 15-27" with a fracture set of ~30°, other fractures are planar and horizontal, spaced 1-24", siltstone and shale are soft.
80	180		C18	121/120	92	5 5 5 5 5 5 5 5 5 5	Vertical fracture in sandstone. Each end of fracture terminated in siltstone. Calcite filled.			C18: INTERBEDDED SANDSTONE AND SILTSTONE, with shale layers, most fractures are planar and horizontal, 1 vertical fracture filled with calcite at 91-97".
70	190		C19	120/120	83	5 5 5 5 5 5 5 5 5 5				C19: INTERBEDDED SANDSTONE AND SILTSTONE WITH SHALE, siltstone and shale are dark gray, sandstone in gray. Fractures planar and generally horizontal, vertical fracture at bottom of core was driller-created.
60 50	200 210						General Comments about Core Samples: Not all sub-horizontal bedding-parallel fractures depicted in fractures column. Bedding-parallel fractures are most frequent in shale and siltstone and less common in sandstone. Vertical fractures occasionally present in sandstone beds. Hand pressure produces bedding-parallel fractures in siltstone of Pulaski Formation during handling and transport.			End of Boring at 195 feet. Groundwater Monitoring well installed upon completion (screen interval: 172 ft to 192 ft). See separate Groundwater Well Installation Log for details.

Notes: Engineering geology description of rock cores and fractures by Stephen Potts.
Rock is hard, fresh, and unweathered unless otherwise noted.
Methane gas pocket at 130 ft.

Project Name: Nine Mile Point Site Characterization
City/State: Oswego, New York
GEI Project Number: 07223

DRAFT

GEI Consultants

NINE MILE POINT SITE CHARACTERIZATION 1 NMP GINT LOGS.GPJ GEI DATA TEMPLATE.GDT 3/6/08

Ground Surface Elev. (ft): 256	Date Start / End: 8/21/2007 - 8/30/2007	**Final Boring Log**
Vertical Datum : NGVD29	Total Depth (ft) : 195.0	Boring No. **B106(MW)** Page 6 of 6

Elev. (ft)	Depth (ft)	Sample Information					Drilling Remarks and Engineering Geology Description of Rock Cores and Fractures	Fractures	Graphic Log	Soil-Sample Description Rock-Lithological Description
		Type	Sample No.	Rec./ Pen. (in)	Blows per 6 in. or RQD	Coring Time (min/ft)				
40							Rock is hard, fresh, and unweathered unless otherwise noted. Fracture surfaces are generally unweathered unless otherwise noted.			
	220									
30										
	230									
20										
	240									
10										
	250									
0										

Notes: Engineering geology description of rock cores and fractures by Stephen Potts.
Rock is hard, fresh, and unweathered unless otherwise noted.
Methane gas pocket at 130 ft.

Project Name: Nine Mile Point Site Characterization
City/State: Oswego, New York
GEI Project Number: 07223

DRAFT

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NINE MILE POINT SITE CHARACTERIZATION 1 NMP GINT LOGS.GPJ GEI DATA TEMPLATE.GDT 3/6/08

Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core[1]

This standard is issued under the fixed designation D 6032; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This test method covers the determination of the rock quality designation (RQD) as a standard parameter in drill core logging.

1.2 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D 6026.

1.2.1 The method used to specify how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in design or other uses, or both. How one applies the results obtained using this standard is beyond its scope.

1.3 The values stated in SI units are to be regarded as the standard. The values stated in inch-pound units are approximate.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 2113 Practice for Rock Core Drilling and Sampling of Rock for Site Investigation

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D 5079 Practices for Preserving and Transporting Rock Core Samples

D 6026 Practice for Using Significant Digits in Geotechnical Data

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 For terminology used in this test method, refer to Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *core run*—in the most basic usage, the length of the interval measured from the depth each core sample was started to the depth at which drilling stopped and the sample was recovered from the core barrel. If required, the core run can also be defined to cover a specific length or lithology in the core samples.

3.2.2 *drill break*—any mechanical or man-made break in the core that is not natural occurring.

3.2.3 *intact core*—any segment of core between two open, natural discontinuities.

3.2.4 *rock quality designation (RQD)*—a modified core recovery percentage in which all pieces of sound core over 100 mm are counted as recovery.

3.2.5 *sound core*—any core which is fresh to moderately weather and which has sufficient strength to resist hand breakage.

4. Summary of Test Method

4.1 The RQD denotes the percentage of intact and sound rock retrieved from a borehole of any orientation. All pieces of intact and sound rock core equal to or greater than 100 mm (4 in.) long are summed and divided by the total length of the core run, as shown in Fig. 1. Rock mechanics judgement may be necessary to determine if a piece of core qualifies as being intact and sound.

5. Significance and Use

5.1 The RQD was first introduced in the mid 1960's to provide a simple and inexpensive general indication of rock mass quality to predict tunneling conditions and support requirements. The recording of RQD has since become virtually standard practice in drill core logging for a wide variety of geotechnical investigations.

5.2 The RQD values provide a basis for making preliminary design decisions involving estimation of required depths of excavation for foundations of structures. The RQD values also can serve to identify potential problems related to bearing capacity, settlement, erosion, or sliding in rock foundations.

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

Current edition approved May 1, 2006. Published June 2006. Originally approved in 1996. Last previous edition approved in 2002 as D 6032–02.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard.**

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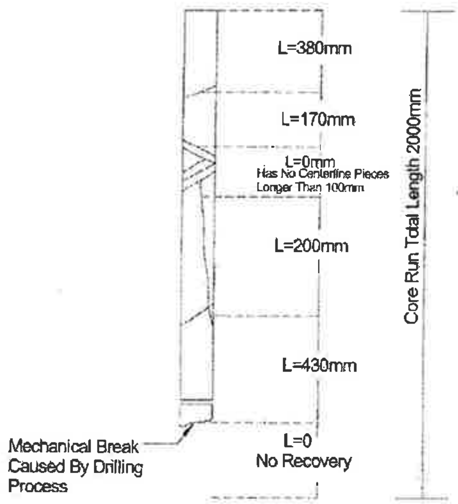

$$RQD = \frac{\Sigma \text{ Length Of Intact and Sound Core Pieces} > 100\text{mm}}{\text{Total Length Of Core Run, mm}} \times 100\%$$

$$RQD = \frac{380+170+200+430}{2000} \times 100\%$$

RQD = 59% (Fair)

RQD (Rock Quality Designation)	Classification of Rock Quality
0 -25 %	Very Poor
25 - 50 %	Poor
50 - 75 %	Fair
70 - 90 %	Good
90 -100%	Excellent

FIG. 1 RQD Logging Center Line Method[1]

The RQD can provide an indication of rock quality in quarries for concrete aggregate, rockfill, or large riprap.

5.3 The RQD has been widely used as a warning indicator of low-quality rock zones that may need greater scrutiny or require additional borings or other investigational work.

5.4 The RQD is a basic component of many rock mass classification systems for engineering purposes.

5.5 Used alone, RQD is not sufficient to provide an adequate description of rock mass quality. The RQD does not account for joint orientation, tightness, continuity, and gouge material. The RQD must be used in combination with other geological and geotechnical input.

5.6 The RQD is sensitive to the orientation of joint sets with respect to the orientation of the core. That is, a joint set parallel to the core axis will not intersect the core, unless the drill hole happens to run along the joint. A joint set perpendicular to the core axis will intersect the core axis at intervals equal to the joint spacing. For intermediate orientations, the spacing of joint intersections with the core will be a cosine function of angle between joints and the core axis.

5.7 Core sizes from BQ to PQ with core diameters of 36.5 mm (1.44 in.) and 85 mm (3.35 in.), respectively, are normally acceptable for measuring RQD as long as proper drilling techniques are used that do not cause excess core breakage or poor recovery, or both. The NX-size (54.7 mm [2.16 in.]) and NQ-size (47.5 mm [1.87 in.]) are the optimal core sizes for measuring RQD. The RQD is also useful for large core diameters provided the core diameter is clearly stated. The RQD calculated for core smaller than BQ may not be representative of the true quality of the rock mass.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 3740 provides a means of evaluating some of those factors.

6. Procedure

6.1 Drilling of the rock core should be done in accordance with Practice D 2113. It is important that proper drilling techniques and equipment are used to minimize core breakage or poor core recovery, or both.

6.2 There are several ways to define a core run for calculating RQD. Three of these are: (*1*) a core run is equal to a drill run; (*2*) a change in formation or rock type could constitute an end of a core run; and (*3*) a core run can be a selected zone of concern. In determining a core run it is important to be consistent throughout a drill hole and to document how the core run was defined.

6.3 Retrieval, preservation, transportation, storage, and cataloging of the rock core should be done in accordance with Practices D 5079. The RQD should be logged on site when the core is retrieved because some rocks can disintegrate, due to poor curatorial handling, slaking, desiccation, stress relief, or swelling, with time. For these rocks it is recommended that the RQD be measured again after 24 h to assist in determining durability.

6.4 Close visual examination of core pieces is required for assessing the type of fracture (that is, natural or drill break). Pieces of core that are moderately or intensely weathered, contain numerous pores, or are friable, or combination thereof, should not be included in the summation of pieces greater than 100 mm (4 in.) for the determination of the RQD. Any rejected piece of core is still included as part of the total length of core run and should be noted in the report.

6.5 Measure all core piece lengths that are intact and greater than 100 mm (4 in.) to the nearest 1 mm (0.04 in.) and record on a RQD data sheet (Fig. 2). Measure such pieces along the centerline of the core as illustrated in Fig. 1[3]

NOTE 2—Centerline measurements ensure that the RQD value resulting from the measurements is not dependent on the core diameter. Centerline measurements also avoid unduly penalizing resulting RQD values for cases where fractures parallel the core axis. Any other method used for accounting for fractures parallel to the core axis, while not advocated by this test method and in the literature, must be clearly stated.[4,5]

6.6 Only those pieces of rock formed by natural fractures (that is, joints, shear zones, bedding planes, or cleavage planes that result in surfaces of separation) shall be considered for RQD purposes. The core pieces on either side of core breaks caused by the drilling process shall be fitted together and counted as one piece. Drilling breaks are usually evident by rough fresh surfaces. In some cases it may be difficult to differentiate between natural fractures and drilling breaks. When in doubt, count a fracture as a natural fracture. If for some reason there is not 100 % core recovery for a drill run, the length of core left in the borehole should be taken into account by adding it to the run in which it was cored rather than the run in which it was retrieved.

6.7 Record the top and bottom depths of each core run.

6.8 Sketch core features such as natural fractures, drilling breaks, lost core, highly weathered pieces, and so forth (see Fig. 1).

6.9 Include remarks concerning judgement decisions such as whether a break in a core is a natural fracture or a drilling break or why a piece of core longer than 100 mm (4 in.) was not considered to be intact.

6.10 Record the sum of intact core pieces longer than 100 mm (4 in.) long, and calculate the RQD value for the core run being evaluated.

6.11 Indicate the rock quality description for the core run using the rock quality table in Fig. 1.

7. Calculation

7.1 Calculate as a percentage, the RQD of a core run as follows:

$$\text{RQD} = \frac{[\Sigma \text{length of intact and sound pieces} > 100 \text{ mm (4 in.)}] \times 100\ \%}{\text{total core run length, mm}} \tag{1}$$

In accordance with Practice D 6026, record the result to the nearest one percent.

8. Report

8.1 A typical report may include the following:

8.1.1 Source of sample including project name, location, and, if known, storage environment. The location may be specified in terms of borehole number and depth of core runs from the collar of the hole.

8.1.2 Description of drilling equipment, method, personnel, and hole orientation.

8.1.3 Physical description of core runs including diameter, rock type and location and orientation of discontinuities, such as, apparent weakness planes, bedding planes, schistosity, and large inclusions or inhomogeneities, if any.

8.1.4 Date of RQD calculations and sketches and/or photographs of core runs.

8.1.5 General indication of any conditions, observations, and assumptions relevant to the RQD values or calculations.

8.1.6 Include a table of RQD values and/or copies of any RQD data forms or sketches.

8.1.7 Report the rock quality classification for the core run using the table in Fig. 1.

9. Precision and Bias

9.1 *Precision*[6]—A round-robin study of the RQD index of cores of four selected types of sedimentary rock (anhydrite/calcite, calcareous shale, limestone, and anhydrite) with four replications per rock type was conducted in accordance with Practice E 691 by eight experienced participants.[7] The repeatability and reproducibility statistics reported in Table 1 refer to within-participant and between-participant precision, respectively. The probability is approximately 95 % that two results obtained by the same participant on the same material will not differ by more than the repeatability limit r. Likewise, the probability is approximately 95 % that two results obtained by different participants on the same material will not differ by more than the reproducibility limit R. The precision statistics are calculated from the following equation:

$$r = 2(\sqrt{2})s_r \tag{2}$$

where s_r = repeatability standard deviation, and

$$R = 2(\sqrt{2})s_R \tag{3}$$

where s_R = reproducibility standard deviation.

NOTE 3—Some combinations of the means and r and K can result in KQD limits that exceed 100 % because the RQD values have been assumed to be normally distributed which may not reflect the actual underlying distribution of the RQD values.

9.2 *Bias*—There is no accepted reference value for this test method; therefore, bias cannot be determined.

10. Keywords

10.1 classification; index; logging; quality; rock; rock core

[3] Deere, D. U., and Deere, D. W., "The Rock Quality Designation (RQD) After Twenty Years," *Rock Classification Systems for Engineering Purposes, ASTM STP 984*, 1988, pp. 91–101.

[4] Deere, D. U., and Deere, D. W., " Rock Quality Designation (RQD) Index in Practice," *Contract Report G1–89–1* , Department of the Army Corps of Engineers, 1989.

[5] Bieniawski, Z.T., "Exploration for Rock Engineering" *Proceeding of the Symposium on Exploration for Rock Engineering,* November 1976, Johannesburg, A.A., Balkema, Rotterdam.

[6] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: ISRD18–1015.

[7] Pincus, H. J., and Clift, S. J., *Interlaboratory Testing Program for Rock Properties: Repeatability and Reproducibility of RQD Values for Selected Sedimentary Rocks*, PCN: 33-000011-38, ASTM Institute of Standards Research, 1994.

RQD DATA SHEET			
Project:			Date:
Core Box I.D. no.:		Recorder(s):	
Total Length of Core Run, mm (in):		Checker(s):	
Core Diameter, mm (in):		Date Checked:	
Depth, m (ft)	Sketch or Photographic Image of Core	Length of Each Sound Piece of Core > 100 mm (4-inch)	Remarks
• Lengths of Sound Pieces of Core > 100 mm (4-in):			
RQD (%) = $\dfrac{\text{• Lengths of Sound Pieces of Core > 100 mm (4-in) * 100\%}}{\text{Total Length of Core Run, mm (in)}}$			
RQD (%) =		Rock Classification:	
Page ____ of ____			

FIG. 2 RQD Data Sheet

TABLE 1 RQD Index of Cores of Sedimentary Rock

Material (Rock Type)	Mean RQD, $\bar{x}$, %	Repeatability, r, % [A]	Reproducibility, R, % [A]
Anhydrite/calcite	86	28	28
Calcareous shale	60	32	40
Limestone	92	14	14
Anhydrite	86	20	20

[A] The numbers in the r and R columns are not to be taken as percentages of the means, but are applied as plus or minus terms to the respective means.

SUMMARY OF CHANGES

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (1996) that may impact the use of this standard.

(1) Added to Section 1 required statement about significant figures and Practice D 6026.
(2) Added Terminology D 653, Practices D 3740, and D 6026
(3) Added Terminology Section , and renumbered subsequent sections.
(4) Added Note 1 in Significance and Use Section, referencing Practice D 3740, and renumbered subsequent notes.
(5) In Section 4.1 defined method as applicable to drill holes in any orientation and added the word "sound" between "intact rock". Changed "Engineering judgement" to Rock mechanics judgement" so that both the engineering and geological considerations were included.
(6) In Calculation Section, added the sentence: "In accordance with Practice D 6026, record the result to the nearest one percent.
(7) In Calculation Section, Note 2, corrected typographical error in a symbol and the abbreviation for RQD. Took out confusing discussion of vertical fractures since it pertains to any fracture that parallels the core axis and added references used to support this section.
(8) In Section 6.1 added words "and equipment" with "proper drilling techniques."
(9) In Section 6.3 added the influence of curatorial handling.
(10) Added Report Section and renumbered accordingly.
(11) Figure 1 — Added "Centerline Method" to title, added "intact and sound" to the formula and changed "Description of Rock Quality" to "Rock Quality Classification."
(12) Figure 2 — Fixed heading to include more relevant background data, added the words "intact and sound" to the formula, changed meters to millimeters, and added place to put the rock quality classification.

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STANDARD OPERATING PROCEDURE

SM-007 Concrete Sampling

1. Objective

Describe methods for collection of concrete samples for chemical analysis.

Two methods of concrete sample collection are described: concrete dust sampling and concrete chip sampling. The concrete dust sampling method produces a uniform, finely ground powder that is easily homogenized, extracted and analyzed. This method generally produces enough sample for one or two analyses and is not to be used for analysis of volatile organic compounds. If a full suite of chemical analysis is required, or if VOC analysis is required, chip sampling may be the preferred method.

2. Execution

- If the full depth of the concrete will be penetrated, and the potential for the presence of underground utilities/obstructions exists, contact the owner to determine the locations of underground utilities/obstructions.
- Sample locations may be pre-marked using a crayon or a non-contaminating spray paint. (Note, the actual sample point must not be marked.)
-

Depending on the appearance of the sample location, or the objectives of the sampling, it may be appropriate to wipe the concrete surface with a clean dry cloth prior to sampling. All sampling decisions and activities should be noted in the field notebook (See Limitations Below).Concrete Dust Sampling

Concrete dust samples are collected using an impact hammer drill, which generates a concrete dust or powder. Therefore, this method is not appropriate for samples analyzed for volatile organic compounds. Samples can be collected from a single depth or from multiple depths at the same location.

A ½-inch deep hole (using a 1-inch diameter drill bit) generates about 10 grams of concrete powder. Based on this and the action levels for the project, determine the sampling depth, and/or the number of sample holes to be composited, to generate sufficient sample volume for all of the required analyses.

Drill bits and sample collection pans (if used), must be decontaminated between samples.

2.1.1 Single Depth Sampling

Floor samples

i. Lock a clean 1-inch diameter carbide drill bit into the impact hammer drill and plug the drill into an appropriate power source. (A gasoline generator will be needed if electricity is not available.)

Begin drilling in the designated location. Apply steady even pressure and let the drill do the work. Applying too much pressure will generate excessive heat and dull the drill bit prematurely. The drill will provide a finely ground concrete powder that can be easily collected, homogenized, and analyzed. Having several decontaminated impact drill bits on hand will help expedite sampling when numerous sample locations are to be drilled.

ii. A decontaminated stainless steel scoop can be used to collect the sample. The powder can be collected directly from the surface of the concrete and/or the concrete powder can be scraped back into the hole and the scoop can be used to collect the sample. For holes greater than 2-inches in depth, a stainless steel spoon will make it easier to collect the sample from the bottom of the hole.

iii. To ensure collection of a representative sample when multiple analyses are required, a concrete sample should always be collected and homogenized in a single container and then divided up into the individual containers for the various analyses or split samples. This is particularly important when sample holes are deep, or when several holes are drilled adjacent to each other to form a composite sample.

Wall Samples

i. A team of two samplers is required for wall sampling. The second person will hold a clean catch surface (i.e., an aluminum pan or a clean sheet of aluminum foil) below the drill to collect the falling concrete powder.
ii. For the sampling method follow steps for Floor Samples.

Ceiling Samples

i. A team of two samplers is required for ceiling sampling. The second person will hold the clean catch surface, as described above, below the drill to collect falling concrete powder.
ii. Samples maybe collected at an angle so powder can fall freely into the collection pan.
iii. Samples may also be collected by drilling a hole through the bottom of the collection pan and mounting the drill bit into the drill through the pan.

This allows the sampler to drill straight up while the assistant steadies the collection pan to catch the falling dust.

iv. For the sampling method follow steps for Floor Samples.

2.1.2 Multiple Depth Sampling

i. Generate and collect the first sample using a 1-inch diameter carbide drill and the procedures in 2.1.1.
ii. Use a vacuum pump or other appropriate method to clean out the hole.
iii. If the next sample is to be collected immediately below the first sample, use a clean ½-inch carbide drill to generate the sample, advancing the drill to the appropriate end depth.
iv. If an additional sample is to be collected at a deeper depth, use the 1-inch carbide drill to open up the hole to the appropriate sample depth and clean out the hole using a vacuum pump or other appropriate method.
v. Use the ½-inch carbide drill to generate the sample from the appropriate sample depth.

2.1. Concrete Chip Sampling

- If possible, remove any non-porous inclusions from the sampling location by brushing or wiping, as appropriate.
- Using a chisel, drill, hole saw, or similar tool, collect a minimum of 100 g of the sample to a depth of 2 cm, or to an alternate depth specified in applicable planning documents. The collected chips may be of any convenient size unless otherwise specified in applicable planning documents.
- Transfer the sample to an appropriate sample container. SC-002 Sample Handling provides guidance regarding the amount of sample, the type of sample container, the holding time, and the preservation techniques to be used for each analysis to be conducted.
- Complete Sample Collection Logs, if appropriate, and Chain of Custody Forms, label sample containers, and complete documentation.

3. Limitations

- Concrete sampling may require removing tiles or laminate coverings with asbestos containing adhesives. These coverings should not be removed without a determination of the presence of asbestos. If asbestos is present, the asbestos-containing material will need to be removed prior to any concrete sampling.
- If collecting multiple samples using this method, avoid cross-contamination by decontaminating all sampling tools prior to collecting the next sample. If the sampler's gloves come in contact with the sampled material during sampling, gloves should also be changed prior to collecting the next sample.

4. References

Draft Standard Operating Procedure for Sampling Concrete in the Field, Environmental Protection Agency, Region 1, December 1997.

Environmental Restoration Project Standard Operating Procedure for Los Alamos National Laboratory, Los Alamos National Laboratory, December 2001.

5. Contact

Brian Conte
Leslie Lombardo

STANDARD OPERATING PROCEDURE
SM-008 Wipe Sampling

1. Objective

Describe methods to standardize the collection of wipe samples.

2. Execution

- Determine the appropriate surface area (typically in cm^2) to be wiped.
- Choose appropriate sampling points and mark the surface area to be sampled. Photo documentation is recommended.
- Record surface area to be wiped.
- Don a new pair of disposable surgical gloves.
- Open new sterile package of gauze pad.
- Soak the pad with required solvent unless the laboratory has provided pre-soaked pads.
- Wipe the marked surface area using firm strokes. Wipe vertically, then horizontally to insure complete surface coverage.
- Place the gauze pad in an appropriately prepared sample container with a Teflon-lined cap.
- Cap the sample container, attach the label and custody seal, and place in a plastic bag. Record all pertinent data in the site fieldbook and/or on field data sheets.
- Store samples out of direct sunlight.
- Follow proper decontamination procedures, then deliver sample(s) to the laboratory for analysis.

3. Limitations

- Wipe sampling may require removing tiles or laminate coverings with asbestos containing adhesives. These coverings should not be removed without a determination of the presence of asbestos. If asbestos is present, the asbestos-containing material will need to be removed prior to any concrete sampling.
- If collecting multiple samples using this method, avoid cross-contamination by decontaminating all sampling tools prior to collecting the next sample. If the sampler's gloves come in contact with the sampled material during sampling, gloves should also be changed prior to collecting the next sample.

4. References

"Wipe Sampling and Double Wash/Rinse Cleanup as Recommended by the Environmental Protection Agency PCB Spill Cleanup Policy," dated June 23, 1987 and revised on April 18, 1991.

Environmental Restoration Project Standard Operating Procedure for Los Alamos National Laboratory, Los Alamos National Laboratory, December 2001.

5. Contacts

Brian Conte
Leslie Lombardo

Section 8

Groundwater (GW)

STANDARD OPERATING PROCEDURE

GW-001 Water Level and NAPL Measurement

1. Objective

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

2. Equipment and Materials

Field forms and/or field notebook.

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

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

3. General Information

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

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

- Water level and/or NAPL measurements should be made before any water is removed from wells because doing so may influence groundwater levels in the area of the investigation.
- Measurements should be made approximately three times to confirm the measurement. Each time a measurement is made it should be determined to the nearest one-hundredth of a foot (0.01).
- Water level and/or NAPL measurements should first be collected at the wells that are least contaminated and proceed towards the wells that are most contaminated. Decontaminate the water level meter or oil/water interface probe prior to initial use and after use at each location. If NAPL is encountered at a well where it was previously not observed, contact your project manager before continuing.
- Refer to the oil/water interface probe or water level meter instruction manual for guidance on indicator signals, as these may differ by manufacturer.

4. Execution

4.1 Water Level and NAPL Measurements Using Interface Probe

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

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

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

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

4.2 LNAPL Measurements Using Clear Bailer

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

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

Calculating Depth to Groundwater
The depth to water can be calculated as follows:

DTW = DTF + PT
DTW = Depth to Groundwater
DTF = Depth to Fluid
PT = Measured Product Thickness

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

Corrected DTW = Static DTW – (PT x G)
DTW = Depth to Ground Water
PT = Measured Product Thickness
G = Specific Gravity (density of free product / density of water)

4.3 DNAPL Measurements Using Weighted Cotton String

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

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

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

5. Health and Safety Considerations

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

6. Considerations

- Weak batteries in water level and oil/water interface meters frequently produce weak or gradual auditory and/or visual responses, making it difficult to accurately determine when the probe of the unit has come in contact with ground water or NAPL. As such, it is recommended that electronic ground water-level indicators be tested before they are brought out into the field.
- Electronic oil/water interface meters do not respond to distilled water. Do not use de-ionized water to test these units.
- Wells that are not vertical may result in probe contact with the side of the well casing providing a false measurement. Once the probe has come in contact with ground water in the well, water may be trapped by capillary action between the probe and the well casing. If this happens, the unit may continue to signal even after the probe has been raised above the ground water surface. The deeper the well, the more likely this problem may occur. To correct this, the cable should be raised several feet above the water and shaken to remove water from the probe. A new ground water-level measurement should then be collected. If the signals from the unit are not abrupt or reproducible, the probe and tape may need to be retrieved and dried off before trying again.
- Accumulation of sediment, organic material, or floating debris in the probe may also result in gradual or non-reproducible readings. Wells that are constructed with metal inner casings may lead to difficulties in collecting reproducible ground water-level measurements because the inner sides of the well casing are conductive.

- In some cases, a rubber grommet or metal centralizer may need to be placed on the probe so that it cannot contact the inner casing.
- Well gauging equipment should be properly decontaminated between wells and piezometers to avoid cross contamination.
- Water levels in wells may be influenced by changes in river stages, pumping of nearby wells, precipitation, tides, etc.
- Using a bailer to estimate LNAPL thickness can result in inaccuracies because successful use of the bailer is dependent upon the expertise of the operator and assumes the check valve does not leak upon retrieval.
- The optical sensor on interface probes may become damaged if solvents are used to clean NAPL from the probes.
- The optical sensor may become smeared when used to measure NAPL, rendering pinpoint accuracy to an estimate at best.
- Close attention to decontamination procedures will improve accuracy, operational life, and reduce the risk of cross contamination with other wells.
- LNAPL thickness can be affected by fluctuations in the water table. In some cases, an LNAPL's thickness may decrease when the water table rises, while its thickness increases as the water table drops. In other cases, fluctuating water tables may cause sudden appearances and disappearances of LNAPL layers.
- Monitoring points with LNAPL can pose a problem when measuring the level of groundwater. Floating LNAPL can depress the groundwater level in a monitoring well or piezometer and distort the measurement. Therefore, the Corrected Depth (CD) formula shown above should be applied to groundwater level measurements in monitoring points where LNAPL are present:
- Some interface probes are factory-calibrated based on an assumed conductivity of NAPL and water, both of which may vary. An interface probe that is functioning properly may not be able to discern different NAPLs at all sites.
- An interface probe may not successfully provide both LNAPL and DNAPL measurements in the same well because the probe is coated by LNAPL and loses its ability to detect DNAPL.
- DNAPL, in particular, may be only slightly heavier than water, or may be neutrally buoyant. As a result, it can be easily disturbed. Once it is disturbed, meaningful measurements can be difficult or impossible to obtain. As such, all tapes or probes used for measurements should be used slowly.

7. References

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

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

8. Contacts

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

STANDARD OPERATING PROCEDURE

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

1. Objective

Provide procedural guidance for routine recovery of non-aqueous phase liquids (NAPL).

2. Equipment and Materials

The following materials and equipment may be necessary for this procedure:

- SOP GW-001 Water Level and NAPL Measurement
- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper personal protective equipment (PPE) including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and health and safety plan (HASP)

3. General Information

Refer to SOP GW-001 and record the depth to NAPL and depth to water measurements If you are using an oil/water interface probe, first check to see if the unit is functioning correctly. Note: De-ionized water will not provide a correct reading. Check the interface probe battery and replace if necessary.

Interface probes usually distinguish between NAPL and water by sounding solid or intermittent tones. See the manufacturer's instructions for details.

4. Execution

4.1 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to NAPL in each monitoring well. Refer to probe manual to determine changes between liquid types (water, light non-aqueous phase liquid [LNAPL] and dense non-aqueous phase liquid [DNAPL]). To achieve accurate depth measurements, ensure the oil/water interface probe is decontaminated (GEI SOP QA-001) prior to and between each measurement taken at each well.

To calculate the volume of NAPL in monitoring wells with well diameters specified below, use the following respective equations:

Light non-aqueous Phase Liquid (LNAPL) Volume

$$LNAPL\,V = (DTW - P_1) \times C$$

Dense Non-Aqueous Phase Liquid (DNAPL) Volume

$$DNAPL\,V = (TD - P_2) \times C$$

Where, V = Volume
DTW = Depth to Water
TD = Total Depth
P_1 = Depth to LNAPL
P_2 = Depth to DNAPL

Conversion factors (C) for wells based on well diameter size are noted in the table below.

Well Diameter (inches)	Conversion Factor (liters)	Conversion Factor (gallons)
2	0.6178	0.1632
4	2.4711	0.6528
6	5.561	1.469

Note: Well diameter sizes are noted for outer diameter. Conversion factors assume Schedule 40 PVC riser and screen, if well is constructed of different material appropriate conversion factors must be used to calculate accurate NAPL volume.

Once measurements have been taken and calculations have been made, collection of NAPL may commence.

4.2 NAPL Collection Procedures

Collection of NAPL shall be accomplished using common recovery techniques or technologies including:

- Peristaltic pump
- Bailer

Some projects require on-going NAPL recovery efforts. For these projects installation of dedicated recovery methods should be considered.

Special care shall be taken to prevent any recovered NAPL from spilling or coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. The specific operating procedures for common recovery methods are discussed in the following sections.

4.2.1 Sampling and Recovery via Peristaltic Pump:

LNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend approximately 12-inches beyond the LNAPL layer. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.
- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just below the top of LNAPL.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly increase the pump rate to begin LNAPL removal from the well. Use the oil/water interface meter to measure the depth to LNAPL. Lower the intake tubing as necessary until all of the LNAPL has been recovered from the well.
- Once the LNAPL has been recovered from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of LNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

DNAPL

- Take and record the required measurements prior to commencing pumping.
- Cut a length of poly tubing (T1) that is long enough to extend to the bottom of the well including additional length to attach to the pump intake. Cut an additional length of poly tubing (T2) that will be connected to the discharge side of the

peristaltic pump silicone tubing that is long enough to extend from the pump to the NAPL collection container. Cut a length of silicone tubing (approximately 8-inches) for use in the peristaltic pump head.

- Insert the silicone tubing into the peristaltic pump head. Check the flow direction of the pump to ensure that the pump will be removing fluid and not pumping air into the well when removal begins.
- Insert T1 into the intake side of the silicone tubing. Lower the intake side into the well and secure in place just above the bottom of the well.
- Insert T2 into the discharge side of silicone tubing and secure to the NAPL collection container with a clamp.
- Turn pump flow rate to lowest setting. Turn the pump on and slowly begin to remove DNAPL from the well. DNAPL removal will be complete when the pump begins to discharge water. Use the oil/water interface meter to check the DNAPL thickness during the removal process. Take care not to pump an excessive amount of water.
- Once the DNAPL has been purged from the well, collect and preserve a sample if required, in accordance with laboratory standards.
- Following completion of DNAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

4.2.2 Sampling and Recovery via Double Check Valve Bailer:

LNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach just below the LNAPL layer. Use the oil/water interface meter to determine the appropriate depth.
- Using slow and controlled motions while lowering (and raising) the bailer to the appropriate depth, commence bailing LNAPL out of the well and draining the bailer directly into collection container.
- Once the LNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

DNAPL

- Take and record the required measurements prior to commencing bailing.
- Ensure the work area is covered in plastic sheeting to avoid potential spills of water and/or NAPL.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom, commence bailing DNAPL out of the well and draining the bailer directly into collection container.
- Once the DNAPL has been purged from the well, collect and preserve a sample, if required, in accordance with laboratory standards.

4.3 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. DNAPL waste management and disposal should be evaluated on a site by site basis.

4.4 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

4.5 Data and Records Management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to water, NAPL, etc.) and all calculations (NAPL column length, volume of NAPL, etc.) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

4.6 Limitations

- NAPL gauging and recovery can be challenging and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to NAPL can accelerate the required maintenance/replacement intervals for tools and equipment.

5. Health and Safety Considerations

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

6. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

7. Contact

Jerry Zak (860) 368-5404 Glastonbury

STANDARD OPERATING PROCEDURE

GW-003 Low Flow (Low Stress) Groundwater Sampling

1. Objective

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

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

2. Execution

- Prior to groundwater sampling consult with the project manager to confirm that the type of pump is appropriate and consistent with the approved work plan.
- Record activities in the field notebook (see SOP FD-001 Field Notebook) and on a Monitoring Well Sampling Record such as the examples in Attachment A. Use a separate form for each sampling location and event. You may forego the forms and record all information in the field notebook if the Project Manager approves.
- Calibrate pH, temperature, Specific Conductance (SC), turbidity, Dissolved Oxygen (DO), and Oxidation-Reduction Potential (ORP) on the meter(s). Use calibration methods provided by the manufacturer of the equipment. Note that appropriate calibration for dissolved oxygen requires a water saturated air environment, along with measured temperature and barometric pressure.
- Begin with the monitoring well believed to have the least contaminated groundwater and proceed systematically to the well with the most contaminated groundwater. Check the well, the lock, and the locking cap for damage or evidence of tampering.
- Slowly and gently measure the depth to water with a water level probe and/or oil-water interface probe. Do not measure depth to well bottom at this time (wait until sampling has been completed). Measure water level in accordance with SOP GW-001 Water Level Measurement.
- Attach new polyethylene or Teflon lined tubing to the sampling pump and the flow-through cell that contains the meter probes.
- Slowly and gently insert new polyethylene or Teflon lined tubing to the pump intake (or use dedicated tubing that remains in the well) and to the middle of the saturated screened interval or to the pre-determined sampling depth.
- The tubing intake should be kept at least two (2) feet above the bottom of the well to prevent disturbance or suspension of any sediment or Non-Aqueous Phase Liquid (NAPL) present in the bottom of the well. Record the depth of the pump intake.

- If possible, position your sampling equipment and tubing so that it is in the shade. The goal is to minimize the effect of sunlight raising the temperature of water being collected.
- Start the pump on the lowest setting and increase slowly until flow begins. Adjust the pumping rate so that drawdown in the well is minimal (0.3 feet or less, is desirable but not mandatory). Use a pumping rate between 100 to 1,000 milliliters per minute (mL/min) (or approximately 0.1 to 1 quarts per minute). Measure flow rate on the pump or using a graduated container every 3 to 5 minutes and record. The minimum purge volume will be twice the combined volumes of the sampling string (i.e. pump, tubing, and flow-through cell).
- While purging, record water levels every 3 to 5 minutes and monitor and record the water quality indicator parameters: pH, temperature, specific conductance (SC), dissolved oxygen (DO), and turbidity. If specified in the field sampling plan also include ORP.
- Purging is complete when, after three consecutive measurements, the water quality parameters have stabilized as follows:
    - pH (+/- 0.1 standard units)
    - temperature (+/- 3%)
    - SC (+/- 3%)
    - turbidity (+/- 10% if >5 NTU; if 3 values are <5 NTU, consider the values as stabilized)
    - DO (+/-10% if >0.5 mg/L; if 3 values are <0.5 mg/L, consider the values as stabilized)
    - ORP (+/- 10 mV)
- Dispose of purge water according to the field plan.

Sample Collection:

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

- Secure the well cap.

3. Limitations

- Prior to departure for the field, obtain available information on well construction for use in field investigation (i.e., screen and riser material, well diameter and depth, screened interval, optimum sampling depth, etc.).
- If possible, when using dedicated equipment, install equipment into well at least 24 hours before sample collection to minimize disturbance of the water column and/or suspension of sediments or NAPL on bottom.
- If water quality indicator parameters do not stabilize after removing 3 to 5 well volumes or 2 hours, contact the Project Manager. Three options will be available: 1) continue purging until stabilization; 2) discontinue purging and do not sample; or 3) discontinue purging and sample.
- The key indicator parameter for VOCs is DO. The key indicator parameter for all other samples is turbidity.
- Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.
- Consult with the project manager before field filtering samples for metals if using low-flow sampling.
- Be aware of any preservatives in the sample bottles and handle with care, in accordance with the Health and Safety Plan.

4. References

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

Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground Water Sampling (1994), M.J. Barcelona, H. A. Wehram, and M.D. Varljen, Ground Water, Vol. 32, No. 1, 12-22.

Low-Flow Purging and Sampling of Ground Water Monitoring Wells with Dedicated Systems (1995), R.W. Puls, and C.J. Paul, Groundwater Monitoring and Review, Summer 1995 116-123.

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

Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling, (1998), Ground-Water Sampling SOP, Final, U.S. Environmental Protection Agency, Region II, March 16, 1998.

RCRA Ground-Water Monitoring: Draft Technical Guidance, (1993), U.S. Environmental Protection Agency, EPA/530-R-93-001.

To Filter, or Not to Filter, That is the Question, (1997), Special Topics Subcommittee Letter Report EPA-SAF-EEC-LTR-97-011, April 29, 1997, Meeting, U.S. Environmental Protection Agency, Science Advisory Board Environmental Engineering Committee, September 5, 1997.

Should Filtered or Unfiltered Groundwater and Surface Water Samples be Collected for the Risk Assessment?, (1995), MCP Q&A: Subparts I and J, Special #4, Bureau of Waste Site Cleanup, Massachusetts Department of Environmental Protection (DEP), February, 1995.

5. Attachments

Attachment A - Monitoring Well Sampling Record

6. Contacts

Brian Conte
Saskia Oosting

GEI Consultants

MONITORING WELL SAMPLING RECORD

PID Reading ____________ Job Name ____________

Job Number ____________ By ____________ Date ____________

Location ____________ Measurement Datum ____________

Well Number ____________

Pre-Development Information Time (start) ____________

Water Level ____________ Total Depth of Well ____________

One Purge Vol ____________ Three Well Volume ____________

Water Characteristics

Color ____________ ____ Clear ____ Cloudy

Odor ____ None ____ Weak ____ Moderate ____ Strong

Any films or immiscible material ____________

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

Total Volume Removed (gal) ____________ pH ____________

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

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

TDS ____________

Post Development Information Time (Finished) ______________

Water Level ________________ Total Depth of Well ______________

Approximate Volume Removed (gal) ____________________________________

Water Characteristics

Color ___________________________ _____ Clear ______ Cloudy

Odor ______ None _____ Weak _____ Moderate ______ Strong

Any films or immiscible material ____

Comments

Low-Flow Groundwater Sampling Form

Project number and name ____________________ Sampling personnel ____________________ Sample date __________ Well ID __________

Well location description: ____________________

____

Well Construction

Well diameter ____________

Well measurement point ____________

Roadbox condition ____________

Well screen interval ____________

Well depth ____________

Sampling Information

Initial depth to water ____________ Time: ____________

Sample intake depth ____________

Pump type and ID ____________

Stabilized flow rate ____________

Stabilized flow rate = flow rate with no further drawdown

Samples Collected

- VOCs 8260 ☐
- SVOCs 8270 ☐
- VPH ☐
- EPH ☐
- Metals ☐
- PCBs ☐
- Other ☐

Field values at time of sample collection:

Time: ____________ Depth to water: ____________

Sp.Cond. ____________ mS/cm

DO ____________ mg/L

ORP ____________ mV

pH ____________ s.u.

Temp. ____________ °C

Turb. ____________ NTU

Cumulative Time (min.)	Volume (gal)	Water depth (ft)	Temp. (°C)	Sp.Cond. (mS/cm)	D.O. (mg/L)	pH (s.u.)	ORP (mV)	Turb. (NTU)
Typical Groundwater Values			5 to 15	0.05 to 5	0 to 4	5 to 7	-100 to +500	aim for <10

Notes: ____________________

Sample Information:

Sample ID ____________

Sample Time: ____________

Color: ____________

Turbidity: ____________

Field Filtered YES / NO Analyses: ____________

Filter type: ____________

Odor/Sheen/NAPL ____________

Duplicate Collected YES / NO

If yes, duplicate ID: ____________

Purge water disposal? to ground drummed other:

Well Volume Conversion:

Diam. (in)	Factor (gal/ft)
1	0.04
1.5	0.09
2	0.16
4	0.65
6	1.50

well volume =
3.14 x (r)^2 x 7.48 gal/ft
where r = 1/2 diameter in ft

Stabilization Criteria:
- Sp.Cond. +/- 3%
- DO +/- 10%
- ORP +/- 10 mV
- pH +/- 0.1 Std Units
- Temp. +/- 3%
- Turb. +/- 10% if values >1 NTU

Guidance:

1 Position tubing at midpoint of saturated screened interval

2 Minimize drop in water level and purge until parameters are stable

3 Disconnect flow thru cell during sampling

4 Call Project Manager if issues arise (e.g. stabilization takes more than 2 hrs, well goes dry, odd data).

5 For VPH and VOC samples, if stabilization flow rate is less than 200 ml/min, contact PM

STANDARD OPERATING PROCEDURE
GW-004 pH and Temperature Measurement

1. Objective

Describe methods for measuring the pH and temperature of liquids using a combination pH/temperature meter.

2. Execution

Calibration

- Calibrate the meter according to the equipment manufacturer's instructions at the beginning of each day of use. Calibration for pH shall be performed using at least two buffer solutions. Solutions chosen should be similar to the expected pH of the liquids tested (pH 7 and 4 buffer solutions are preferred in most cases for groundwater or surface water measurements).
- Check calibration at the end of the day by reading the two solutions used in calibration. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). Record measurements and time of measurement in the field book or sample sheet. If the readings are outside +/– 0.2 pH units, recalibrate the meter.

Sample Measurement

- Immediately prior to testing a sample, decontaminate testing container and probe assembly with one rinse of distilled water. Do not use methanol to rinse the probe. Methanol rinses could damage the probe.
- Gently dry the probe with a paper towel and shake beaker to remove excess solution. Visually inspect the bottom of the probe to ensure that liquid or sediment is not trapped between outer casing and probe.
- Pour the sample into the testing container and insert both temperature and pH probe. Stir sample for 30 seconds using both probes. Let the probes equilibrate in the sample solution for another 30 seconds. Measure and record the temperature. Measure and record pH reading after stabilization or 60 seconds, whichever is sooner. A reading has stabilized if pH units have not changed +/– 0.1 pH units during a 30 second period.
- Record pH to the nearest 0.1 unit and temperature to the nearest whole number.

3. Limitations

- Coatings and particulates may affect the response of the probe; more thorough cleaning using a weak alconox solution and distilled water rinse and gently wiping the probe surface with a paper towel may be required to clean the surface of the probe.

- Temperature affects both the response of the instrument to pH and the actual pH of the sample. The Automatic Temperature Compensation (ATC) function compensates for the variation in the response of the meter only. Therefore, the pH must always be reported with temperature.
- The probe is a fragile thin glass bulb surrounded on three sides by a plastic casing. Care must be taken in handling the probe to avoid breakage.
- Do not use buffer solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-005 Turbidity Measurement

1. Objective

Describe calibration and use of a Hach nephelometer/turbidimeter.

The meter is used to measure turbidity of liquids by quantifying how much light passes through them. Turbidiity readings are required to be read using a portable (e.g Hach) instrument directly from the tubing before going through the flow-through cell.

This SOP is specific to a Hach turbidimeter. Follow manufacturer's recommendations for other meters.

2. Execution

i. Turn the meter "ON".
ii. Rinse the sample cell 3 times with distilled water.
iii. Fill the cell to the fill line with distilled water and then cap the cell.
iv. Wipe off excess water and streaks with a non-abrasive lint-free paper or cloth (preferably lens paper).
v. Open the cover and insert the cell (arrow to the front) into the unit and close the cover.
vi. Press "READ" and wait for the 'light bulb' icon to go off. Record the reading.
vii. Using the Gelex standards, repeat steps above. Record all measurements (note anomalies).
viii. Fill the cell with sample liquid to the fill line (about 15 mL) and replace the cap on the cell.
ix. Wipe off excess water and any streaks with a non-abrasive lint-free paper or cloth (lens paper).
x. Press "I/O" and the instrument will turn on. Place the meter on a flat, sturdy surface. Do not hold the instrument while making measurements.
xi. Insert the sample cell, arrow to the front, in the instrument. Close the lid.
xii. Select manual or automatic range selection by pressing the range key.
xiii. Use signal average mode if the sample causes a noisy signal (display changes constantly). Select signal averaging mode by pressing the "Signal Average" key.
xiv. Press Read. The display will show "---- NTU" and then the turbidity in NTU. Record the result after the lamp symbol turns off.
xv. Rinse the cell with distilled water.
xvi. Confirm the validity of the sample measurement by double-checking with one of the Gelex standards.

xvii. Periodically check the turbidity meter during the day by using the Gelex secondary standards provided.

xviii. Perform a post calibration at the end of the day and record all measurements.

3. Limitations

If the turbidity measurements are for National Pollutant Discharge Elimination System (NPDES) reporting purposes, all samples with values above 40 NTU must be diluted with turbidity free water (e.g. distilled water) and sample turbidity is calculated by multiplying the reading of the diluted sample by the dilution factor.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-006 Specific Conductance Measurement

1. Objective

Describe standard methods to measure conductivity of water using a field conductivity meter.

2. Execution

- Calibrate the meter according to equipment manufacturer's instructions at the beginning of each day of use. Calibration shall be performed using a standard KCl or other solution recommended by the manufacturer.
- Record the make, model, and serial or identification number of the instrument and calibration information in the field notebook.
- Check calibration at the end of the day by measuring the standard used in calibration and record in field book. Also perform additional field checks as needed based on observed readings (i.e., inconsistent readings). If the readings are outside +/- 0.02 mS/cm, the meter must be recalibrated. Initial calibration should be conducted under the same conditions (i.e., temperature, and location) of field testing.
- Immediately prior to testing a sample, decontaminate testing container and probe assembly with distilled water.
- Gently dry the probe with a paper towel and shake container to remove excess solution.
- Pour sample into the container and insert probe. Stir sample with the probe for approximately 10 seconds. Let the probe equilibrate in the sample solution for another 30 seconds. Measure conductivity and record in the field notebook.
- Record conductivity to the nearest whole number.

3. Limitations

- Oily coatings and particulates may affect the probe's response; more thorough cleaning using a weak alconox solution and distilled water rinse and gently wiping the probe surface may be required to clean the surface of the probe.
- If sample liquid is contaminated, (e.g. stained, conductance >0.75 mS/cm), rinse probe with distilled water immediately after measuring sample to minimize fouling of probe.
- Do not use calibration solutions past their expiration date.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contact

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-007 Dissolved Oxygen Measurement

1. Objective

Describe calibration and field use of dissolved oxygen meter.

2. Execution

- Place instrument in the intended operating position (vertical, tilted, or horizontal) before it is prepared for use and calibrated.
- Recalibration may be necessary when the instrument operating position is changed.
- Attach the prepared probe to the Probe connector of the instrument and adjust the retaining ring finger tight. Check that membrane is intact and check for presence of air bubbles under membrane. If bubbles are present or membrane is damaged, prepare probe again according to manufacturer's instruction.
- Place approximately 1/8 inch of water into the bottom of the calibration cup. Place the probe into the cup and engage only one thread of the calibration cup onto the probe to ensure that the DO probe is readily vented to the atmosphere. Make sure the DO and temperature probes are not in contact with the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
- Calibrate meter according to the procedures outline in the instrument manual. Calibrate probe to a zero oxygen solution provided by manufacturer, and water saturated air.
- The calibration procedure may require correction factors or input of site-specific barometric pressure and temperature. Correction factors can be found at:

  http://water.usgs.gov/owq/FieldManual/Chapter6/6.2_v2.1.pdf

- Otherwise, use appropriate instruments at the site to determine temperature and pressure.
- Perform Dissolved Oxygen Measurement using the following procedure:
  - i. Submerge probe in flow-through chamber or water body.
  - ii. Gently raise and lower probe in sample.
  - iii. Allow sufficient time for probe to stabilize to sample temperature and dissolved oxygen.
  - iv. Read and record the temperature and the value of the dissolved oxygen in mg/L.
  - v. Document field analysis data and general observations in the field log book or groundwater sampling sheet.

3. Limitations

- Collect DO measurements in the field during sampling. Storing samples in containers will alter the DO concentration of the sample.
- Detection Limit (DL) = 0.1 mg/L for 0-10 mg/L range; do not record values less than Detection Limit: a zero reading is recorded < 0.1 mg/L.

4. References

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

5. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE
GW-008 Temporary Groundwater Sampling Points

1. Objective

To define the procedures for installation of temporary groundwater sampling points (hereafter referred to as well point) for measuring depth to groundwater and collecting groundwater samples. Well points may aid in the placement of permanent monitoring wells.

A well point is a small diameter (1-2 inch) probe constructed of continuously wrapped stainless steel or wrapped stainless steel gauze screen over perforated carbon steel pipe. No filter or gravel pack is used in the installation.

Well point installations are not the only type of temporary monitoring wells. Alternative temporarily well constructions should be discussed with the project manager and may be more appropriate based on-site conditions.

2. Execution

2.1. Installation

- The well point can be placed with the use of a conventional hollow-stem auger rig, Geoprobe®, slide hammer, jack hammer, rotary hammer, or by hand.

- The well point may be driven through the unsaturated zone only in known "clean" soils. Driving the well point through contaminated soil may carry contamination downward with the point resulting in analytical sample results which are biased high. In areas with contamination above the desired screening zone, the well points should be installed with the aid of either hollow-stem augers or Geoprobe®, to "case off" contamination from the upper layer.

- If the well point is to be installed in an oversized (20% larger than the well point) pre-drilled hole, the hollow-stem augers or bull drive point must be advanced to a point which is just above the targeted sample zone. The well point is then placed in the hole and advanced beyond the bottom of the hole by hammering or pushing into place. The use of pre-drilled holes will reduce clogging of well point screens when driving.

- If the well point is used for piezometeric data, make a survey mark on top of the casing as a reference point for water level measurements.

- Caution must be used when using well points in areas of contaminated soil. Possible cross contamination may be introduced to the screen as it passes through the zone of contamination.

2.2. Sampling Procedures

Development of a well point is not required prior to sampling. Sampling of groundwater or collecting piezometric data must be performed by one of several recommended methods described in this manual.

After sample collection, (See Groundwater Sampling SOP) the well point is removed by back hammering or pulling the tool out with the rig hydraulics.

3. References

ASTM D6001 - 05 Standard Guide for Direct-Push Water Sampling for Geoenvironmental Investigations

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

Ground Water and Wells. Johnson Division, UOP Inc.; St. Paul, Minn. 1982. p277-294.

Ground Water Manual - A Water Resources Technical Publication; U.S. Dept. of Interior, Bureau of Reclamation. Government Printing Office, Washington DC 1977.

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

4. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-009 Potable Well Sampling

1. Objective

Describe methods to collect a drinking water supply sample and to reduce the bias of system related variables (pumps, piping, holding tanks, etc.).

2. General Information

- Inquire if any treatment units are used on the system. Softening (pH adjustment), iron removal, turbidity removal, and chlorination are often used; these may give misleading results depending upon the parameters of interest. Consult with the project manager if these treatment units may affect the sample to be collected.
- Home carbon filters used for the removal of organics have become increasingly popular. Basement and outside faucets may by-pass such treatment systems.
- Important considerations to record in the field book, if available, are:
  - Well driller and date drilled
  - Construction of well and casing depth
  - Well and pump location
  - Well depth and pump capacity (if available)
  - Storage tank capacity
  - Treatment or conditioning unit (if any)
  - Plumbing arrangement
  - Possible sample collection points
  - Distance of well to any septic systems or underground storage tanks
  - Aesthetic information (color, odor, observed suspended material)
- If possible, obtain the name(s) of the resident or water supply owner/operator, the resident's mailing address, and the resident's home and work telephone numbers. The information is needed so that the residents or water supply owner/operators can be informed of the results of the sampling program.
- For long term monitoring projects a specific tap or faucet should be designated as the target sample access point for consistency and data comparability of future samples.

3. Execution

- If possible, collect the sample from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units.
- It may not be possible to collect the sample at or near the well head or pump house.
- If the sample must be collected at the downstream side water tanks/system equipment, calculate the volume of water in the system prior to the sampling point. For example, if the closest sampling point follows a 30-gallon pressure

tank and four gallons of water in the piping then a 34 gallon volume should be recorded.

- If possible, purge at least three volumes of water in the system prior to the sampling point. Purge a minimum of one-volume. This allows a complete exchange of fresh water where the sample is collected and avoids sampling stagnant water.
- If the volume of water cannot be determined or the owner prohibits purging of the full one-volume, then a 15-minute purge time should be used. The project manager should be informed that the sample was collected in this manner and the information should be recorded in the field book.
- Home faucets, particularly kitchen faucets, usually have a screen (aerator) installed on the discharge. The screen must be removed prior to sampling for bacteria or for volatile organics, since the screen tends to aerate the water and some organics may be lost. Also, when sampling for bacteria, do not take a sample from a swivel faucet since the joint may harbor a significant bacterial population.
- Open several taps during the purge to ensure a rapid and complete exchange of water in the tanks and reduce system backflow.
- After purging for several minutes, measure the turbidity, pH, specific conductivity, and temperature of the water. Continue to monitor these parameters until three consistent readings are obtained. Consistent readings means:
  - pH remains constant within 0.1 standard units.
  - Specific conductance and turbidity does not vary more than 10 percent. Turbidity readings should be below 10 Nephelometric Turbidity Units (NTUs).
  - Temperature remains constant.
- After three consistent readings have been obtained, collect the sample.
- If consistent readings cannot be attained, but adequate volume has been purged, collect the sample.

4. Limitations

- When sampling for bacterial content, the sample container should not be rinsed before use due to possible contamination of the sample container or removal of the thiosulfate dechlorinating agent (if used).
- Homeowners' plumbing systems should not be tampered with in any way except for removal of the faucet screen (aerator) with permission of the homeowner.
- When filling any sample container, care should be taken that no splashing drops of water from the ground or sink enter into either the bottle or cap.
- When sampling at a water treatment plant, samples are often collected from the raw water supply and the treated water after chlorination.
- Do not remove the pump from a homeowner's well unless the removal is authorized by the homeowner and is performed by a licensed pump installer.
- Continually running wells do not require purging and can be sampled immediately.

5. References

Potable Water Supply Sampling, United States Environmental Protection Agency, Region 4, SESDPROC-305-R1, November 1, 2007.

Standard Methods for the Examination of Water and Wastewater, 18th Edition, Method 4500-H. American Public Health Association (1992).

Ground Water and Wells. Johnson Division, UOP Inc.; St. Paul, Minn. 1982. p277-294.

Ground Water Manual - A Water Resources Technical Publication; U.S. Dept. of Interior, Bureau of Reclamation. Government Printing Office, Washington DC 1977.

6. Contacts

Brian Conte
Saskia Oosting

STANDARD OPERATING PROCEDURE

GW-010 Slug Tests

1. Objective

Describe methods to use slugs, pressure transducers, and data loggers to collect data that will support calculation of horizontal hydraulic conductivity of distinct geologic strata.

General Information

Slug tests are performed on single monitoring wells to estimate the hydraulic conductivity of the aquifer in which the well is screened. The test consists of adding or removing a known volume (slug) to or from the well to instantaneously change the water level. Subsequently, the recovery of the water level back to the static water level is measured. The resulting data are used to determine the hydraulic conductivity of the aquifer test zone using an appropriate analytical method.

Falling head tests can only be performed in fully-penetrating wells (well screened completely below the water table). Rising head tests can be performed in both fully- and partial-penetrating wells.

2. Execution

2.1 Setup

- Determine how water levels will be recorded. If the geologic materials in the test zone are expected to be slightly permeable (e.g., a glacial till or clay), then measurements may be recorded manually with an electronic water level indicator. If the geologic materials in the test zone are expected to be moderately- or highly-permeable (e.g., outwash sands), record measurements using a pressure transducer attached to an automatic data logger.

  The remainder of this SOP assumes that an automatic data logger is being used to measure water levels.

- Check to see if test equipment functions prior to leaving for the site.
- Decontaminate the transducer and cable using alconox and distilled water. Do not use methanol. Do not use transducer in wells containing non-aqueous phase liquid (NAPL).
- Make initial water level measurements
- Test wells in the following order: from the least contaminated to the most contaminated, and from low to high expected permeability, where possible.
- Measure the static water level (i.e., depth to water) in the well to be tested manually using an electronic water level indicator. Record all

measurements taken during the test in the field log book or on the attached log form.

- Install the pressure transducer as far below the deepest point of insertion of the slug bar or bailer as possible. Allow the transducer to thermally equilibrate for 15 to 30 minutes (to allow instrumentation wiring to expand/contract) before measurements are taken.
- Secure the transducer cable at ground surface with tape or weight to keep the transducer at a constant depth.
- Cover sharp edges of the well casing with duct tape to protect the transducer cables.
- Transducer measurement setup: For wells screened in sand and silty sand, a linear setting of one reading per second is generally used. In coarser soil where full recovery may occur over a few seconds, a linear setting for more frequent readings is necessary. If a transducer is used for silt and clay, a linear setting of one reading per minute, or a logarithmic setting, may be used to avoid risk of exceeding the memory capacity of the transducer.

2.2 Field Procedure – Rising Head Test

In this test, a slug is inserted in the well prior to the test and the water level is allowed to return back to static level. The test is then started by removing the slug from the well and immediately measuring rising water levels. In wells where recovery is slow, this test can be performed by pumping or bailing water from the well and immediately starting measurements.

- Record the initial water level and other setup information on the attached form.
- Fully submerge the slug bar or bailer into the water column of the well.
- Allow the water level in the well to return to static condition after both the slug and transducer have been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to static condition, start the transducer ("Start Test" if using Win Situ software). Periodically view graphical data during the test, to confirm adequate data collection.
- Rapidly remove the slug bar or bailer from the water column and well. Avoid moving or pulling up the transducer cable when removing the slug.
- Continue recording water levels with the transducer until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect measurements every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

2.3 Field Procedure – Falling Head Test

In this test, a slug is inserted in the well at the start of the test and the falling water levels are measured immediately. In wells where recovery is slow, this test can be performed by adding water to the well and immediately starting measurements.

- Record the initial water level and other set up information on the attached form.
- Allow the water level in the well to return to static conditions after the transducer has been inserted. The transducer readout should indicate the height of water above the transducer.
- When the water level in the well has returned to a static condition, begin recording transducer readings ("Start Test" if using Win Situ software).
- Fully submerge the slug bar or bailer into the water column of the well.
- Periodically view graphical data during test, to confirm adequate data collection. The transducer should continue to record water levels until the water level has recovered to within 15 percent of the original static water level relative to the initial test displacement (85 percent recovery), or until one hour has elapsed. If less than 50 percent recovery has been achieved after one hour, continue to collect a measurement every 10 to 20 minutes.
- Where possible, repeat the test to establish the repeatability of measurements and calculated hydraulic conductivity results.
- As soon as practicable, download data stored in the transducer and transfer data.

3. Additional Information

- Do not perform hydraulic conductivity tests on wells that have not previously been developed and allowed to equilibrate.
- It is critical to either add or remove the slug to the well as quickly as possible and to start collecting depth-to-water measurements immediately.
- The early-time data is critical because the rate of recovery of head in the well is exponential. Collect measurements frequently at the start of all variable head tests.
- The time required for a slug test to be completed is a function of the volume of the slug, the hydraulic conductivity of the formation, and the type of well completion. The slug volume should be large enough that a sufficient number of water level measurements can be made before the water level returns to equilibrium conditions. Two bailers connected in series can be used to increase the slug volume, provided the water column is deep enough.
- Decontaminate all down well equipment before using it in the well.

- NAPL will damage the transducer. Gauge recovery manually in these instances.
- Where possible, take periodic water level readings manually during recovery. The manual data are used to check for transducer noise or movement.
- If using automatic data loggers, download the data as soon as possible. Batteries in the data loggers may run down and result in a loss of data.
- Be prepared to containerize water generated from rising head tests if the water is contaminated.
- Where possible, take more than one pressure transducer to site. This will provide backup and allow testing of multiple wells simultaneously.

4. Calculations

The simplest interpretations of piezometer recovery are Hvorslev (1951) and Bouwer and Rice (1976). The analyses assume a homogenous, isotropic medium in which soil and water are incompressible. Spreadsheets and software are available to calculate hydraulic conductivity from slug test data according to the methods below.

Hvorslev's expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (L/R)}{2\,L\,T_0} \qquad \textit{for } L/R > 8$$

where:
K = hydraulic conductivity [ft/sec]
r = casing radius [ft]
L = length of open screen (or borehole) [ft]
R = filter pack (borehole) radius [ft]
T_0 = Basic Time Lag [sec]; value of t on semi-logarithmic plot of $H\text{-}h/H\text{-}H_0$ vs. t, where H-h/H-Ho = 0.37
H = initial water level prior to removal of slug
H_0 = water level at t = 0
h = recorded water level at t > 0

(Hvorslev, 1951; Freeze and Cherry, 1979)

The Bouwer-Rice expression for hydraulic conductivity (K) is:

$$K = \frac{r^2 \ln (R_e/R) \ln(h_o/h_t)}{2\,L\,t}$$

where:
r = casing radius [ft]
t = time of drawdown measurement since start of test [sec]

h = drawdown of water in well at time = t [ft]
h_o = drawdown of water in well at t = 0 (initial drawdown) [ft]
L = length of open screen (or borehole) [ft]
R_e = effective radius (radius of influence) [ft]
R = gravel pack radius [ft]

Both the Hvorslev and Bouwer-Rice methods can be applied for partially-penetrating wells. Hvorslev is generally applicable only to fully penetrating wells.

5. References

Bouwer, H., "The Bouwer and Rice Slug Test – An Update," Ground Water, vol. 27(3), 304, 1989.

Butler, James, J., Jr. "Improving the Quality of Parameter Estimates Obtained from Slug Tests", Ground Water, Vol. 34, No. 3, May-June 1996.

Butler, James J., Jr., "The Design, Performance, and Analysis of Slug Tests", Kansas Geological Survey, Lewis Publishers, 1997.
Chirlin, G.R. (1989), A Critique of the Hvorslev Method for Slug Test Analysis: The Fully Penetrating Well.

Fetter, C.W. (1994), Applied Hydrogeology, 3rd edition.

Freeze, R. Allen and John A. Cherry, 1979. Groundwater, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Hvorslev, M.J., "Time Lag and Soil Permeability In Ground-water Observations," U.S. Army Corps of Engrs. Waterways Experiment Station Bulletin No. 36, 1951.

Lambe, T.W, and R.V. Whitman (1969), Soil Mechanics.

Sanders, Laura L., "A Manual of Field Hydrogeology", Prentice-Hall, Inc., 1998.

U. S. EPA ENVIRONMENTAL RESPONSE TEAM STANDARD OPERATING PROCEDURES SOP: 2043,"Water Level Measurement" REV: 0.0, 10/03/94.

U. S. EPA ENVIRONMENTAL RESPONSE TEAM STANDARD OPERATING PROCEDURES SOP: 2046,"Slug Tests" REV: 0.0, 10/03/94

6. Attachments

Attachment A – Slug Test Data Form

7. Contacts

Andy Adinolfi
Saskia Oosting

Attachment A. Slug Test Data Form

SITE ID: ________________

SLUG TYPE (solid/bailer/pumped)

LOCATION/WELL ID ___________

SLUG DIAMETER: _____________

DATE: ______________________

SLUG LENGTH: _______________

FIELD PERSONNEL: ______________

____

METHOD:

RISING HEAD ____________

FALLING HEAD __________

DATALOGGER TYPE:

____

____

COMMENTS:

____

____

===

SETUP

Time _______________
Depth to Water - Initial Static (before installing troll/slug) ___________
Confirm well recovers to static after installing slug, or note otherwise
____

===

MANUAL CONFIRMATORY MEASUREMENTS

ELAPSED TIME (min.)	DTW	ELAPSED TIME	DTW
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________
____________	_____________	_______________	_______________

Form based on:
USEPA, 1994; Sanders, 1998.

STANDARD OPERATING PROCEDURE

GW-011 Constant Head Permeability Testing

1. Objective

Describe procedures for performing constant head borehole permeability testing in granular soils. Constant head permeability testing is used when the soil permeability is sufficiently high for testing to be practical.

2. Execution

- All borehole permeability testing shall be performed below the static groundwater table. As the boring is advanced, attempt to determine the static groundwater level by:
  - Observing the water content of samples collected from the boring to identify the transition from moist to saturated soil.
  - For higher permeable soils, allowing the water level in the borehole to stabilize before performing the test.
  - If the borehole is left open overnight or for an extended period, measure the static groundwater level in the borehole at the beginning of the next day.
  - Measure the water level in nearby observation wells or piezometers.
  - If a well or piezometer is installed in the borehole, measure the water level in the well or piezometer after the water level has stabilized.
- Advance the drill casing to the top of the test zone and clean the borehole to the bottom of the casing.
- Obtain a split spoon sample in the test zone below the bottom of the casing.
- Advance the borehole 2 feet below the bottom of the casing using a side discharge roller bit. The roller bit should be only slightly smaller than the inside diameter of the casing. Record the diameter of the casing and the diameter of the roller bit. Avoid jetting the borehole walls or bottom during cleaning. Continue flushing the borehole until return water is clear.
- Measure the depth to groundwater in the borehole over a 10 to 15 minute period to observe if the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole.
- Using a weighted tape, sound the bottom of the borehole to verify that the hole is cleaned to the correct depth and caving hasn't occurred. If more than 3 inches of wash remains in the borehole, lower the roller bit back to the bottom of the borehole and continue to clean the borehole.
- Measure and record the depth to the bottom of the borehole to the nearest 0.05 feet.
- Determine the length of the test zone (L = distance from the bottom of the casing to the bottom of the borehole) to the nearest 0.05 feet and record on the field form.
- Add clean water to fill the casing.

- Using a calibrated flow meter, adjust the flow rate into the casing so the water level remains within 0.5 inches of the top of the casing. Once the water level has stabilized, take a flow meter reading at the start of the test (time=0). Record the inflow volume at regular intervals (generally 1 minute) for a period of 10 minutes.
- Check the depth to the bottom of the borehole after completion of the test to check for caving.
- Record all measurements and observations on the Borehole Permeability Test Field Data Form.

3. Limitations

Site-specific conditions must be evaluated to determine appropriate test intervals. Test interval shall be determined by the Project Manager or their designee.

4. References

GEI Procedure No. 44, Borehole Permeability Testing in Granular Soils

U.S. Department of the Interior Bureau of Reclamation Ground Water Manual, Chapter 10: Permeability Tests in Individual Drill Holes and Wells.

5. Attachments

Attachment A - GEI Borehole Permeability Test Field Data Form – Constant Head

6. Contacts

Steve Hawkins
Kari Weber

BOREHOLE PERMEABILITY TEST - CONSTANT HEAD
FIELD DATA FORM

PROJECT:		BORING :
LOCATION:		PROJ NO.:
CLIENT:		TEST NO.:
PERF'D BY:	DATE:	PAGE NO.:
CALC'D BY:	DATE:	GROUND
CHECKED:	DATE:	SURF. EL.:

STANDPIPE/RISER DETAILS

Riser inside diameter,d,inches: __________

Riser length, feet: __________

Riser stick up above ground surface, feet: __________

Groundwater depth below ground surface, H, feet: __________

Test Start Time: __________

Test End Time: __________

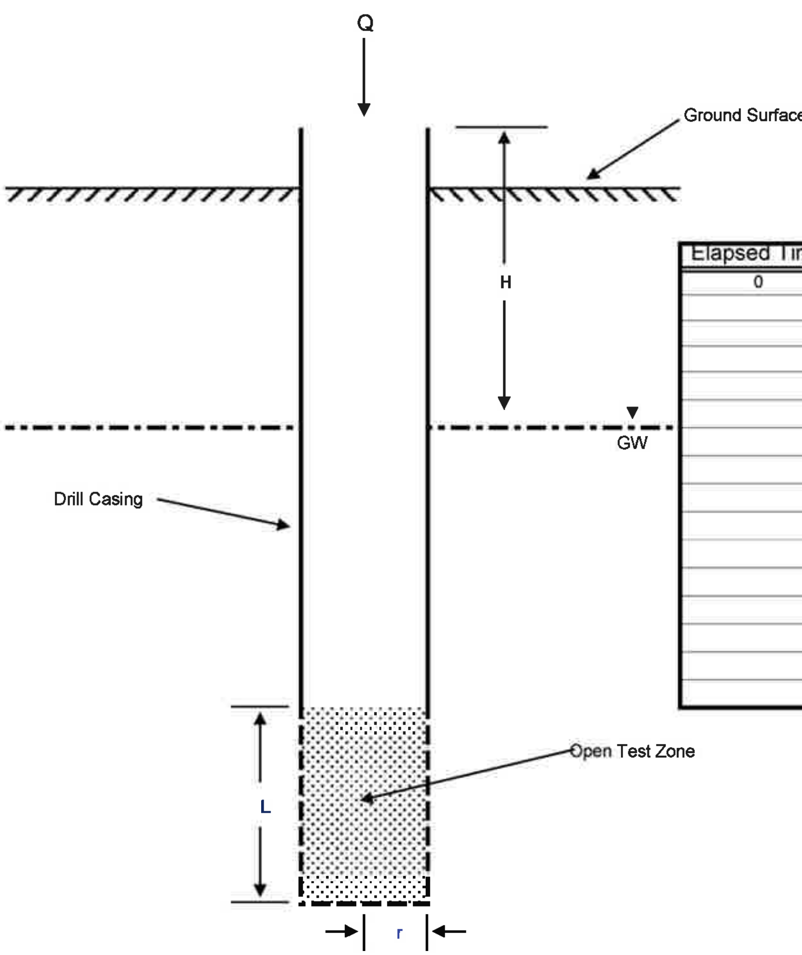
TEST INTERVAL DETAILS

Depth to bottom, feet (below ground surface): __________

Depth to top, feet (below ground surface): __________

Length, L, inches: __________

Water flow to achieve constant head, Q: __________
(volume/time)



Elapsed Time	Inflow	Overflow
0		

NOTES: 1. Based on the Constant Head Permeability Test SOP:
Created for the CT River Levee Projects, GEI Consultants
October 2008.

STANDARD OPERATING PROCEDURE

GW-012 Open Standpipe Piezometer

1. Objective

The objective of this standard operating procedure (SOP) is to standardize the installation of open standpipe piezometers for geotechnical evaluations. This SOP assumes the piezometers will be constructed from threaded, flush-joint PVC pipe; the piezometer tip will either be constructed from a factory-slotted pipe or a porous stone. Piezometer dimensions (riser diameter, riser length, piezometer tip length, and slot-diameters for screened tip or pore size for porous tips) and filter sand gradation will be specified in the Work Plan.

2. Execution

All measurements taken during the installation are to be recorded on the GEI Open Standpipe Piezometer Installation Report Form.

- Using a weighted tape, measure and record the depth of the completed soil boring before beginning the piezometer installation.
- Measure the depth to groundwater in the borehole over a 10 to 15 minute period to observe that the groundwater elevation has approximately stabilized. Compare the saturated soil depth estimated from split-spoon samples to the measured water level in the borehole.
- Choose the riser length so that the piezometer tip (slotted section or porous stone) is located in the appropriate zone as specified in the Work Plan or determined by the project manager or their designee.
- If the borehole is deeper than the desired piezometer depth, then fill the base of the borehole with bentonite up to a depth equal to 12 inches below the bottom of the piezometer. If bentonite is added, slowly extract the casing or augers while adding the bentonite to maintain the level of bentonite at or near the bottom of the casing or augers. As an alternative to bentonite, the driller may, at their option, replace the bentonite with grout, but the grout must be allowed to set up overnight before proceeding with the installation.
- Pour at least 12 inches of clean filter sand into the borehole. As sand is added to the borehole, slowly extract the casing or augers to maintain the sand level at or near the bottom of the casing or augers. The bottom of the casing or augers should not extend more than 6 inches above the top of the filter sand at any time. Allow the filter sand enough time to settle. Measure and record the depth to the top of the filter sand to the nearest 0.1 foot.
- Assemble the piezometer including the riser, screen, silt trap, etc. Install and secure a bottom cap. The bottom cap should be secured with either a threaded coupling and/or stainless steel screws.
- Temporarily cover the top of the riser pipe and lower the complete piezometer plus riser into the borehole allowing the base to rest on the filter sand placed previously. Make sure that the piezometer is centered in the borehole.

- Pour sand around the piezometer, frequently checking the depth to confirm that the sand is not bridging. As sand is added to the borehole, slowly extract the casing or augers to maintain the sand level at or near the bottom of the casing or augers. The bottom of the casing or augers should not extend more than 6 inches above the top of the filter sand at any time.
- Add enough filter sand to fill the annulus between the piezometer and the borehole to a height of approximately 2 feet above the top of the slotted or porous section of the piezometer tip. Record the depth to the top of the filter sand to the nearest 0.1 foot.
- Slowly pour bentonite chips into the annulus between the piezometer riser and the borehole. As bentonite is added to the borehole, slowly extract the casing or augers to maintain the bentonite level at or near the bottom of the casing or augers. Frequently check the level of the bentonite in the borehole to ensure that the bentonite is not bridging.
- Place bentonite to form a minimum 3-foot-thick seal above the filter sand pack. Record the depths to the top and bottom of the bentonite seal to the nearest 0.1 foot. If the seal extends above the water table, use at least 5 gallons of potable water to hydrate the bentonite.
- Before removing the casing or augers, lower a tremie pipe to the bottom of the borehole, and begin to pump bentonite-cement grout into the borehole. Grout should be mixed in approximately the following proportions: 7.5 gallons water to one 94-lb. bag of cement to 2-4 lbs of pulverized bentonite. The grout must be mixed using the pump on the rig to ensure proper mixing.
- As grout is added to the borehole, slowly extract the casing or augers to maintain the grout level at or near the bottom of the casing or augers. The bottom of the casing or augers should not extend more than 6 inches above the top of the grout at any time.
- Continue pumping grout to fill the borehole. The driller should use caution to ensure that grout does not enter the piezometer riser. Protective surface casing will consist of either a flush-mounted road box or a steel guard pipe. If a road box is to be used for surface casing, measure the length of the road box. Fill the grout so that the level reaches 4” to 6” below the bottom of the roadbox length. Fill the annular space with filter sand for drainage.
- If a steel guard pipe is used as protective casing, place the protective surface casing in the grout before it sets. The base of the guard pipe must extend at least 3.5 feet below the ground surface (below the frost line), and have a stick-up of no more than 3 feet above the ground surface.
- Cut the piezometer riser flat and place a mark or "V"-notch or an arrow on the casing with an indelible marker at one point for surveying and groundwater measurements. Cut the riser so that the top of the riser is 3 to 6 inches below the top of the protective casing.
- In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the road box FLUSH with the ground surface to avoid damage to the piezometer. Additional protection such as steel pole bumpers around the guard pipe may be necessary.
- Place a vented, locking cap on the piezometer pipe.

- All piezometer locations should be photo documented in accordance with SOP FD-004 Photo documentation.
- Label the protective casing with a paint pen and tape out the location to nearby landmarks so that the piezometer may be located in the future. Make sure to enter this information in the field notebook). If possible, place a brightly colored stake or other identifier adjacent to the piezometer.
- Develop the piezometer (see SOP DM-009, *Monitoring Well Development*).

3. Limitations

- If drilling mud is used to advance the borehole, the drilling mud MUST be Revert or other biodegradable drilling mud approved by the project manager.
- At all times, follow safety procedures as defined in the site-specific Health and & Safety Plan.
- Site-specific conditions must be evaluated to determine appropriate materials.
- Do not screen across different hydrostratigraphic units if possible (for example, outwash sands and till) unless specified in the Work Plan or approved by the Project Manager.
- If the formation is composed of a material that is uniformly coarser than the filter sand, the grain size of the filter sand must be increased. Consideration should also be given to changing the slot size on the well screen. Differences in average grain size should generally not be greater than a factor of two to four times. Gradation of filter sand used is to be reviewed and approved by the project manager or their designee.
- Do not use borehole/auger cuttings for backfill during monitoring well installation. If the cuttings are suspected to contain contamination which was identified during drilling, cuttings are to be containerized for later characterization and not used for filter pack materials.
- Do not screen across a confining layer (e.g., silt or clay). Backfill all confining layers with hydrated bentonite or grout.

4. References

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

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

5. Contact(s)

Steve Hawkins
Kari Weber

STANDARD OPERATING PROCEDURE

GW-013 Vibrating Wire Piezometer Construction and Installation

1. Objective

The objective of this standard operating procedure (SOP) is to standardize the installation of vibrating wire piezometers for geotechnical evaluations. This SOP assumes the piezometers will be supplied by the manufacturer ready for installation and accompanied by factory calibration data. Piezometer details (installation depth and cable length) will be specified in the Work Plan.

2. Execution

- All measurements taken during the installation, including the manufacturer's serial number and calibration data are to be recorded on the GEI Vibrating Wire Piezometer Installation Report Form.
- Using a weighted tape, measure and record the depth of the completed soil boring before beginning the piezometer installation.
- Measure the length of the cable required to set the piezometer tip at the depth specified in the Work Plan or determined by the project manager or their designee. Make a mark on the cable with a permanent marker or electrical tape at a distance from the piezometer tip equal to the planned installation depth. Record the distance from the piezometer tip to the mark to the nearest 0.05 feet. This mark should line up with the top of the borehole when the piezometer tip is lowered to the correct depth. Place an additional mark 5 feet above the initial mark. The additional mark can be used to determine the final piezometer depth in the event that the first mark becomes obscured.
- Place the piezometer in a piece of slotted PVC pipe or a porous filter bag filled with filter sand, and attach the PVC or bag to the piezometer cable. This will aid in removing slack from the instrument cable during installation.
- If the borehole is deeper than the bottom of the desired sand filter zone depth, slowly fill the borehole with bentonite chips to a depth of approximately 2 feet below the planned piezometer tip elevation. Take a borehole depth measurement after adding bentonite to make sure the bentonite did not bridge.
- Slowly raise the casing or augers and simultaneously pour clean filter sand in the borehole to maintain the level of the filter sand near the bottom of the casing or augers. The bottom of the casing or augers should not be raised more than 6 inches above the top of the filter sand at any point during the installation.
- Continue placing sand until the level of the sand is approximately 6 inches below the planned piezometer tip elevation.
- Lower the piezometer into the borehole to a point just above the water level in the casing, and allow the piezometer to stabilize thermally. Thermal stabilization usually takes about 5 to 15 minutes. Thermal stabilization is assumed to have occurred once

the piezometer reading has stopped changing while the piezometer is suspended in the borehole.

- Obtain the initial zero reading from the piezometer using a read-out box. Record the zero reading and the temperature reading. If the read-out box does not have a temperature read-out, use an ohm meter to measure the resistance across the thermistor. This resistance can be converted to a temperature reading. Compare the measured zero reading to the factory zero reading. The zero reading should be within 20 digits of the factory zero reading after barometric and temperature corrections are made.
- Lower the piezometer in the borehole to the planned installation depth, and allow the piezometer to thermally stabilize for 15 to 20 minutes.
- Measure the depth to the water level in the borehole using a water level indicator, determine the height of the water column above the piezometer tip, and estimate the water pressure at the piezometer tip (height of water column times the unit weight of water). Record the measured water level and estimated water pressure.
- Take a piezometer reading to verify that the vibrating wire piezometer is reading correctly. Calculate the temperature-corrected pressure head. Record the piezometer reading, temperature, and pressure head. The piezometer is reading correctly if the measured pressure head approximately equals the estimated water pressure at the piezometer tip, calculated based on the measured water level. The piezometer reading should be within 0.5% of the estimated water pressure.
- Raise the piezometer 5 to10 feet, measure the water level in the borehole, and calculate the water pressure at the piezometer tip. Take a piezometer reading, and calculate the temperature-corrected pressure head. Record the piezometer reading, temperature, and pressure head. Compare the pressure head from the piezometer with the estimated water pressure. Again, the piezometer reading should be within 0.5% of the estimated water pressure.
- Lower the piezometer tip back to the planned installation depth, measure the water level in the borehole, and calculate the water pressure at the piezometer tip. Take a piezometer reading, and calculate the temperature-corrected pressure head. Record the piezometer reading, temperature, and pressure head. Compare the pressure head from the piezometer with the estimated water pressure. Again, the piezometer reading should be within 0.5% of the estimated water pressure.
- Tie off the piezometer cable to prevent the cable from falling into the borehole while the casing or augers are removed. The cable should be kept free of slack during the casing or auger removal and backfilling of the borehole.
- Remove the drill casing or augers from the borehole slowly at a maximum of 6inch intervals. As the casing or augers are raised, the driller should slowly add filter sand to maintain the level of the filter sand near the bottom of the casing or augers. As the driller pours the sand into the borehole, take frequent measurements of the depth to the top of the sand. Do not let the sand "bridge" in the borehole.
- Using the marks placed on the cable at the start of the installation, confirm that the piezometer is installed to the correct depth.
- Continue slowly removing the casing or augers and slowly add adequate filter sand to surround the piezometer and fill the borehole to a height of approximately 2 feet above the piezometer tip and record the depth to the nearest 0.1 foot.

- Confirm that the piezometer is installed to the correct depth.
- Measure the water level in the borehole.
- Place at least 3 feet of bentonite chips above the filter pack to create a seal. Record the depths of the top and bottom of the bentonite seal to the nearest 0.1 foot.
- Before removing the drill casing or augers from the borehole, lower a tremie pipe to the bottom of the borehole, and pump bentonite-cement grout through the tremie pipe until good quality, undiluted grout return is observed at the ground surface. Grout should be mixed in approximately the following proportions: 7.5 gallons of water to one 94-lb. bag of cement to 2-4 lbs. of pulverized bentonite. The grout must be mixed using the pump on the drill rig or other high shear mixer to ensure proper mixing.
- After grouting the borehole and removing the drill casing or augers, place the protective surface casing in the grout before it sets. The protective surface casing will be either a flush-mounted road box or a steel guard pipe. If a steel guard pipe is used, the base of the guard pipe must extend at least 3.5 feet below the ground surface (below the frost line), and have a stick-up of no more than 3 feet above the ground surface.
- Confirm that the piezometer is installed to the correct depth.
- Record a second set of readings to verify that the piezometer continues to operate as expected. Coil any excess cable inside the protective surface casing. The cable must be accessible from the top of the protective surface casing.
- Place concrete in the annular space between the protective casing and the borehole up to the ground surface. Slope the concrete radially away from the protective casing at the ground surface to promote surface water runoff. In areas of high traffic or areas of parking lots and/or roadways where plowing occurs, set the road box FLUSH with the ground surface to avoid damage to the road box.
- If the piezometer is installed in a high-traffic area with a guard pipe, additional protection such as steel pole bumpers around the guard pipe may be necessary.
- All piezometer locations should be photo documented in accordance with SOP FD-004 Photo documentation.
- Label the protective surface casing with a paint pen and tape out the location to nearby landmarks so that the piezometer may be located in the future. Enter this information in the field notebook. If possible, place a brightly colored stake or other identifier adjacent to the surface casing.

3. Limitations

- At all times, follow safety procedures as defined in the site-specific Health and Safety Plan.
- Site-specific conditions must be evaluated to determine appropriate materials.
- The gradation of the filter sand should be selected based on the gradation of the formation material. The gradation of the filter sand is to be reviewed and approved by the project manager or their designee.

- Do not use drill cuttings for backfill during piezometer installation. If the cuttings are suspected to contain contamination which was identified during drilling, cuttings are to be containerized for later characterization.

4. References

Dunnicliff, J. (1988), Geotechnical Instrumentation for Monitoring Field Performance,John Wiley and Sons, Inc.

Instruction Manual, Model 4500 Vibrating Wire Piezometer (2005), Geokon, Inc.

5. Attachments

Attachment A - GEI Pressure Calculation and Temperature Correction Sheet
Attachment B - GEI Vibrating Wire Piezometer Installation Report Form

6. Contacts

Steve Hawkins
Kari Weber

Attachment A

Pressure calculation and Temperature correction Sheet

Vibrating Wire Piezometer

Pressure = (Initial Reading – Current Reading) x Linear Gage Factor

Or

$$P = (R_0 - R_1) \times G$$

Temperature Correction = (Current Temp. – Initial Temp.) x Thermal Factor

Or

$$P_T = (T_1 - T_0) \times K$$

Corrected Pressure = Pressure + Temperature Correction

Or

$$P_{corrected} = ((R_0 - R_1) \times G) + ((T_1 - T_0) \times K)$$

1	2	3

Note: If the Linear Gage Factor with the units of psi/digit and the Thermal Factor with the units of psi/°C are used, the calculated pressures will be in units of psi. To convert from psi to feet of water, multiply by 144 and divide by 62.4.

Estimated water pressure at piezometer tip = height of water above tip x unit wt. of water
Unit weight of water = 62.4 lb/ft^3

Note: The height of water must be in units of feet. The water pressure will be in units of feet of water.

<u>Calculation Results</u>:

1.) Initial Calculation – Planned installation depth:

Temperature-corrected pressure head: ______________________________

Estimated water pressure at piezometer tip: ______________________________

2.) Second Calculation – Raise piezometer 5 to 10 feet:

Temperature-corrected pressure head: ______________________________

Estimated water pressure at piezometer tip: ______________________________

3.) Third Calculation – Lower piezometer back to planned installation depth:

Temperature-corrected pressure head: ______________________________

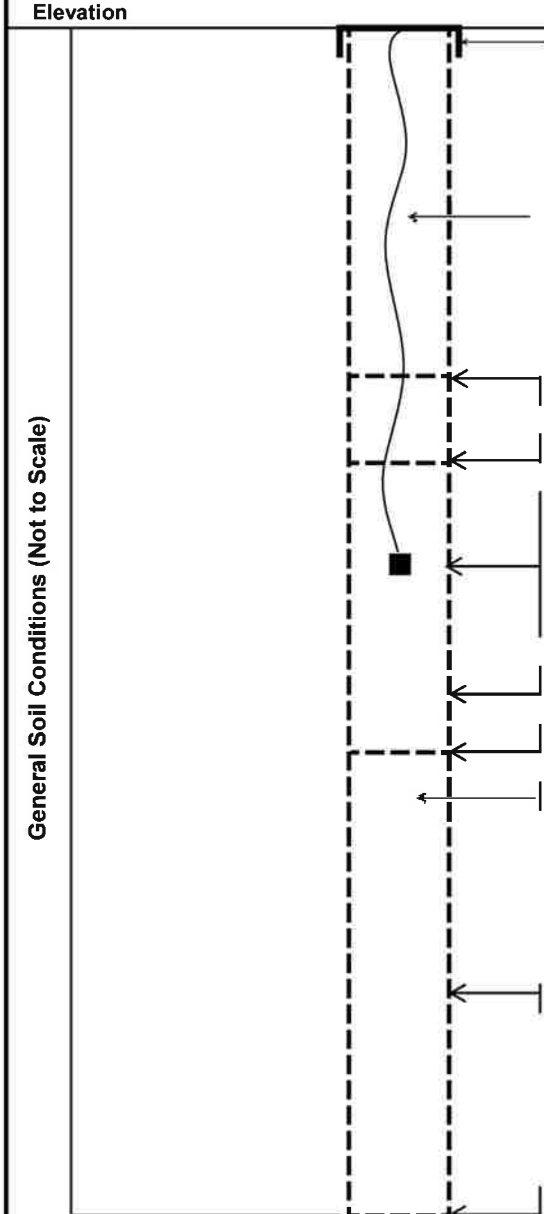
Estimated water pressure at piezometer tip: ______________________________

Vibrating Wire Piezometer Installation Report

PROJECT	Hartford Levee Certification Phase II	**PROJECT NO.**	
LOCATION	Hartford, Connecticut	**BORING NO.**	
CLIENT	The City of Hartford	**LOCATION**	
CONTRACTOR			Station:
DRILLER			Offset:
GEI REP.		**INSTALL DATE**	

Survey Datum NAVD 88

Ground Surface Elevation



Type and size of protective cover ______

Type of Backfill Above Betonite Seal ______

Depth to Betonite Seal ______ ft

Depth to Top of Sand Filter ______ ft

Piezometer Model # ______
Piezometer Designation ______
Depth of Piezometer Tip ______
Elevation of Piezometer Tip ______
Piezometer Serial No. ______

Type of Sand Filter Around Instrument ______

Depth to Bottom of Sand Filter ______ ft

Type of Backfill Below Sand Filter ______

Diameter of Borehole ______

Bottom of Borehole ______ ft

<u>**NOTES**</u>:

______ feet = Length of cable and instrument
______ Calibration Factor
______ in HG = initial barometric pressure
______ Digits = Zero reading
______ Temperature / deg C = Zero reading

1. Based on the Vibrating Wire Piezometer Installation SOP: Created for the CT River Levee Projects, GEI Consultants October 2008.

GEI Consultants

STANDARD OPERATING PROCEDURE

GW-014 Dense Non-Aqueous Phase Liquid (DNAPL) Measurement and Recovery

1. Objective

Provide procedural guidance for routine gauging and recovery of dense non-aqueous phase liquids (DNAPL) related to former manufactured gas plant (MGP) operations.

2. Execution

2.1 Equipment and materials

The following materials and equipment are necessary for this procedure:

- Oil/water interface probe
- Appropriate pump and required tubing/piping
- Double check valve bailers and string
- Drums or buckets for NAPL collection
- Proper PPE including gloves and protective eyewear
- Drum labels
- Field data sheets or logbooks
- Decontamination supplies and plastic sheeting
- Additional equipment identified by site-specific work plan and HASP
- Example specifications of DNAPL management equipment is included as Attachment A.

2.2 General Measurement Procedures

Using an oil/water interface probe will provide a depth to water and a depth to product in each monitoring well. Refer to probe manual to determine changes between liquid type. To achieve accurate depth measurements, ensure the oil/water interface probe is decontaminated (GEI SOP QA-001 prior to and between each measurement taken at each well.

To calculate the volume of product in monitoring wells with these specifications, take the following measurements:

- Total well length
- Depth to water
- Depth to product (s) – c1 and c2

Using the following equations, determine the length of the water column and the length of the product column:

[1] (a) – (b) = Water column length (d)
[2] (a) – (c1) = Product column length (e) dense non-aqueous phase liquid (DNAPL)

Calculate the volume of DNAPL product in the well using the following equation:

DNAPL for a 2" diameter well
[4] (e) x 0.1632 = Volume (gallons) of product in well
(e) x 0.6178 = Volume (liters) of product in well

DNAPL for a 4" diameter well
[4] (e) x 0.6528 = Volume (gallons) of product in well
(e) x 2.4711 = Volume (liters) of product in well

DNAPL for a 6" diameter well
[4] (e) x 1.469 = Volume (gallons) of product in well
(e) x 5.561 = Volume (liters) of product in well

Once measurements have been taken and calculations have been made, collection of dense non-aqueous phase liquid (DNAPL) may commence.

2.3 DNAPL Collection Procedures

Collection of DNAPL shall be accomplished using common recovery techniques or technologies as follows:

- Peristaltic pumps
- Bailers
- Positive displacement down hole pumps (e.g. Hammerhead, Blackhawk pumps, etc)

Special care shall be taken to prevent any purged DNAPL causing a spill and coming into contact with the ground and sampling personnel. This includes the use of proper personal protective equipment (PPE), including gloves and protective eyewear (Tyvek® if necessary), along with plastic sheeting set beneath the pump, tubing, and collection container (sealed top 55-gallon drum or 5-gallon bucket with lid), and the surrounding work area. A site-specific work plan, HASP and job specific job safety analysis need to be developed prior to the start of work. Examples of DNAPL specific management equipment and tools are included as Attachment A. The specific operating procedures for common recovery methods are discussed in the following sections.

2.3.1 Sampling and recovery via peristaltic pump with dedicated tubing:

- Take and record the required measurements prior to commencing pumping.
- Connect the dedicated tubing to the peristaltic pump with the long end of the silicon tubing set to discharge water and product directly into either a 5-gallon bucket or a 55-gallon closed-top drum, ensuring that the entire set-up is underlain by plastic sheeting.
- Begin purging the well, occasionally checking the depth to water and depth to product.
- Once the DNAPL has been purged from the well, a sample will be collected and preserved if required, in accordance with laboratory standards.

- Following completion of NAPL recovery, disconnect the tubing from the pump, secure the well and road box, and clean/decontaminate the pump and oil/water interface probe, prior to moving to the next location.
- Impacted tubing will either be containerized for proper disposal or left in well for reuse.

2.3.2 Sampling and recovery via double check valve bailer:

- Take and record the required measurements prior to commencing bailing.
- Ensure the entire work area is covered in plastic sheeting to avoid potential spills of water and/or product.
- Tie the bailer to a piece of string that will allow the bailer to reach the bottom of the well.
- Using slow and controlled motions while lowering (and raising) the bailer to the bottom of the well, commence bailing product out of the well and draining the bailer directly into either a 5-gallon bucket or a 55-gallon closed-top drum.
- Once the NAPL has been purged from the well, collect and preserve the analytical sample, if required, in accordance with laboratory standards.

2.3.3 Sampling via piston-style pumps (HammerHead, Blackhawk etc)

For significant accumulations of DNAPL a variety of dedicated pumping technologies exist. Refer to manufacturer-specific operating procedures and site specific means and methods.

2.4 Waste Management and Disposal

Investigation derived waste should be managed in accordance with GEI SOP SC-003. Additional care should be taken with DNAPL while infrequent the potential for hazardous waste characteristics does exist. DNAPL waste management and disposal should be evaluated on a site by site basis as discussed in Section 3.

2.5 Troubleshooting Information

If there are any performance problems with the oil/water interface probe which result in inability to achieve the proper measurements presented in Section 5.1, or if there are any problems with the peristaltic pump, consult the appropriate section of the probe instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

Lower temperatures can affect the ability to pump and/or bail NAPL. Weather should be taken into consideration when scheduling gauging and recovery sampling events.

2.6 Data and records management

All information pertaining to maintenance of the oil/water interface probe and the peristaltic pump shall be maintained in the project file. Field measurements (depth to water, product, *etc.*) and all calculations (product column length, volume of product, *etc.*) shall be recorded on the appropriate field data sheets or in the logbook consistent with GEI SOP Section 5.

2.7 Health and safety considerations

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

3. Limitations

- DNAPL gauging and recovery can be problematic and requires adaptive thinking. A variety of measurement and collection techniques may be necessary to properly execute the work.
- Exposure to DNAPL can accelerate the required maintenance/replacement intervals for tools and equipment.
- A site specific work plan, HASP and JSA needs to be developed prior to commencing work. The documents should address: safety, recovery technologies, waste containment and waste management.

4. References

U.S. EPA. Ground Water Issue: Dense Non-aqueous Phase Liquids, EPA/540/4-91-002, March 1991.

5. Attachments

Attachment A – Example specifications of DNAPL recovery and management tools and equipment.

6. Contact

Jerry Zak

nationalgrid

Tracey Bell
Manager
Environmental Asset Management

April 13, 2009

Mr. Amen M. Omorogbe, P.E.
Project Manager
New York State Department of Environmental Conservation
MGP Remedial Section, Division of Environmental Remediation
Bureau of Western Remedial Action, 11th Floor
625 Broadway
Albany, New York 12233-7017

Re: DNAPL Recovery Wells Pilot Test Work Plan
Carroll Gardens/Public Place
Former Citizens Gas Works Manufactured Gas Plant Site
Brooklyn, New York
Site No.: C224012

Dear Mr. Omorogbe:

The DNAPL Recovery Wells Pilot Test Work Plan (Work Plan) program is intended to characterize and assess the mobility and potential for recovery of dense non-aqueous phase liquid (DNAPL) at the Former Citizens Gas Works Manufactured Gas Plant (MGP) site (Site) located in the Carroll Gardens/Public Place neighborhood of Brooklyn, New York (Figure 1). The pilot test program will generate data required to develop a final DNAPL recovery approach for the Site, which will be presented as part of the Remedial Design Work Plan (RDWP).

The Final Remedial Investigation Report (RI), dated October 2005, and the Remedial Design Work Plan, dated September 12, 2007, included the recommendation that an on-site DNAPL recovery system be evaluated as one mechanism to control potential DNAPL migration on Parcels I, II, and III. The DNAPL recovery test wells will be installed at boring locations where DNAPL (tar) saturated soils, considered to have the potential for DNAPL recovery, were observed during boring installations. The intended recovery test well locations were selected based on the following investigations:

- During the RI field effort, a number of locations were identified as meeting the criteria for potential DNAPL recovery wells and were noted for consideration in the RDWP. These locations were further evaluated by additional borings at each location during the RDWP pre-design field investigation.
- During the RDWP pre-design field activities, additional locations were identified and investigated as potential DNAPL recovery well locations.

The final proposed wells are listed in Table 1 with locations shown on Figure 2. A brief summary of RDWP findings, pertinent to the activities proposed in this Work Plan, is provided below. The complete RDWP findings will be presented and submitted to the New York State Department of Environmental Conservation (NYSDEC) in a Data Report to follow the pre-design investigation as outlined in the RDWP. The soil boring and test pit logs utilized to develop this Work Plan are attached.

The pertinent findings from the RI and RDWP pre-design investigation used to locate potential recovery well stratigraphic zones are as follows:

- **Parcel I**: DNAPL saturated soils were observed at a number of locations within the intermediate zone soils to approximately El.-51 ft (the zone is defined as being approximately El -20 ft to -90 ft NAVD 88). No DNAPL saturated soils, considered to have the potential for DNAPL recovery, were observed in the shallow zone soils (above approximately El. -20 ft) and the deep zone soils (below El. -90 ft).

- **Parcel II**: DNAPL saturated soils were observed beneath a clay layer bordering the Gowanus Canal in the shallow and intermediate zone soils from approximately El.-15 ft to El.-57 ft (CGSB-127). No DNAPL saturated soils, considered to have the potential for DNAPL recovery, were observed in the deep zone soils (below El. -90 ft).

- **Parcel III:** DNAPL saturated soils were observed in shallow zone soils in test pit CGTP-103B located adjacent to the bulkhead of the Gowanus Canal at approximately El. 1.5 ft. A clay layer was observed along the bulkhead of the Gowanus Canal between approximately El.-4 ft and El.-17 ft between borings CGSB-120 and CGSB-123. DNAPL saturated soils were observed above the clay layer in the shallow zone soils in the vicinity of CGSB-121, CGSB-122 and CGSB-125. DNAPL saturated soils were observed within the intermediate zone soils and slightly into the deep zone soils. Specifically, DNAPL saturated soils were observed between approximately El.-69 ft and El.-91 ft at CGSB-121, and at CGSB-122 between El.-74 ft and El.-81 ft. These observations are consistent with the findings for the adjacent RI monitoring well CGRW-08D (boring log indicated tar saturated soil and tar veins from El.-76 ft to El.-86 ft).

The activities proposed in this Work Plan will address each of the following primary objectives.

- **Assess DNAPL mobility and recovery rates.**
  DNAPL recovery evaluation activities will include monitoring the wells for DNAPL accumulation, performing periodic recovery pumping and disposal events, and assessing the DNAPL recharge rates.

- **Evaluate the location of productive DNAPL recovery zones.**
  The results of the investigations will be used to evaluate which recovery wells have the potential to effectively and efficiently collect DNAPL.

- **Evaluate DNAPL recovery methods and equipment.**
  A number of different recovery methods and equipment will be evaluated as well as options for stand alone or manifolded well collection systems.

The remainder of this Work Plan has been organized into the follow sections: Scope of Work, Pilot Test Report, and Proposed Schedule. The scope of work includes details on recovery well construction, DNAPL monitoring and pumping frequency, and data analysis.

1.0 Scope of Work

1.1 Recovery Well Construction

As detailed above, potential DNAPL recovery zones exist in the intermediate zone soils in Parcel I, the shallow and intermediate zone soils in Parcel II, and the shallow, intermediate and deep zone soils in Parcel III. Well screens for the proposed DNAPL recovery pilot test wells will be placed within these zones and terminate above lower permeability soils (i.e. clay, till), if present. In general, the proposed screen interval was selected to intercept soil layers containing DNAPL saturated soils within a grain matrix conducive to potential DNAPL migration (i.e. sand, silty sand, gravel, etc.). The screen interval was also extended to include adjacent soil layers containing DNAPL saturated soil lenses. The supporting boring and test pit logs from the RDWP pre-design investigation used to site the recovery wells are attached. Table 1 summarizes the construction details of each proposed recovery well, and lists each well with the corresponding soil boring that was installed during RDWP pre-design investigation. The selected locations of the recovery wells are depicted on Figure 2. Parcel I and II recovery wells will be installed at their corresponding RDWP pre-design investigation soil boring locations. Since these were logged and soil samples were collected during the RDWP pre-design investigation, no additional samples or logs will be taken upon installation of these recovery wells.

For Parcel III, at proposed recovery pilot test well locations CGRW-05, CGRW-06 and CGRW-07, multiple recovery wells will be installed in a cluster formation within the vicinity of the corresponding RDWP pre-design investigation soil boring. Each cluster will contain a shallow, intermediate, and deep recovery well as described below. Each recovery well within a cluster will be installed within approximately 5 feet of the other wells in the cluster. For wells in the cluster that are not located at an existing boring location, drilling will advance to the proposed top of screen depth with continuous sampling thereafter to confirm the screen and sump location. When installation requires extension beyond the previous terminal depth due to the boring not terminating in a clean zone, the well boring will be continuously sampled below the former termination depth until approximately 10 feet of soil with minimal DNAPL impact is observed.

Due to the DNAPL chemistry at the Site, the PVC monitoring wells installed during the RI degraded and were subsequently abandoned. Therefore, as detailed below, the pilot test wells will be constructed using 6-inch diameter stainless steel. Based on the volume of DNAPL that was delineated during RI activities and coupled with the observations made during the RDWP pre-design field program, a 5-foot sump is proposed below the screen interval to facilitate DNAPL accumulation and collection. This is an increase from the 2-foot sump recommendation made in the RDWP.

Table 1 summarizes the proposed screen depth intervals and sump locations. These depths are approximate, and may be adjusted accordingly in the field based on subsurface conditions identified at the time to maximize potential DNAPL recovery. The recovery wells will be installed using hollow stem auger drilling techniques (or other appropriate methods) to the targeted depth of the recovery well, and will create a bore hole of approximately 10 inches in diameter. The recovery wells will be constructed of 6-inch inside diameter (ID), flush-threaded stainless steel continuous-slot well screen and solid casing with a 5-foot sump. The screen slot size and filter pack gradation will be developed as a function of the related soil formation. A 5-foot bentonite seal will be placed surrounding the sump. The annular space between the well screen and the borehole will be backfilled with filter sand to approximately 2-feet above the top of the screen interval. A 2-foot bentonite seal will be placed at the top of the sand pack. The remaining annular space will be filled with a cement/bentonite grout to the ground surface by tremie method. Each well will be protected with a lockable traffic rated well vault (Parcel II) or steel surface casing (Parcels I and III) secured with cement. Figure 3 depicts typical recovery well construction.

Final proposed recovery well locations vary from those initially proposed in the RDWP as follows:

- **Parcel I:** CGRW-01 has been added south of former Holder 3 due to the presence of potentially recoverable DNAPL; CGRW-02 has been moved about 50-feet north of its original location (CGMW-02) due to the limited recoverable DNAPL observed at the original location; and CGMW-03 has been deleted as a location due to the poor recharge rate noted during RI testing (2.5% DNAPL recovery after 6 months of recharge).

- **Parcel II:** The CGMW-07 location was deleted due to limited recoverable DNAPL observed at the original location; and CGRW-03 and CGRW-04 have been added due to the presence of potentially recoverable DNAPL.

- **Parcel III:** Clustered recovery wells (shallow (S), intermediate (I), and deep (D)) are proposed for each location. Specifically, recovery wells CGRW-05 S/I/D, -06 S/I/D and -07 S/I/D are proposed. The recovery well 06-cluster is located adjacent to the former CGMW-08 location. The remaining proposed wells (05- and 07-clusters) are at new locations farther north due to the presence of potentially recoverable DNAPL.

- Original well location CGMW-06 is located off site across Huntington Street along the southeast boundary of Parcel III. Due to its off-site location and permitting difficulties, the potential recovery well location is proposed on site across the street from the original well, designated as CGRW-08. This location is presently within the warehouse on the parcel. However, the warehouse and slab are presently being demolished and the approved Parcel III Pre-Design Investigation Work Plan will be implemented following the demolition. Under the Parcel III pre-design program a boring (CGSB-77) will be installed at the potential well location. Following the pre-design plan, this boring will be continuously sampled to a minimum depth of 95-feet bgs (El.-85 ft) or until approximately 10 feet of soil with minimal DNAPL impact is observed. Appropriateness as a recovery well location will be based on this boring.

- Other recovery well locations will be evaluated based on the finding of the Parcel III Pre-Design Investigation.

1.2 DNAPL Monitoring, Recovery and Disposal

Development of the recovery wells will be delayed for 3 to 5 days to distinguish between initial or stagnant DNAPL flow into the well versus DNAPL flow into the well that was influenced by well development procedures. Development procedures will follow the GEI standard operating procedures for well development included in the approved Field Sampling Plan of the Parcel III Pre-Design Investigation Work Plan. Recovery wells may be developed using a high flow pump and will be monitored for drawdown and recovery. Well development fluids will be pumped into 55-gallon drums, a large volume tank, or mobile tanker truck. All groundwater and DNAPL generated during development activities will be disposed off site at an appropriate facility. For the first month after a recovery well has been installed, the recovery well will be gauged and monitored weekly for depth to water, depth to DNAPL, and accumulated DNAPL thickness in the well sump.

If DNAPL is observed in a recovery well after 1 month, DNAPL recovery and monitoring activities will begin at the well and continue for 4 to 5 months in accordance with the following:

- After the DNAPL is recovered or pumped from the recovery well, the well will be gauged at a minimum of every 15 minutes for a period of up to 3 hours.

- If less than 10 percent recovery of the pre-pumping DNAPL level is measured during the initial 3-hour period, then the well will be gauged daily for 1 week and then weekly for up to 3 months or until 85 percent recovery is achieved. If 85 percent recovery is achieved within 1 month following the pumping event, then a second recovery event will proceed and be monitored according to the recharge rate observed after the initial pumping event.

- If greater than 10 percent recovery of the pre-pumping DNAPL level is measured during the initial 3-hour period, then hourly gauging would continue for a period of up to 8 hours or until the DNAPL level recovers to within 20 percent of its original level prior to pumping. After the 8 hours or 20 percent of the pre-pumping DNAPL level is recovered, gauging will proceed daily for 1 week and then weekly until 85 percent recovery is achieved. If 85 percent recovery is achieved within 1 month following the pumping event, then a second recovery event will proceed and be monitored according to the recharge rate observed after the initial pumping event.

- The general parameters may be modified based on observations made in the field.

Different methods of DNAPL recovery will be evaluated throughout the pilot test. These methods may include, as appropriate, pneumatic pumping, belt skimmer, periodic manual removal (bailers), peristaltic pumps, etc. If a bailer is used to recover the DNAPL, then time will be allotted (i.e. 1 to 2 hours) to allow for settlement of any DNAPL that may have been agitated by the bailer. Recovered DNAPL will be temporarily stored onsite in 55-gallon drums or other appropriate storage vessels pending off-site disposal.

Fieldwork will be performed under the approved Health and Safety Plan (HASP) of the RDWP.

2.0 Pilot Test Report

After the field recovery and monitoring program, a Pilot Test Report will be prepared and submitted to the NYSDEC. This report will summarize the recovery well installation and DNAPL recovery activities. The summary will include a calculation of DNAPL recovery rates, and an evaluation of the productivity of each recovery well and the recovery methods. Based on the estimated DNAPL recovery rates and evaluations provided in this report, a determination will be made on the viability of each well for an active DNAPL recovery system, a passive DNAPL recovery program, or abandonment of the well due to limited recovery potential.

3.0 Proposed Schedule

Work is anticipated to begin following NYSDEC approval of this Work Plan. It is anticipated that the field work detailed in this Work Plan can be completed within 6 months of NYSDEC approval of the plan.

If you have any questions or require additional information, please feel free to contact me at (718) 963-5645 or via e-mail at tracey.bell@us.ngrid.com.

Sincerely,

Tracey Bell
Manager

Enclosure

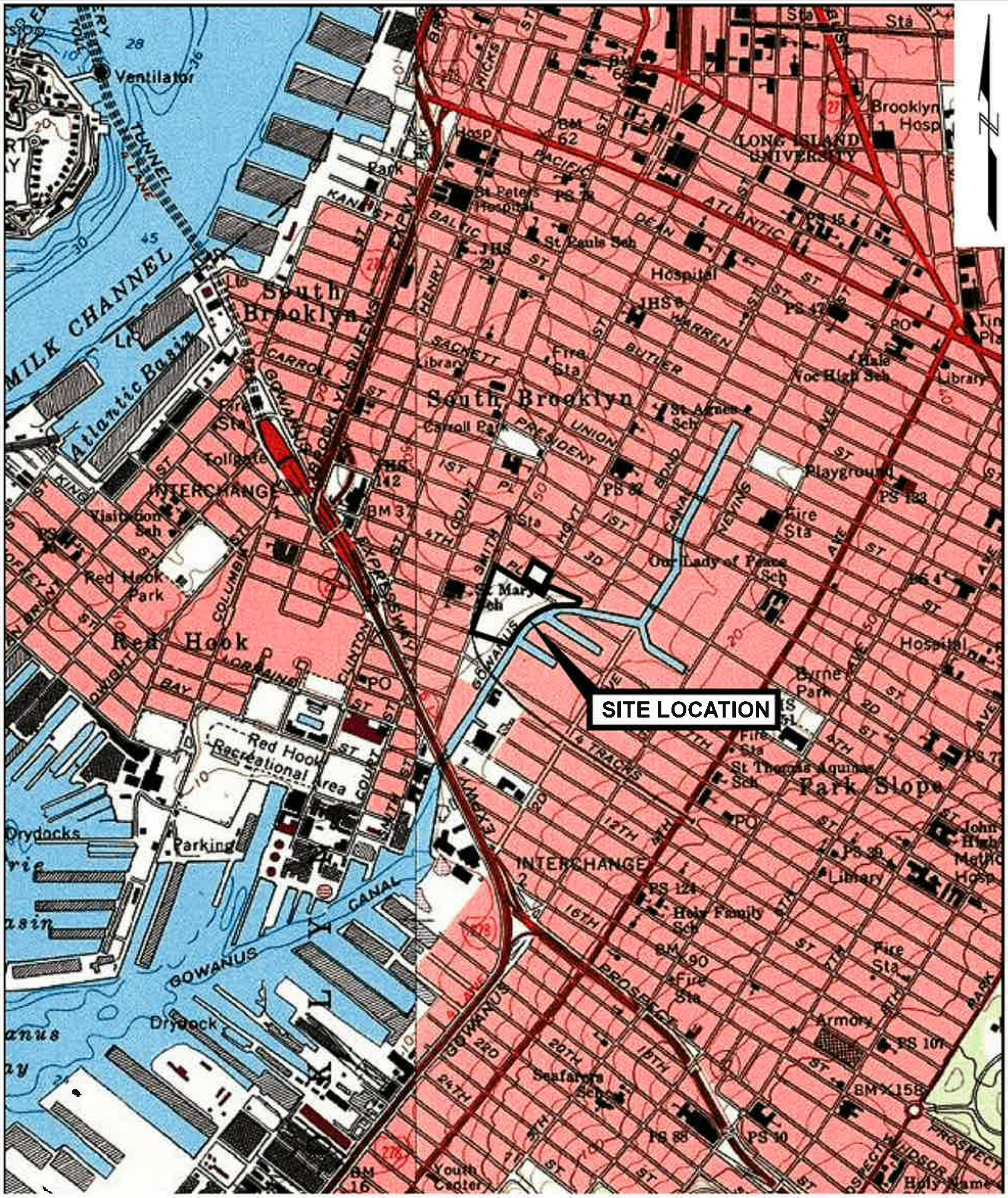
ec: G. Cross (NYSDEC)
C. Doroski (NYSDOH)

MZ/at H:\WPROC\Project\KEYSPAN\Citizen's Gas\Remedial Design\Remedial Design Investigation\DNAPL Recovery\Pilot Test\Work Plan\DNAPL Recovery WP Final to DEC (4-13-09).docx

Table 1
Proposed Pilot Test Recovery Well Construction
Carroll Gardens/Public Place Former MGP Site
Brooklyn, New York

Pilot Test Recovery Well (at/near RDWP pre-design investigation boring location noted)	Total Depth[1] (ft bgs)[2]	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Screen Interval Length (ft)/ Elevation (ft NAVD 88)	Adjacent RI/RDWP pre-design investigation Boring/Test Pit/Monitoring Well
Parcel I					
CGRW-01(at CGSB-117)	70	30	65	35 (-3 to -38)	CGSB-04
CGRW-02(at CGSB-119)	50	30	45	15 (-16 to -31)	CGSB-10/CGMW-02
Parcel II					
CGRW-03 (at CGSB-128)	57	22	52	30 (-10 to -40)	CGSB-23
CGRW-04 (at CGSB-127)	72	27	67	40 (-15 to -55)	CGSB-8 & 23/CGMW-07
Parcel III					
Shallow Recovery Wells					
CGRW-05S (near CGSB-121)	25	10	20	10 (0 to -10)	CGSB-28/CGMW-08
CGRW-06S (near CGSB-125)	25	10	20	10 (0 to -10)	CGSB-28/CGMW-08
CGRW-07S (near CGSB-122)	30	15	25	10 (-5 to -16)	CGSB-27/CGTP-15
CGRW-08S (at CGSB-77)	TBD	TBD	TBD	TBD	CGMW-06
Intermediate Recovery Wells					
CGRW-05I (near CGSB-121)	74	39	69	30 (-29 to -59)	CGSB-28/CGMW-08
CGRW-06I (near CGSB-125)	67	32	62	30 (-22 to -52)	CGSB-28/CGMW-08
CGRW-07I (near CGSB-122)	62	47	57	10 (-37 to -47)	CGSB-27/CGTP-15
CGRW-08I (at CGSB-77)	TBD	TBD	TBD	TBD	CGMW-06
Deep Recovery Wells					
CGRW-05D (at CGSB-121)	106	81	101	20 (-71 to -91)	CGSB-28/CGMW-08
CGRW-06D (at CGSB-125)	101	86	96	10 (-76 to -86)	CGSB-28/CGMW-08
CGRW-07D (at CGSB-122)	96	81	91	10 (-71 to -81)	CGSB-27/CGTP-15
CGRW-08D (at CGSB-77)	TBD	TBD	TBD	TBD	CGMW-06

1 - Includes a 5 foot sump at depth. Recovery wells in Parcel II will be completed with a flush-mounted lockable steel and/or concrete vault. All other well will be completed with a steel riser pipe with locking cap.
2 - Feet below current ground surface.



SOURCE: Map created with TOPO! ® ©2001 National Geographic (www.nationalgeographic.com/topo)

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SCALE, FEET

DNAPL RECOVERY PILOT PROGRAM
CARROLL GARDENS/PUBLIC PLACE
BOROUGH OF BROOKLYN, NEW YORK

nationalgrid

GEI Consultants

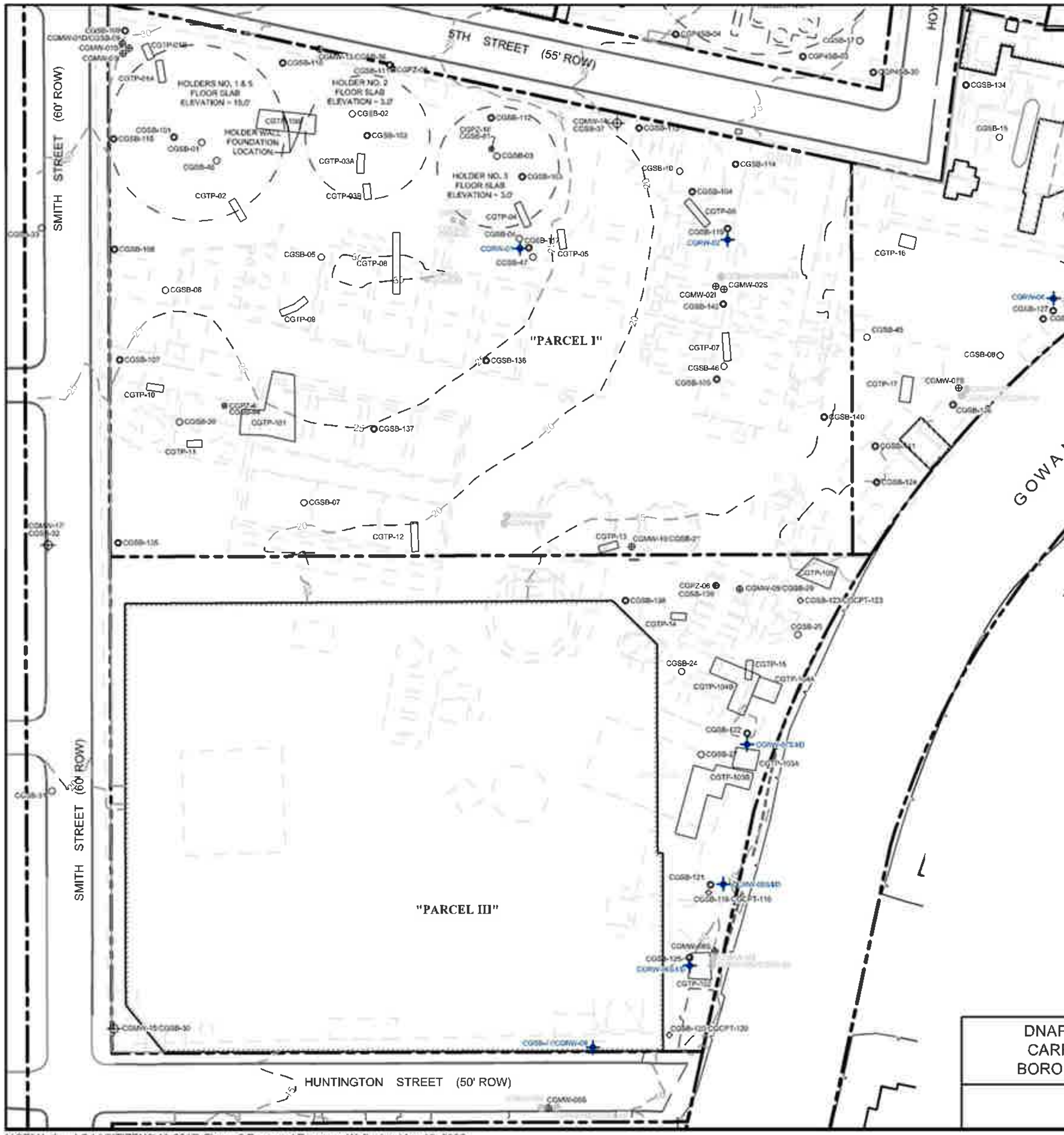
Project 061140-19-2807

SITE LOCATION MAP

April 2009

Figure 1

NATIONAL GRID\CITIZENS\19-2817\CITIZENS-LOCATION MAP.CDR



SAMPLE LEGEND:

- CGMW-09/CGSB-29 — MONITORING WELL/SOIL BORING - REMEDIAL INVESTIGATION
- ABANDONED MONITORING WELL
- CGMW-17/CGSB-32 — MULTICHANNEL MONITORING WELL - REMEDIAL INVESTIGATION
- CGSB-25 — ROTOSONIC SOIL BORING - REMEDIAL INVESTIGATION
- CGSB-113 — GEOTECHNICAL SOIL BORING - REMEDIAL DESIGN INVESTIGATION
- CGPZ-4/CGSB-84 — PIEZOMETER/SOIL BORING - REMEDIAL DESIGN INVESTIGATION
- DESTROYED PIEZOMETER/SOIL BORING - REMEDIAL DESIGN INVESTIGATION
- CGSB-123/CGCPT-123 — SOIL BORING / CONE PENETROMETER BORING - REMEDIAL DESIGN INVESTIGATION
- CGTP-103A — TEST PIT - REMEDIAL INVESTIGATION AND REMEDIAL DESIGN INVESTIGATION
- CGSB-121 — PROPOSED DNAPL RECOVERY WELL

SITE LEGEND:

- PROPERTY LINE
- EXISTING STRUCTURE
- HISTORICAL STRUCTURE
- 20 — GRADE CONTOUR - MAJOR (FEET)

SURVEY NOTES:

1. "BOUNDARY & TOPOGRAPHIC SURVEY, BLOCK 471, LOTS 1, 100 & 200, BLOCK 468, LOT 25, BOROUGH OF BROOKLYN, KINGS CO., CITY AND STATE OF NEW YORK", PREPARED FOR GEI CONSULTANTS, INC. BY GEOD CORPORATION, PHOTOGRAMMETRIC SCIENCES - SURVEY TECHNOLOGIES, 24 KANOUSE ROAD, NEWFOUNDLAND, N.J.
2. PROPERTY KNOWN AS BLOCK 471, LOT 1 (PARCEL 1), BLOCK 471, LOT 125 (PARCEL 2), BLOCK 471, LOT 200 (PARCEL 3) AND BLOCK 468, LOT 25 (PARCEL 4) AS SHOWN ON THE OFFICIAL TAX MAPS OF THE BOROUGH OF BROOKLYN, KINGS COUNTY, CITY AND STATE OF NEW YORK.
3. COORDINATE AND HORIZONTAL REFERENCE BASED ON NY LI 3104 (NAD 83). VERTICAL DATUM IS BASED UPON USC&G DATUM (NAVD 88) OBTAINED BY DIFFERENTIAL LEVELING AND STATIC GPS METHODS.
4. SURVEY OF SAMPLE LOCATIONS CONDUCTED BY GEI CONSULTANTS, INC. BY NEW YORK STATE-LICENSED LAND SURVEYOR NO. 050146.
5. TEST PIT CGTP-107 LOCATION IS APPROXIMATE.

SOURCES:

1. CITIZENS WORKS SURVEY, JOHNSON AND HIGGENS, N.Y., FEBRUARY 4, 1928.
2. SANBORN MAPS (1886 THROUGH 1996).
3. TECHNICAL SCOPE OF WORK, DVIRKA AND BARTILUCCI, 2000.
4. CITIZENS WORKS PROPERTY PLAN, OCTOBER 1937, CORRECTED MAY 18, 1964.
5. CARROLL GARDENS/PUBLIC PLACE, BOROUGH OF BROOKLYN, NEW YORK SITE PLAN, METCALF & EDDY, DECEMBER 2004.

0 80 160

SCALE, FEET

DNAPL RECOVERY PILOT PROGRAM
CARROLL GARDENS/PUBLIC PLACE
BOROUGH OF BROOKLYN, NEW YORK

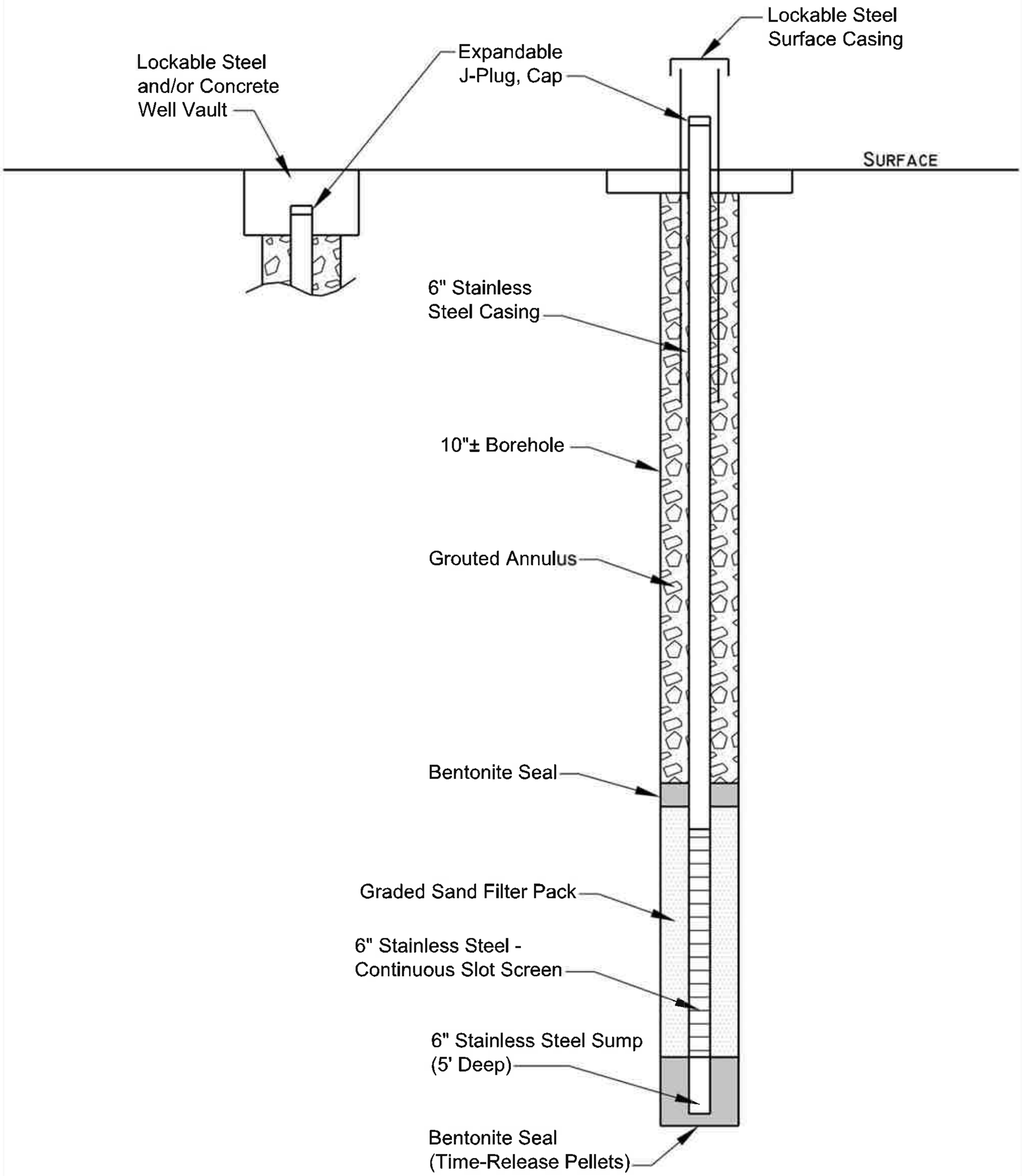
nationalgrid

GEI Consultants

PROPOSED RECOVERY WELLS

Project 061140-19 | April 2009 | Figure 2

I:\GEI\National Grid\CITIZENS\19-2817\ Figure 2 Proposed Recovery Wells.dwg \Apr 13, 2009



NOT TO SCALE

DNAPL RECOVERY PILOT PROGRAM CARROLL GARDENS/PUBLIC PLACE BOROUGH OF BROOKLYN, NEW YORK	GEI Consultants	TYPICAL RECOVERY WELL CONSTRUCTION DETAILS	
nationalgrid	Project 061140-19-2817	April 2009	Figure 3

I:\GEI\National Grid\CITIZENS\19-2817\ Figure 3 Citizens-Well Detail.dwg \Apr 13, 2009

Section 9

Surface Water Sampling (SW)

STANDARD OPERATING PROCEDURE

SW-001 Surface Water Sampling

1. Objective

Describe methods used to collect surface water samples.

This SOP is applicable to the collection of representative surface water samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth as well as samples collected from the surface. Location, equipment, and sampling situations will dictate the applicable method of sample collection for each point. Four recommended techniques for collecting representative surface water samples are:

- Kemmerer bottle
- Van Doran sampler
- Direct method
- Peristaltic pump

Materials

Depending on the sampling method, the following is a list of equipment that may be used for collection of surface water samples:

- Kemmerer bottles
- Van Doran sampler
- Line and messengers
- Peristaltic pump
- Teflon™/polyethylene tubing
- Laboratory provided sample bottles
- Resealable plastic bags Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent marker
- Sample bottle labels
- Paper towels
- Secchi Disk – Illustration provided as Figure 1
- Personal Protection Equipment (PPE)

- Global Positioning System (GPS) survey equipment or another appropriate method to document the location of surface water sampling locations.

2. Execution

2.1. Pre-Sampling Procedures

2.1.1. Sample Location

Ideally, a GPS navigation system should be used to identify and record the sample location coordinates. Taped measurements from easily identifiable existing permanent features are also acceptable. If necessary, the proposed locations may be adjusted if there are issues with sample location access and/or obstructions.

2.1.2. Water Quality Data

Water quality data should be collected during sampling from the sample depth interval, if appropriate, using an appropriate instrument to measure pH, specific conductance, temperature, turbidity, dissolved oxygen, and oxidation-reduction potential. In addition, water clarity may be measured at each sample location using a secchi disk (Figure 1). The water quality meter should be calibrated daily in accordance with manufacturer's specifications.

2.2. Sample Collection Methods

2.2.1. Kemmerer Bottle

A Kemmerer bottle can be used in most situations to collect representative samples from specific depths. A picture of the Kemmerer bottle is provided as Figure 2. Sampling procedures are as follows:

- Prior to sample collection, properly decontaminate the Kemmerer (see SOP QA-001 Equipment Decontamination). The sampling device should be set so that the upper and lower stoppers pull away from the body of the sampler, allowing the surface water to enter tube.
- Lower the pre-set sampling device to the predetermined depth while avoiding disturbance of the bottom sediments.
- When the Kemmerer bottle is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.
- Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve.
- This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited (except for samples analyzed for volatiles) or transferred directly to appropriate sample containers.

2.2.2. Van Doran Sampler

A Van Doran sampler can be used to collect surface water from very specific sampling depths or from a shallow water body. A picture of the Van Doran sampler is provided as Figure 3. Since the sampler is suspended horizontally, the depth interval sampled is equal to the diameter of the sampling tube. The sampling procedure is as follows:

- Prior to sample collection, properly decontaminate the Van Doran Sampler (see SOP QA-001 Equipment Decontamination). The sampling device should be set so that the end stoppers are pulled away from the body allowing surface water to enter the tube.
- Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom sediments.
- When the Van Doran is at the selected depth, send the weighted messenger down the suspension line, closing the sampling device.
- Retrieve the sampler and discharge the first 10-20 mL from the drain to clear potential contamination from the valve.
- This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited (except for samples analyzed for volatiles) or transferred directly to appropriate sample containers.

2.2.3. Direct Method

For surface water samples collected within the top 6-inches of the water column, or in waters shallow enough that wading is feasible and safe. The direct method should only be used to collect water samples in unpreserved the sample container(s).

- Analytical samples that require field preservation will be transferred from the unpreserved container to a laboratory pre-preserved sampling container. Samples analyzed for volatiles should be filled directly in laboratory pre-preserved sampling container.
- Samples should be collected in a downstream to upstream direction.
- Avoid disturbing the sediment surface during collection.
- In shallow locations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector.
- Hold the sample container below the surface to avoid the collection of floating debris.

2.2.4. Peristaltic Pump

A peristaltic pump can be used to collect surface water from very specific sampling depths or at a remote location that cannot be accessed with other sampling methods. Since the tubing can be weighted and suspended horizontally, the depth interval sampled is equal to the opening of the sampling tubing. The sampling procedure is as follows:

- Prior to sample collection, the tubing weights will be thoroughly decontaminated. Cut a length of the clean, Teflon™ or polyethylene tubing to match the predetermined sampling depth. Lower the tubing and water quality meter to the predetermined sample depth. Avoid disturbance of the bottom sediments.

- When the tubing is at the required depth, attach it to a multi-parameter water quality meter to gather information on water quality at the sample collection interval.
- Turn on the peristaltic pump.
- Discharge approximately two volumes of water from the submerged tubing to collect a representative sample from the predetermined depth interval.

2.2.5. Precautions

Proper sampling procedures should be used to collect samples in accordance with this SOP to prevent cross contamination and improper sample collection. Common problems are listed below to ensure that the samplers can avoid potential sample collection problems.

- Cross Contamination: Eliminated or minimized through the use of dedicated or disposable sampling equipment where appropriate. Where the use of dedicated or disposable sampling equipment is not possible or practical, the equipment will be decontaminated in accordance with the SOP QA-001 Equipment Decontamination.

- Improper Sample Collection: Typical improper sample collection techniques include:
    - Use of sampling equipment or sample containers that are not compatible with the contaminants of concern or the laboratory analytical method
    - Excess sediment in the sample due to disturbance of the sediments by sampling equipment
    - Sample collection in an obviously disturbed or non-representative area
    - Sample collection during a period of increased surface water velocity that causes significant re-suspension of sediments (i.e. tidal influences, storm surge)

3. References

Wilde, F.D., D.B. Radtke, J. Gibs and R.T. Iwatsubo. 1998. National Field Manual for the Collection of Water-Quality Data - Selection of Equipment for Water Sampling. U.S. Geological Survey Techniques of Water - Resources Investigations, Book 9, Chap. A2, variously paged. http://water.usgs.gov/owq/FieldManual/index.html and http://water.usgs.gov/owq/FieldManual/mastererrat.html

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

U.S. Environmental Protection Agency. 2002. U.S. EPA Environmental Response Team, Standard Operating Procedures #2013, Surface Water Sampling. EPA, 12/17/02.

4. Attachments

Figures 1, 2, and 3 (included on following pages)
Attachment A – USEPA Surface Water Sampling SOP

5. Contacts

Steven Canton
Bill Simons

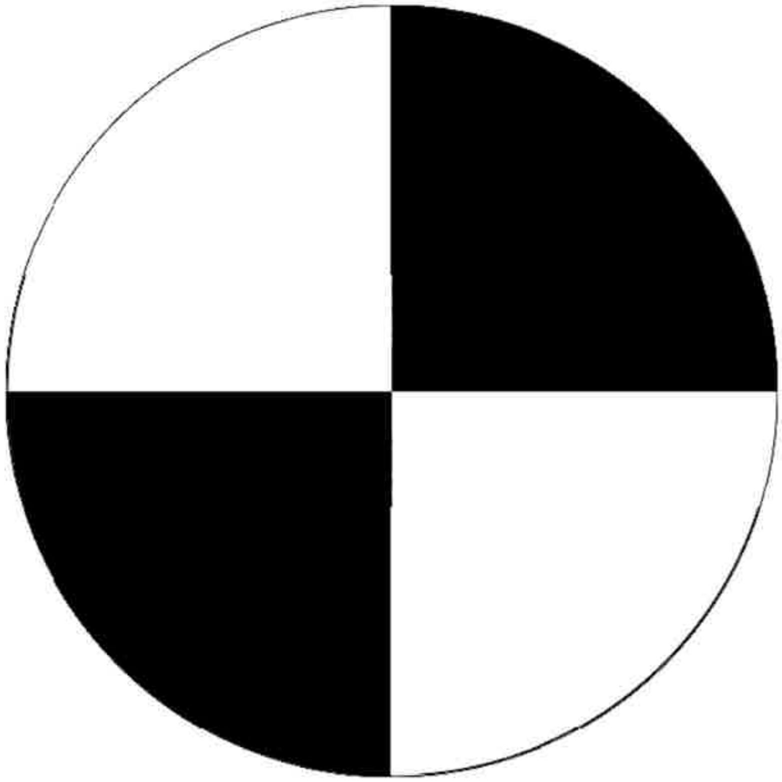


Figure 1 - Secchi Disk

Figure 2 – Kemmerer Bottle

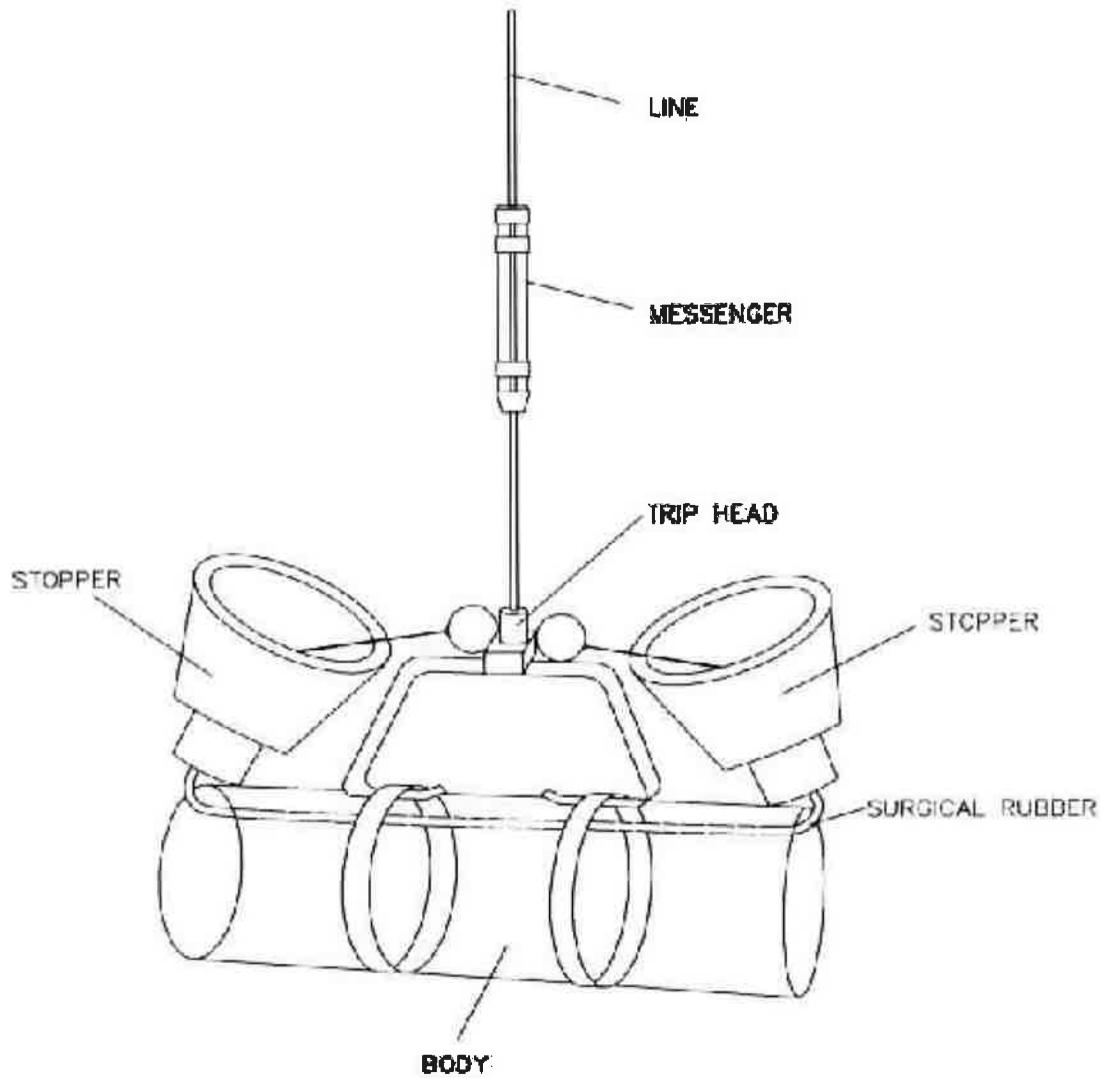


Figure 3 - Van Doran Sampler

U. S. EPA ENVIRONMENTAL RESPONSE TEAM

STANDARD OPERATING PROCEDURES

SURFACE WATER SAMPLING

CONTENTS

CONTENTS (Cont'd)

* These sections affected by Revision 0.0.

SUPERSEDES: SOP #2013; Revision 0.0; 11/17/94; U.S. EPA Contract 68-C4-0022.

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) is applicable to the collection of representative surface water samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sampling situations vary widely; therefore, no universal sampling procedure can be recommended. However, surface water sampling is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- Van Doren sampler
- Bacon bomb sampler
- Dip sampler
- Direct method

These samplers and sampling techniques will result in the collection of representative samples from the majority of surface waters and impoundments encountered.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Once samples have been collected, the following procedures should be followed:

1. Transfer the sample(s) into suitable, labeled sample containers specific for the analyses to be performed.

2. Preserve the sample, if appropriate, or use pre-preserved sample bottles. Do not overfill bottles if they are pre-preserved.

3. Cap the container securely, place in a resealable plastic bag, and cool to 4°C.

4. Record all pertinent data in the site logbook and/or on field data sheets.

5. Complete the Chain of Custody record.

6. Attach custody seals to cooler prior to shipment.

7. Decontaminate all non-dedicated sampling equipment prior to the collection of additional samples.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems associated with surface water sampling. These include cross contamination of samples and improper sample collection.

1. Cross contamination problems can be eliminated or minimized through the use of dedicated or disposable sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to ERT/REAC SOP #2006, *Sampling Equipment Decontamination*.

2. Improper sample collection can involve using contaminated equipment, equipment that is potentially not compatible with the contaminants of concern, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed or non-representative area. Be sure to use sampling equipment of an appropriate composition based upon the suspected contaminants and analyses to be performed.

Following proper decontamination procedures, minimizing disturbance of the sample site, and careful selection of sampling locations will eliminate these problems. Proper timing for the collection of samples must be taken into consideration due to tidal influences and low or fast-flowing streams or rivers.

5.0 EQUIPMENT/APPARATUS

Equipment needed for collection of surface water samples may include (depending on technique chosen):

- Kemmerer bottles
- Van Doren sampler
- Bacon bomb sampler
- Dip sampler
- Line and messengers
- Peristaltic pump
- Tygon tubing
- 0.45 micron (• m) filters
- Sample bottles/preservatives
- pH paper
- Resealable plastic bags
- Ice

- Coolers, packing material
- Chain of Custody records, custody seals
- Field data sheets
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Logbook/waterproof pen
- Sample bottle labels
- Paper towels
- Disposable pipets
- Hydrolab
- Personal protection equipment (PPE)*
- Global positioning system (GPS)

* Be sure to use types appropriate for analytes to be measured to avoid contamination of samples. Powdered gloves may contain contaminants of concern.

6.0 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed and are summarized in ERT/REAC SOP #2003, *Sample Storage, Preservation and Handling*. Decontamination solutions are specified in ERT/REAC SOP #2006, *Sampling Equipment Decontamination.*

7.0 PROCEDURES

7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain the necessary sampling and monitoring equipment.

3. Decontaminate or pre-clean equipment, and ensure that it is in working order.

4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry, in accordance with the site specific Health

and Safety Plan (HASP).

6. Use stakes, flags, or buoys to identify and mark all sampling locations. Alternatively, a GPS radio-navigation system may be used to identify and record sample location coordinates. If required, the proposed locations may be adjusted based on site access, property boundaries, and obstructions.

7.2 Representative Sampling Considerations

In order to collect a representative sample, the hydrology and morphometrics of a stream, river, pond, lake or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths.

Water quality data should be collected in ponds, lakes and impoundments to determine if stratification is present. Measurements of dissolved oxygen, pH, conductivity, oxidation-potential, temperature and turbidity can indicate if strata exist that would affect analytical results. Measurements should be collected at one-meter intervals from the surface to the bottom using the appropriate instrument (i.e., a Hydrolab or equivalent). These water quality measurements can assist in the interpretation of analytical data, and the selection of sampling sites and depths when surface water samples are collected.

Factors that contribute to the selection of a sampling device used for sampling surface waters in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

- Width, depth, flow and accessibility of the location being sampled
- Whether the sample will be collected onshore or offshore

7.2.1 Sampler Composition

The appropriate sampling device must be of a proper composition. Selection of samplers constructed of glass, stainless steel, polyvinyl chloride (PVC) or PFTE (Teflon®) should be based upon the suspected contaminants and the analyses to be performed.

7.3 Sample Collection

7.3.1 Kemmerer Bottle

A Kemmerer bottle (Figure 1, Appendix A) may be used in most situations where site access is from a boat or structure, such as a bridge or pier, and where samples at specific depths are required. Sampling procedures are as follows:

1. Use a properly decontaminated Kemmerer bottle. Set the sampling device so that the upper and lower stoppers are pulled away from the body, allowing the surface water to enter tube.

2. Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom.

3. When the Kemmerer bottle is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.

4. Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.2 Van Doren Sampler

A Van Doren sampler (Figure 2, Appendix A) is used to collect a surface water from a very specific sampling depth or from a shallow water body. Since the sampler is suspended horizontally, the depth interval sampled is the diameter of the sampling tube. The sampling procedure is as follows:

1. Use a properly decontaminated Van Doren sampler. Set the device so that the end stoppers are pulled away from the body allowing surface water to enter the tube.

2. Lower the pre-set sampling device to the predetermined depth. Avoid disturbance of the bottom.

3. When the Van Doren is at the required depth, send the weighted messenger down the suspension line, closing the sampling device.

4. Retrieve the sampler and discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.3 Bacon Bomb Sampler

A bacon bomb sampler (Figure 3, Appendix A) may be used in situations similar to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for

the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut. This will allow the sampler to fill.

2. Release the trigger line and retrieve the sampler.

3. Discharge the first 10-20 milliliters (mL) from the drain to clear potential contamination from the valve. This procedure may be repeated if additional sample volume is needed to fulfill analytical requirements. Subsequent grabs may be composited or transferred directly to appropriate sample containers.

7.3.4 Dip Sampler

A dip sampler (Figure 4, Appendix A) is useful in situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.

2. Extend the device to the sample location and collect the sample by dipping the sampler into the water.

3. Retrieve the sampler and transfer the sample to the appropriate sample container(s).

7.3.5 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples directly into the sample container(s). Health and safety considerations must be addressed when sampling lagoons or other impoundments where specific conditions may exist that warrant the use of additional safety equipment. These issues must be addressed in the site-specific HASP.

Using adequate protective clothing, access the sampling station by appropriate means. When possible, collect samples in a downstream to upstream direction. For shallow stream stations, collect the sample under the water surface while pointing the sample container upstream; the container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface while avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

3. To avoid the incidental inclusion of disturbed sediment in the sample, surface water should be collected from a downstream to upstream direction and upstream of any activity that may disturb the sediment (i.e., wading).

4. While collecting surface water using the direct method, the sample container should be held below the surface to avoid the collection of floating debris.

5. Water quality data should be collected to detect the presence of stratified layers or other site-specific characteristics that would affect the sample.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA and Occupational Health and Safety (OSHA) health and safety procedures.

More specifically, when sampling lagoons or surface impoundments containing known or suspected hazardous substances, adequate health and safety and boating precautions must be taken to ensure the safety of sampling personnel.

12.0 REFERENCES

Wilde, F.D., D.B. Radtke, J. Gibs and R.T. Iwatsubo. 1998. National Field Manual for the Collection of Water-Quality Data - Selection of Equipment for Water Sampling. U.S. Geological Survey Techniques of Water -

Resources Investigations, Book 9, Chap. A2, variously paged.

http://water.usgs.gov/owq/FieldManual/index.html and http://water.usgs.gov/owq/FieldManual/mastererrat.html

U.S. Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA/600/4-84-076.

13.0 APPENDICES

A - Figures

APPENDIX A
Figures
SOP #2013
December 2002

FIGURE 1. Kemmerer Bottle

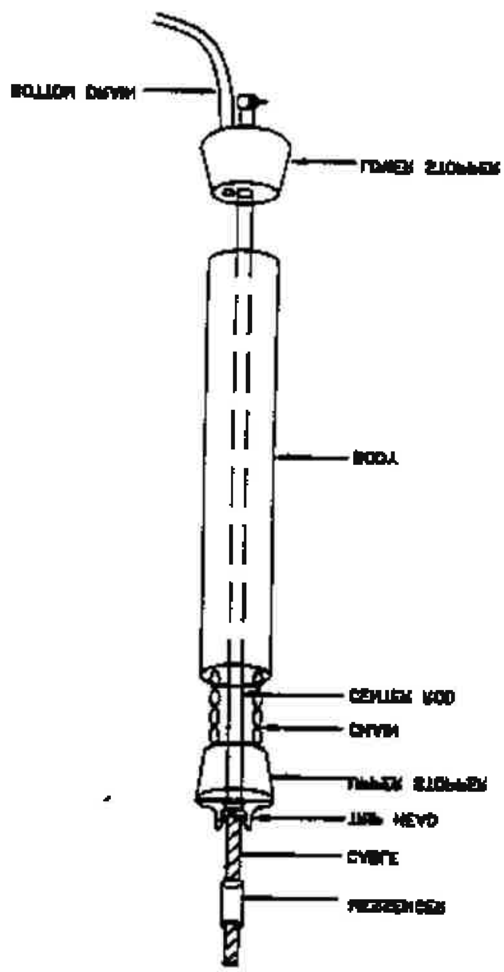


FIGURE 2. Van Doren Sampler

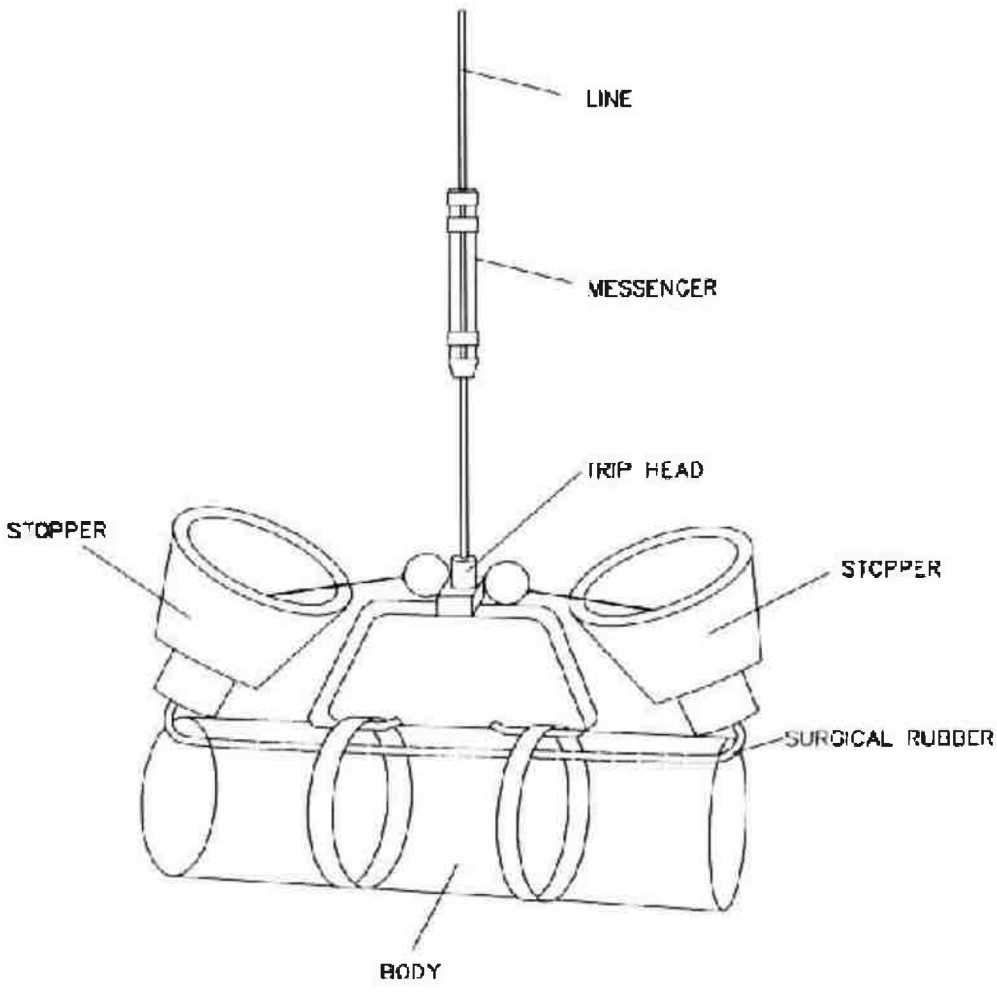


FIGURE 3. Bacon Bomb Sampler

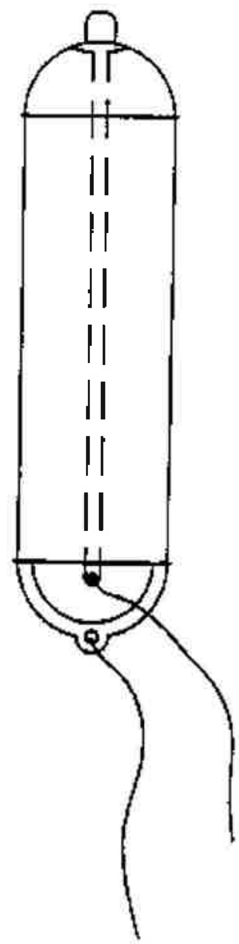
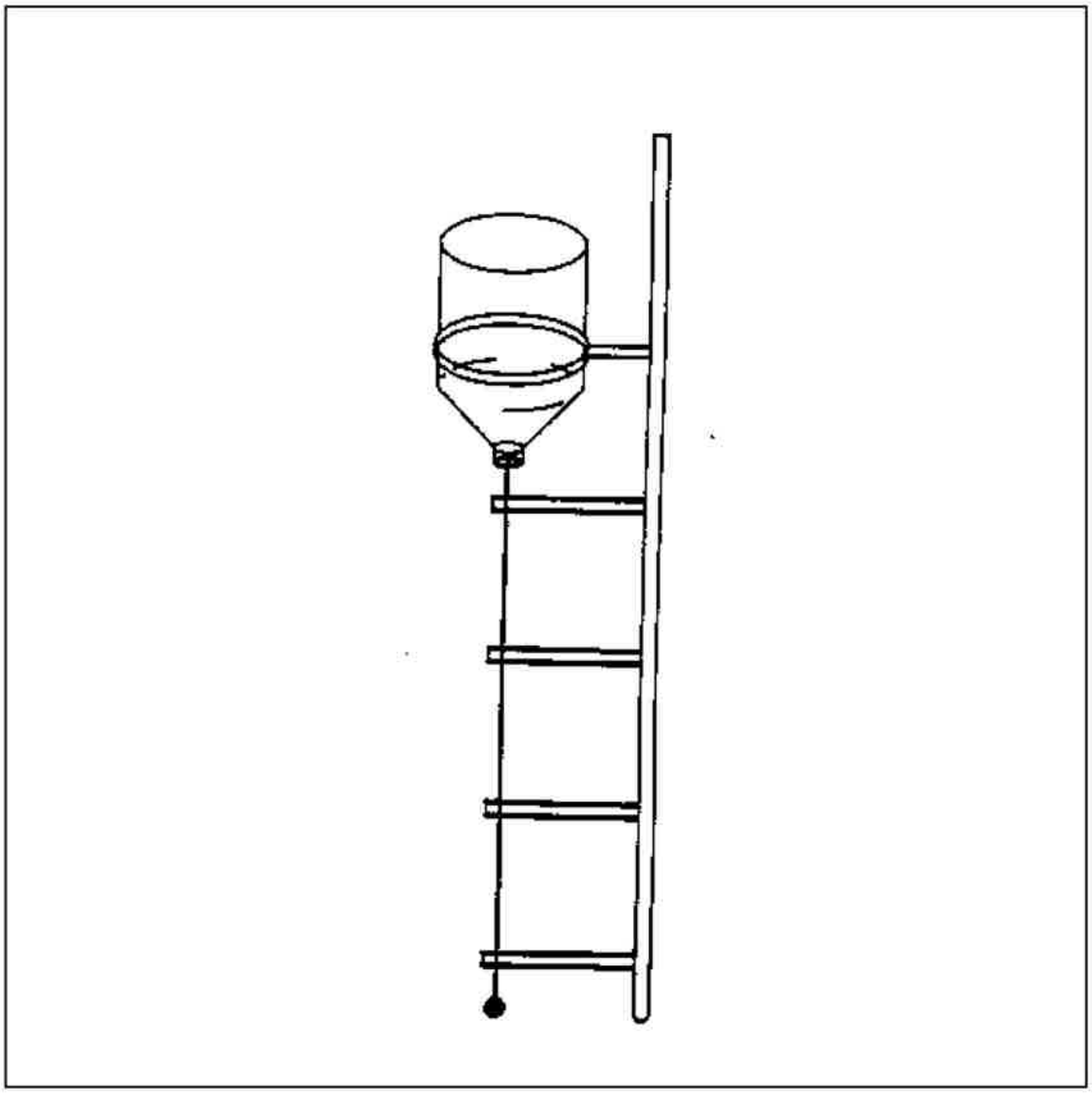


FIGURE 4. Dip Sampler



Section 10

Sediment Sampling (SS)

STANDARD OPERATING PROCEDURE

SS-001 Sediment Sampling Using a Ponar or Shipek Grab Sampler

1. Objective

Describe surficial sediment (approximately upper 6 inches) sample collection using a Ponar or Shipek type grab sampler.

Both devices are relatively easy to handle and operate, readily available, moderately priced, and versatile in terms of the range of substrate types they can effectively sample. Both samplers provide sufficient sample volume (approximately 7.5 or 3 cubic liters, respectively) to support sub-sampling for multiple analytes.

2. Materials

Equipment needed for collection of sediment samples may include (depending on technique chosen):

- Ponar/Shipek Sampler
- Stainless steel sampling tools
- Laboratory provided sample bottles
- Resealable plastic bags
- Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal Protection Equipment (PPE)
- Global Positioning System (GPS)

3. Execution

- Prior to sample collection, the grab sampler will be decontaminated in accordance with SOP QA-001 – Equipment Decontamination or in accordance with specific project requirements.
- Sample from downstream to upstream locations so that disturbed sediment does not affect subsequent sampling locations.

- When deploying the grab sampler, do not allow it to "free fall". This will prevent kinking of the rope or cable. In deep water, use a winching system to control the rate of descent and ascent.
- The sampler should be carefully lowered the last few feet to minimize dispersal of fine material due to a sampler-induced shock wave.
- After the sample is collected, the sampling device should be lifted slowly off the bottom and raised to the surface at a slow and steady rate.
- Open the jaws of the Ponar slightly and allow the water to drain. If the trapped water is turbid, allow suspended solids to settle before draining.
- Sediments in direct contact with sides or teeth of the grab sampler will be excluded from samples, when possible, to prevent potential contamination from the grab sampling device.
- When it is not possible to collect material directly from the sampler, it should be slowly opened over a clean sample platform, with minimal disturbance.
- If required, photograph the sediments while it is still in the sampler or, if necessary, on the sampling platform. Place a small label with sample field ID number and approximate depth so that it appears in each frame. SOP FD-004 Photodocumentation provides further guidance on photodocumentation.
- Record sediment description in the field notebook based on SOP SM-003, Soil Classification.
- Place sediment samples into pre-cleaned laboratory provided jars for the analyses identified in the work plan.
- The samples should be placed in bubble wrap and then placed in a cooler with ice until transfer to the analytical laboratories.
- At the time of the sample collection, the sample location will be measured from known reference points or may be surveyed with GPS or other survey equipment.

4. Limitations

Careful use of grab samplers is required to avoid problems such as loss of fine-grained surface sediments from the bow wave during descent, mixing of sediment layers upon impact, lack of sediment penetration, and loss of sediment from tilting or washout upon ascent.

Following proper decontamination procedures, minimizing disturbance of the sample site, and careful selection of sampling locations will minimize the potential for cross-contamination.

Larger materials such as twigs and stones may prevent jaw closure. In areas with significant debris or course organic matter, collection of a representative sample may not be possible.

5. References

U.S. Environmental Protection Agency, Office of Water, Office of Science & Technology. 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823B-01-002, October 2001.

State of Ohio, Environmental Protection Agency, Division of Surface Water. 2001. Sediment Sampling Guide and Methodologies, Second Edition. November 2001.

ASTM, 2003. D4823-95 (2003) Standard Guide for Core Sampling Submerged, Unconsolidated Sediments. ASTM International, West Conshohocken, PA. August 2003.

Newfield's Environmental Forensics Laboratory, 2005. Geochronologic Sample Handling Procedure.

6. Contacts

Kim Bradley
Ryan Hoffman

STANDARD OPERATING PROCEDURE

SS-002 Sediment Sampling Using Vibracore Equipment

1. Objective

Describe use of Vibracore methods to collect sediment samples.

Fine-grained sediments, such as sands, silts and clays can be collected using Vibracore (VC) equipment. The VC consists of a metal core barrel with a cutting edge, a sample retaining ring, a replaceable plastic liner, and an air powered piston vibrator to drive the core pipe into the unconsolidated sediments. A new plastic liner is used for each sample.

2. Materials

Equipment needed for collection of sediment samples may include (depending on technique chosen):

- Vibracore sampler
- Stainless steel sampling tools
- Laboratory provided sample bottles
- Resealable plastic bags
- Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal Protection Equipment (PPE)
- Global Positioning System (GPS)

3. Execution

- Sample from downstream to upstream locations so that disturbed sediment will not affect subsequent sampling locations.
- If sediment samples are being collected for laboratory analysis, the sampling equipment (i.e., cutting shoe, retainer, and sampling barrel) shall be decontaminated prior to the collection of samples at each location. Decontamination shall be conducted in accordance with SOP QA-001 –

Equipment Decontamination or according to any requirements that are outlined in the site-specific work plan(s).

- Moor the VC watercraft in a multi-point fashion.
- Measure and record the depth of the water column (depth to top of sediments).
- If possible, record the latitude, longitude, and elevation of the sample location using Global Positioning System (GPS) equipment.
- If GPS is not available, mark the sampling locations with a labeled stake, buoy, flagging, or other device, and document the locations by measuring from known reference points.
- Vibrate the core barrel into the sediments. Penetration rates will vary depending on the sediment type. When the target depth is attained, retrieve the core.
- If sufficient room is available on the VC watercraft, log the core in accordance with SOP SM-003 Soil Classification and collect analytical samples. Note attributes such as cementation, color and mineralogy (if it can be determined). The presence of iron-staining, or other staining, presence of organic matter, shells, debris or detritus will be recorded. Any odors (i.e., tar-like vs. gasoline-like vs. fuel oil-like, etc.) will be recorded. Any visual impacts will be recorded (i.e., sheens vs. non-aqueous phase liquid (NAPL) vs. staining vs. oil blebs).
- Otherwise, ferry core samples to a field representative on shore as soon as practical for logging and sampling.
- Screen for Volatile Organic Compounds (VOCs) throughout the core and record any instrument response. A photoionization detector will be used for this process. When selecting portions of the core for screening, select undisturbed portions if present. Otherwise, disturbed portions may be screened. Screening should be performed in accordance with SOP SC-004 Head Space Screening.
- Analytical samples will be selected based on criteria stipulated in the associated site-specific work plan. Analytical samples shall be collected with stainless steel spatulas (or similar) that have been decontaminated according to procedures that are outlined in SOP QA-001 Equipment Decontamination or the site-specific work plan(s). The samples shall be contained in laboratory provided jars or glassware and kept cool. The sample identification, date, time, and associated details will be recorded. Pertinent information regarding the samples will be recorded on a chain-of-custody form.

4. Limitations

4.1. When marking locations in navigable waterways, inform the appropriate regulatory agencies and take precautions to prevent navigational hazards before, during, and after sampling.

5. References

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

6. Contacts

Kim Bradley
Ryan Hoffman

STANDARD OPERATING PROCEDURE

SS-003 Sediment Sampling Using a Remote Sampler

1. Objective

Describe use of a remote sampler to collect surficial sediment samples at shallow depths.

The remote sampler is used when Ponar/Shipek and/or vibracore methods are not used.

2. Materials

Equipment needed for collection of sediment samples may include (depending on technique chosen):

- Remote sampler
- Stainless steel sampling tools
- Laboratory provided sample bottles
- Resealable plastic bags
- Ice
- Coolers, packing material
- Chain of custody records, custody seals
- Decontamination equipment/supplies
- Maps/plot plan
- Safety equipment
- Tape measure
- Camera
- Field data sheets/field notebook/waterproof pen
- Permanent markers
- Sample bottle labels
- Paper towels
- Personal Protection Equipment (PPE)
- Global Positioning System (GPS)

3. Execution

- Prior to sample collection, the remote sampler should be decontaminated.
- Sample from downstream to upstream locations so that disturbed sediment will not affect subsequent sampling locations.
- The remote sampler consists of a stainless steel or Teflon scoop attached to a telescoping pole or similar device.
- The remote sampler is extended to the location of the sediment sample targeted for collection.
- Once sediment is collected in the scoop, the sampler should be retrieved slowly to avoid the loss of fine material as the sampler passes through the water column.

- If necessary, photograph the sample with a camera. Place a small label with sample field ID number and approximate depth so that it appears in each frame. SOP FD-004 Photodocumentation provides further guidance.
- This process may be repeated if additional sample volume is necessary.
- Describe and record the sediment in the field notebook in accordance with SOP SM-003 Soil Classification.
- Place sediment samples into pre-cleaned laboratory provided jars for the analyses identified in the work plan. Label each jar with a unique sample identification number and depth of the sample.
- The samples should be placed in bubble wrap and then placed in a cooler with ice until transfer to the analytical laboratories.
- At the time of the sample collection, the sample location will be measured from known reference points or may be surveyed with GPS or other survey equipment.

4. References

U.S. Environmental Protection Agency, Office of Water, Office of Science & Technology. 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA-823B-01-002, October 2001.

State of Ohio, Environmental Protection Agency, Division of Surface Water. 2001. Sediment Sampling Guide and Methodologies, Second Edition. November 2001.

ASTM, 2003. D4823-95 (2003) Standard Guide for Core Sampling Submerged, Unconsolidated Sediments. ASTM International, West Conshohocken, PA. August 2003.

Newfield's Environmental Forensics Laboratory, 2005. Geochronologic Sample Handling Procedure.

5. Contacts

Kim Bradley
Ryan Hoffman

Section 11

Air Sampling and Monitoring (AR)

STANDARD OPERATING PROCEDURES

AR-001 General Guidance on Work Zone Monitoring Methods

1. Objective

Protect human health by measuring air quality at the perimeter of a work area.

2. Execution

Walk-around perimeter and work zone monitoring for Total Volatile Organic Compounds (TVOC), Respirable Particulate matter less than 10 microns (RPM_{10}), and odor will occur along the perimeter of the project site on a regular and as-needed basis. Specific site conditions that will trigger walk-around perimeter or work zone monitoring include:

- visible dust
- odor complaints
- detection of TVOCs and/or RPM_{10} at levels approaching or exceeding action levels
- direction by the site oversight consultant or client

Perimeter air monitoring and work zone monitoring, in the absence of any specific triggering criteria, will be conducted on a regular basis during the normal work day. Particular attention will be given to the direction of any residences or other sensitive receptors.

At the time when a triggering condition is observed, the walk-around perimeter and work zone monitoring will occur continuously until the conditions that triggered the monitoring have subsided. Additional temporary monitoring points may be established due to changing site or meteorological conditions.

TVOC concentrations will be monitored and recorded using a Rae Systems MiniRAE 2000 Portable Ionization Detector (PID) or equivalent. RPM_{10} will be measured and recorded using a MIE personal DataRAM 1200 (PDR-1200) portable real-time aerosol monitor equipped with a PM-10 monitor and Gilian personal air sampling pump. AR-002 Suspended Particulate Matter in Ambient Air using the MIE DataRAM Real-time Aerosol Monitor (Portable) provides guidance on the use of this meter. Odors will be noted based on the n-butanol scale, as adapted from ASTM E544-99.

At each monitoring point, the 15-minute average value of TVOC and RPM_{10}, sample time, and sample location will be collected and recorded. The odor intensity based on the n-butanol scale will be monitored over a 15-minute period and recorded. At each location, air temperature, wind direction, and wind speed may be monitored and recorded using a hand-held wind meter.

Odors as a function of naphthalene concentration will be monitored over a 15-minute period and recorded. To measure naphthalene concentrations, the zNose™ Model 4200 system will be used. The zNose™ is an ultra-fast gas chromatograph (GC) that is capable of analyzing airborne concentrations of VOCs and SVOCs in less than one minute. The zNose™ uses a surface acoustic wave (SAW) detector that changes in vibration frequency as compounds elute from the column and condense onto the surface of the detector.

The zNose™ is a portable instrument and will be positioned downwind of the remedial activities. Up to five samples will be analyzed for naphthalene concentrations over a 15-minute period. The concentrations will be averaged to produce a 15-minute result. The calibration will be checked at the start of the day, at mid-day, and at the end of the day. An air blank will be run every two hours. A blank will also be run if a reading exceeds the calibration range of the instrument.

The zNose™ also has the capability of generating fingerprint images of the chemical constituents in the vapor called VaporPrints™. A VaporPrint™ of an air sample can be collected through a headspace analysis. This VaporPrint™ can be compared to others generated at the perimeter and off-site to see if remedial operations are the source of the odors. VaporPrints™ can allow for identification of odors that may not be affiliated with remedial operations.

To monitor cyanide (as hydrogen cyanide gas), a real-time hand-held meter in conjunction with the Dräger Chip Measuring System (CMS) will be used. Types of continuously monitoring equipment include the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems and are available from rental equipment suppliers. Due to potential interference from sulfur compounds, hydrogen sulfide gas (H_2S) will also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real-time meter.

At each location, air temperature, wind direction, and wind speed will be monitored and recorded using a hand-held wind meter.

3. References

New York State Department of Environmental Conservation. 2010. DER-10 / Technical Guidance for Site Investigation and Remediation. Division of Environmental Remediation. May 3, 2010. Appendix 1A. pp. 204-206

ASTM E544 - 99(2004) Standard Practices for Referencing Suprathreshold Odor Intensity

4. Attachments

None

5. Contact

Brian Skelly

STANDARD OPERATING PROCEDURE

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

1. Objective

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

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

2. Materials

- MIE DataRAM™ model DR-2000
- Shelter/Enclosure - a pre-constructed enclosure capable of protecting the instrumentation from severe weather conditions during sample collection
- Omnidirectional inlet
- Inlet heater
- $PM_{2.5}$/PM_{10} impactor
- IBM compatible computer loaded with MIE DataRAM™ software
- Field notebook

3. Meter Calibration

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

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

4. Sample Collection

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

5. Limitations

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

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

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

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

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

7. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

AR-003 Air Sampling for PM_{10} Particulate Matter using the High-Volume Sampler Method

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1. Objective

Describe standard procedures for the collection of air samples for laboratory analysis of PM_{10} particulate matter using the high volume sampler method.

2. Materials

- General Metal Works (GMW) Model IP 10-8000 or equivalent. The GMW sampler can be rented.
- Calibration kit, as specified for the selected sampler.
- PM_{10} sampling filters, to be supplied by the contract laboratory. A Whatman QM-A quartz filter is currently the only commercially available PM_{10} filter that satisfies all criteria specified in 40 CFR 50, Appendix J. .
- Ice chest for sample storage or shipping.

3. Sampling

This method measures the mass concentration of particulate matter with an aerodynamic diameter equal to or less than 10 micrometers (µm). A high volume (HV) sampler draws a known volume of ambient air at a constant flow rate through a size selective inlet and through one or more filters. Particulates of 10 µm or smaller are collected on the filter(s) during the prescribed time period. Each sample filter is weighed before and after sampling to determine the net weight gain of the collected PM_{10} sample.

A HV sampler consists of two basic components: a specially designed inlet that transmits only particles equal to or less than 10 µm in diameter and a flow control system capable of maintaining a constant flow rate within the design specifications of the inlet.

3.1. Sampler Installation

- On receipt of the sampler, inspect all shipping cartons to ensure that all components have been received and verify that the unit is operational.
- On site, assemble the unit according to the manufacturer's instructions. Check all power cords and tubing for crimps, cracks, and breaks. The HV sampler should be placed on a sturdy platform or table, with the air inlet 4 to 6 feet above ground level.
- The sampler should be strategically placed according to the work plan or objectives of the study and located free of any obstructions to ambient air flow.
- The HV sampler requires 110 V AC power. The electrical outlet should be protected by a ground fault interrupter and water proof electrical connectors should be used.

- Operate the sampler for 30 minutes to ensure that the motor is operating at full performance.
- Calibrate the sampler in accordance with the instructions provided with the appropriate calibration kit. Proper calibration of the sampler is critical.
- Field personnel should be familiar with both the sampling unit and the calibration procedure before attempting to record data.

3.2. Sampling Procedure

- Operate sampler as per manufacturer's instructions.
- Filters are received from the laboratory numbered and pre-weighed in their individual envelope or folder within an envelope. Powder free latex gloves, or equivalent, should be worn during the handling of filters. Only touch the edges of the filter.
- Examine the filter support screen to confirm that it is clean. If it appears to be dirty, wipe it clean using lint free wipes such as laboratory wipes or equivalent. Check the gasket to be sure that it is in good condition. The filter is placed on the support screen with the numbered side facing down. Tighten thumb nuts on alternate corners to properly align and seat the gasket. The nuts should be only hand tightened to avoid damaging the gasket.
- Record the sampler serial number, filter ID number, sampler location, sampling date, and the operator's initials in the field notebook, any field data sheets being used, and on the back of a clean chart and install the chart in the flow recorder.
- Turn the sampler on and allow it to equilibrate to operating temperature, about 3 to 5 minutes. Verify that the recorder is operating and that the pen is inking. Allow the sampler to run for the required sampling interval.
- When sampling interval is completed, turn off the sampler and carefully remove the filter as soon as possible. Sample degradation can occur if the filter is left in the sampler for an extended period of time. The filter should be folded in half with the exposed side inward and the folded filter carefully placed in its respective folder and/or envelope. When removing and folding the filter touch only the outer edges. Powder free latex gloves, or equivalent, should be worn when handling filters.
- Record the following parameters in the field notebook and in any field data sheet being used:
    1. Elapsed time of sampling interval in minutes
    2. Average recorder response in arbitrary units
    3. Starting flow rate and ending flow rate
- The average flow rate for GMW Model IP 10-8000 sampler should be close to 1.13 m^3/min.
- Calculate the total flow rate for the sampling interval by time weighted averaging the flow rate readings. Air monitoring results where the flow rates

varied more than +/- 10%, from beginning to end, should be qualified accordingly and discussed with the project manager.

- The exposed filters, folded in half, are placed back into their shipping envelope and forwarded with completed chain of custody forms to the contracted laboratory for analyses. Follow the contracted laboratory's instructions for handling and returning the exposed filters.

4. General Guidance

The total volume of air sampled is determined from the measured volumetric flow rate and the sampling time. The mass concentration of PM_{10} in the ambient air is calculated as the total mass of collected PM_{10} particles divided by the total volume of air sampled. The PM_{10} measurement is expressed as micrograms (µg) per standard cubic meter (µg/std M^3). The sampled volume must be corrected to EPA standard conditions, 25° C, 760 mm Hg or 101 kPa.

A field blank may be collected, which consists of an unexposed filter removed from its envelope, put in place in the HV sampler, immediately removed, folded, replaced in its envelope and sent to the laboratory. Field blanks, if collected, should be taken at a frequency of one per twenty samples. If fewer than twenty samples will be collected during one week, collect one field blank weekly during sampling.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

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

6. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

AR-004 Air Sampling for Polycyclic Aromatic Hydrocarbons (PAHs) using EPA Method TO-13A

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for polycyclic aromatic hydrocarbons (PAHs) using U.S. EPA Method TO-13A.

2. Materials

- Modified High Volume Sampler
- General Metal Works (GMW) Model PS-1 sampler, or equivalent, sample cartridges and filters
- GMW Model GMW-40 calibrator and associated equipment, or equivalent, for calibration of the GMW PS-1 sampler
- Cooler with ice
- Stopwatch
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Airtight, labeled, screw-capped container (wide mouth, glass with Teflon seal) to hold filter and adsorbent cartridge during transport to analytical laboratory
- Raised platform for the GMW PS-1 sampler

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- Filters and adsorbent cartridges (containing XAD-2, Polyurethane Foam (PUF), or combination XAD-2 and PUF) are stored in screw-capped containers wrapped in aluminum foil (for protection from light) prior to installation in a modified high volume sampler. The filters and cartridges are supplied by the laboratory ready for use.
- A GMW Model PS-1 or equivalent sampler must be calibrated to draw approximately 325 cubic meters (m^3) of air through the filter and adsorbent sample cartridge.
- The filter and sample cartridge are placed in an appropriately labeled container and shipped to the analytical laboratory for analysis. Since heat, ozone, nitrogen dioxide (NO_2), and ultra violet (UV) light can cause sample degradation, the exposed sampling media must be immediately removed from the sampler using polyester gloves, wrapped in clean aluminum foil, tightly sealed, and packed in ice or refrigerated.

3.2. Sample Collection

- Calibrate each unit weekly and check the calibration daily, before use and at the end of the run, using the calibration kit and calibration curves supplied by the manufacturer.
- The samplers should be located in an unobstructed area, at least six feet from any obstacle to air flow. The exhaust hose should be stretched out in the downwind direction to prevent recycling of air into the sample head. The sampler should be placed off the ground on a sturdy stand, with the air inlet 4 to 6 feet off the ground.
- Remove the empty sample module from the sampler, rinse all sample contact areas using reagent grade hexane from a Teflon bottle. Allow the hexane to evaporate from the module in a well ventilated area before loading the sample cartridge.
- Detach the lower chamber of the rinsed sampling module. While wearing disposable, clean, lint-free nylon or powder-free latex or nitrile gloves, remove a clean glass sample cartridge from its container (wide-mouthed glass jar) and unwrap its aluminum foil covering. Place the foil back into the jar for rewrapping the sample cartridge after use.
- Insert the sample cartridge into the lower chamber and tightly reattach it to the module.
- Using clean Teflon tipped forceps, carefully place a clean fiber filter atop the filter holder and secure in place by clamping the filter holder ring over the filter using the three screw clamps. Ensure that all module connections are tightly assembled. Failure to do so may cause leaks which could affect sample representativeness. Ideally, sample module loading and unloading should be conducted in a controlled environment within a centralized sample processing area so that the sample handling variables can be minimized.
- With the module removed from the sampler and the flow control valve fully open, turn the pump on and allow it to warm up for approximately five minutes.
- Record the required information for the sampling run on the test data sheet. Record location, sampling date, starting and stopping times. Calculate the volume of air sampled.
- Attach the loaded sample module to the sampler.
- Connect the sampler to a 110 volt AC power source. Turn the power switch on. Activate the lapsed time meter and record the start time.
- Record the Magnehelic reading every six hours during the sampling period. Use the calibration curve to calculate the flow rate. Record the temperature, barometric pressure, and the Magnehelic reading at the beginning and end of the sampling period.
- At the end of the sampling period, turn the power off. Carefully remove the sampling head containing the filter and adsorbent cartridge in a clean area. While wearing lint-free nylon or powder-free latex or nitrile gloves, remove the sorbent cartridge from the lower module chamber and lay it on the

retained aluminum foil in which the sample was originally wrapped. Carefully remove the glass fiber filter from the upper chamber using clean Teflon tipped forceps.

- Fold the filter paper in half twice (sample side inward) and place it in the glass cartridge above the sorbent.
- Wrap the combined samples in aluminum foil and place them in their original glass sample container. Complete and fix a sample label to the sample container. Maintain chain-of-custody records for all samples.
- Store the glass container in a cooler with ice and protect the samples from light to prevent photodecomposition of collected analytes. If the time span between sample collection and lab analysis will exceed 24 hours, samples must be kept refrigerated. The sample holding time is less than 20 days.
- Perform a final calculated sample flow check. If flow rate calibration deviated by more than 10 percent from the initial reading, the flow data for that sample must be marked as estimated.
- Store all samples in the field on ice at approximately 0°C until delivered to the laboratory.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: If necessary, collect a field blank, which consists of an unexposed filter that is removed from its envelope, put into the sampler, immediately removed, folded, replaced in its envelope and sent to the laboratory for analysis. Collect field blanks at a frequency of one per twenty samples. If fewer than twenty samples will be collected during one week, collect one field blank weekly during the sampling.

5. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

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

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-13A, Determination of PAHs in Ambient Air Using GC/MS, US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

6. Contacts

Brian Skelly
Mark Ensign

STANDARD OPERATING PROCEDURE

AR-005 Hydrogen Cyanide Work Zone Air Monitoring Procedures

1. Objective

Describe real-time monitoring of hydrogen cyanide gas during field activities.

2. Equipment

To monitor cyanide (as hydrogen cyanide gas), the GEI field representative should utilize a real time handheld meter in conjunction with the Dräger Chip Measuring System (CMS) during subsurface activities including subsurface excavations, borings and monitoring well installation, materials handling, and groundwater sampling in areas with confirmed or suspected cyanide impacts.

Continuous monitoring equipment includes the V-RAE by Rae Systems and the Mini-Warn by Dräger Safety Systems, and are available from rental equipment suppliers. Due to potential interference from sulfurs, hydrogen sulfide gas (H_2S) should also be monitored for comparison to the hydrogen cyanide gas levels detected. Hydrogen cyanide gas detections will also be confirmed with CMS Dräger tubes due to this interference. The Dräger CMS can quantify other gases that could potentially provide false positives for hydrogen cyanide gas (including sulfur dioxide, hydrogen sulfide, phosphine gas, chlorine, and nitrogen dioxide) detected by the real time meter.

3. Calibration

Prior to commencing work on-site, the real-time cyanide meter should be calibrated in accordance with the equipment manufacturer's specifications. If the meter is calibrated in the field, the daily calibration results should be recorded in the field notebook.

4. Execution

Cyanide will be monitored around the perimeter of the work zone on a regular basis. Continuous monitoring should be completed every fifteen minutes if sulfur odor or suspected purifier waste material (former MGP sites only) is encountered. Measurements should be monitored in the breathing zone and should be recorded into the field notebook or on an applicable form. In the event that hydrogen cyanide is detected, the GEI field representative should proceed as follows:

4.1. Action Level: HCN ≤1 ppm for 15-minute average using real time meter

- Run CMS Dräger tube.
- Continue monitoring with real time meter.
- Continue work if CMS Dräger tube for hydrogen cyanide reads <2 ppm.

4.2. Action Level: 1 ppm < HCN < 2ppm for 15-minute average using real time meter.

- Run CMS Dräger using hydrogen cyanide gas chip and confirm <2 ppm concentration.
- Continue monitoring with real time meter.
- Run CMS Dräger tube using sulfur dioxide, hydrogen sulfide phosphine chip to evaluate potential interference.
- Recalibrate the real time meter and continue to monitor the work zone.

4.3. Action Level: HCN 2 ppm on CMS Dräger tube

- Stop work and move (with continuous monitoring meter) at least 25 feet upwind from excavation or until continuous monitoring meter registers <1 ppm.
- Run CMS Dräger hydrogen cyanide chip and re-evaluate activities
- Continue monitoring with real time meter.
- Allow area to ventilate and continue to monitor while returning to the work zone.
- Do not move into an area when readings are >1 ppm without confirming with additional CMS Dräger measurement.
- May resume work if Dräger tube for cyanide reads <2 ppm.

5. Limitations

No air purifying respiratory protection is available for hydrogen cyanide gas.

The American Conference of Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) for Hydrogen Cyanide is 4.7 ppm.

6. References

Code of Federal Regulations, 40 CFR 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods (Interim Edition), Addendum to Section 2.11 Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere (High-Volume Sampler Method), US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA/600/R-94/038b April 1994.

7. Contacts

Brian Skelly
Ryan Hoffman

STANDARD OPERATING PROCEDURE

AR-006 Air Sampling for Volatile Organic Compounds (VOCs) using Summa Canisters

1. Objective

Describe standard procedures for the collection of ambient air samples to be analyzed for volatile organic compounds (VOCs) using Summa canisters. Typically, U.S. EPA Method TO-15 is used for laboratory analysis. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Materials

- Sampling canister
- Flow controller
- Vacuum gauge
- Wrench for removing fittings and assembling the sample train
- Data sheets for recording the sampling location, date, duration, starting and stopping times, and calculated sample volume
- Camera and measuring tape
- Weather station data
- PID

3. Sampling

This section details the sampling methodology and the media preparation by the analytical laboratory.

3.1. Sampling Equipment Overview

- The laboratory prepares the canister for sampling by cleaning and then evacuating the contents to a vacuum of approximately 29.9 inches of Mercury (in. Hg). Opening the stainless steel bellows valve allows the air sample to enter the canister. When the target volume of sample is collected, close the valve and return the canister to the laboratory.
- A flow controller is used as part of the sample train to control the amount of air allowed to flow into the container over time. Flow controllers are typically set to a flow rate that collects a sample continuously over a 1-hour (hr), 8-hr, or 24-hr interval. The sampling duration needs to be communicated to the laboratory prior to sampling, so that the laboratory can provide the appropriate flow controller.
- Summa canisters are typically used and named after the “Summa” process which describes the electro polishing of the interior surface of the canister to prepare it for sampling.
- The holding time for a standard VOCs list of EPA Method TO-15 is 30 days after sample collection, although some projects may require a shorter hold time.

3.2. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- Sketch the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Record pertinent observations, such as odors and readings from field instrumentation.

3.3. Sample Collection

- Collect samples in a clean Summa canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (e.g. 8-hour, 24-hour, etc.). The flow controller flow rate should not exceed 0.2 liters per minute.
- Verify the initial vacuum of the canister using the vacuum gauge. If the canister vacuum is less than 25 in. Hg, do not use it. The procedure to verify the initial pressure is simple, and a missed step can compromise the validity of the sample media.
    i. Confirm the canister's bellows valve is closed by turning the knob clockwise to tighten.
    ii. Remove the brass cap from the canister inlet.
    iii. Attach the vacuum gauge.
    iv. Open and close the bellows valve quickly (a few seconds).
    v. Read and record the vacuum on the gauge as 'Initial vacuum' on the chain-of-custody (COC).
    vi. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
    vii. Remove the vacuum gauge and replace the brass cap.
- <u>Begin Sampling</u>
    i. Confirm the bellows valve is open by turning the knob counter-clockwise to loosen.
    ii. Remove the brass cap.
    iii. Attach the flow controller.
    iv. Attach a "J"-shaped sampling cane to prevent precipitation from entering the canister.
    v. Place the canister at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.

vi. Record the start date and time on the COC.
vii. Record the identification numbers for the canister and flow controller and the vacuum gage.

- Begin Sampling (with a field duplicate)
  i. Confirm the bellows valve is closed by turning the knob clockwise to loosen on both canisters.
  ii. Remove the brass cap from both canisters.
  iii. Attach a flow controller on both canisters.
  iv. Attached a “T”-shaped sample train designed for field duplicates to both canisters.
  v. Attach a “J”-shaped sampling cane to the common end of the sampling “T” to limit precipitation entering the canisters.
  vi. Place the attached primary and duplicate canisters at the sampling location open the bellows valve. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
  vii. Record the start date and time on the COC.
- Monitoring Sample progress
  i. At regular intervals, record the vacuum on the flow controller to confirm that the vacuum is decreasing in the canister. If the vacuum reads 5 in. Hg or less the bellows valve should be closed and the sample interval ended.
  ii. Some residual vacuum is important to maintaining sample integrity. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Evaluate whether another sample will be taken after sharing the laboratory’s opinion with your project manager.
- End Sampling
  i. Sampling will end when the time interval (e.g., 8-hr period) is completed, or when the canister vacuum reads 5 in. Hg or less.
  ii. Close the bellow valve by turning the knob clockwise to tighten.
  iii. Remove the “J”-shaped sampling cane.
  iv. Remove the flow controller.
  v. Attach the vacuum gauge.
  vi. Open and close the bellows valve quickly (a few seconds).
  vii. Read and record the vacuum on the gauge as ‘Final vacuum’ on the chain-of-custody (COC).
  viii. Confirm the bellows valve is closed by turning the knob clockwise to tighten.
  ix. Remove the vacuum gauge and replace the brass cap.
- Sample Transport
  i. Return the canister, flow controller, and sampling cane to the laboratory in the boxes provided.
  ii. Fill out the COC and relinquish samples properly with flow controller and canister numbers on the COC.

iii. Place the COC in the box and retain a copy of the COC for your records.
iv. Tape the box shut.
v. Deliver or ship the samples to the laboratory as soon as practical to adequately meet the holding time of the sample.

4. General Guidance

- This method may be modified for indoor air sampling.
- Field Blank: Do not collect a field blank.
- Trip Blank: Do not collect a trip blank. The canister is prepared for sampling by evacuating the contents to a vacuum of, so no air exists for a trip blank to provide meaningful information.

5. References

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS), US Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Cincinnati, OH, EPA/625/R-96/010b, January 1999.

Guide To Air Sampling & Analysis, Air Toxics, Ltd., Folsom, CA.

6. Contacts

Brian Skelly
Mark C. Ensign

Section 12

Soil Gas Sampling (SG)

STANDARD OPERATING PROCEDURE

SG-001 General Guidance on Soil Vapor Intrusion Evaluations

1. Objective

The goal of a soil vapor intrusion evaluation is to assess whether complete exposure pathways of soil vapor to indoor air exist. A complete exposure pathway exists if vapors from constituents are migrating through various pathways into residential or commercial buildings at concentrations that may result in an unacceptable human health risk. If a complete exposure pathway does not exist, then further assessment of soil vapor intrusion is not required.

Depending on the status of investigation performed at the site it may be appropriate to approach an evaluation of soil vapor intrusion at different tiers. If little work has been performed relative to the potential for contaminants to affect soil vapor near a structure, then a screening level assessment is an appropriate first step. However, if a plume is well delineated and the potential for groundwater impacts, or nearby source material, to affect soil vapor near a potential receptor structure is well understood, then it may be more appropriate to directly develop and implement a soil vapor and/or indoor air sampling plan. To accommodate the potential varied states of knowledge when a vapor intrusion evaluation is required, a flexible approach is needed that incorporates the following elements.

- SOP SG-002 Soil Vapor Sample Collection
- SOP SG-003 Sub-Slab Soil Vapor Collection
- Indoor Air Sampling
- SOP SG-004 Ambient Air Sample Collection

Soil vapor intrusion evaluations should be approached on a site-specific basis and depending on the site-specific setting and proximity to impacted groundwater or source material, it may be appropriate to proceed in a hierarchical fashion through each tier of evaluation or a variety of tiers may be combined and implemented simultaneously. The SOPs presented in this SOP address each of these sampling procedures.

2. Execution

2.1. Implementation Triggers

Soil vapor intrusion evaluations may be implemented at various times based on event triggers throughout the Site Characterization (SC), Remedial Investigation (RI), and site remedial action plan. The following event triggers would require the implementation of this soil vapor intrusion investigation.

- Identification of a potential complete exposure pathway
- Private property owner request for sampling

- State or Federal administrative order

2.2. Factors Affecting Soil Vapor Intrusion

Prior to conducting a soil vapor intrusion assessment at a private property, an analysis of the factors contributing to the migration of soil vapor to indoor air should be conducted. The completion of this analysis should take into account the two types of factors: environmental and building factors.

2.2.1. Environmental Factors

Environmental factors include site specific conditions in the subsurface and above the ground surface that may affect the rate and direction at which soil vapor may migrate.

The soil and groundwater conditions between the contamination and the residential/commercial building should be evaluated and recorded in any soil vapor intrusion investigation. If the SC/RI has been completed, then the data are available for this review. If the SC/RI has not been completed, then at a minimum the nature and extent of impacted soil and/or groundwater between the site and the residential/commercial building should be defined.

After compiling the necessary site-specific data, that information should be reviewed to determine groundwater conditions at the site. The potential for man-made or natural preferential pathways for vapor migration in the vadose zone and/or for groundwater migration in the saturated zone should also be determined at this time.

- The depth to groundwater below the residential or commercial building will be determined. For example, in cases where groundwater intersects the foundation there is no vadose zone to collect a sub-slab sample. In cases where the groundwater is close to the foundation, there is a risk of causing/exacerbating groundwater intrusion through the foundation during periods of high groundwater.

Additional Site Observations

- Direction of groundwater flow from the contaminant source to the residential or commercial building;
- The location, depth, extent, and concentration of potential constituents in unsaturated soil and groundwater on the property; and,
- Presence of an overlying water bearing zone that does not have impacts beneath the residential or commercial building. An un-impacted shallow water zone will significantly retard or completely prohibit the potential for deeper impacted groundwater to affect soil vapor.
- Potential “smear zones” (residual non-aqueous phase liquid (NAPL) present at depths over which the water table fluctuates) should also be identified as they may also affect the rate of soil vapor migration.
- Location, depth, extent of NAPL, if present.

Soils which are highly organic, wet, and/or of low permeability should be identified. If these soils are present beneath a structure and above impacted groundwater or soil, they may effectively shield the building from potential vapor intrusion. Conversely, dry and porous soils underlying a building may provide a less inhibited soil vapor intrusion pathway. The limits of backfill surrounding residential or commercial building should be also noted.

2.2.2. Building Factors

Building Factors include the physical characteristics, such as structure, floor layout, air flow, and physical conditions. These conditions will be documented during the evaluation. The New York State Department of Health (NYSDOH) Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory form is presented in Attachment A. At a minimum, the following information should be recorded.

- Building foundation construction characteristics (basement, footers, crawl spaces, etc), including potential preferential vapor intrusion pathways such as foundations cracks and utility penetrations.
- Basement wall materials (hollow block, stone, or poured concrete, etc.)
- Presence of an attached garage.
- Recent renovations to the building such as new paint or new carpet.
- Mechanical heating/cooling equipment that may affect air flow.
- Use and storage of petroleum products such as home heating oil storage tanks, underground storage tanks (USTs), or kerosene heaters.
- Recent use of petroleum-based finish or other products containing volatile organic compounds (VOCs).
- Areas of pavement on the property should also be identified in the event sub slab vapor sampling is not feasible or appropriate due to a high groundwater table. Paved areas could serve as surrogate locations in lieu of sub slab soil vapor sampling if high water table conditions exist.

The construction materials and integrity of the floor of the structure closest to the potential point of entry for soil vapor (basement level or first floor for slab-on-grade constructions) should be identified. In addition to the foundation type and integrity, this survey should note any preferential pathways (utility lines/pipes, sumps, etc.) that may exist within the bottom-most level of the structure.

The operation and presence of heating systems, including fireplaces and clothes dryers, may create a pressure differential between the structure and the outside environment, causing an increase of migration of soil vapor into the building. The NYSDOH guidance document suggests limiting indoor air sampling to the heating season (with the exception of immediate inhalation hazard situations), which is roughly defined as November 15th to March 31st. However, sampling may be completed at any time during the year for any sampling completed in response to a request by a community member. In situations where non-heating season sampling has taken place, consideration should be given to re-sampling the property within the heating season. The operation of HVAC systems should be noted on the building inventory form (Attachment A).

During the initial building assessment and visit, and again when sub-slab soil vapor and/or indoor air sampling are performed, differential pressure measurements between indoor air, ambient air, and soil vapor should be collected and recorded to document the potential effect building conditions have on soil vapor migration.

2.2.3. Property Visit

A property visit will be conducted prior to sampling. During the site visit, technical representatives will complete site visit observations, inventories and occupant questionnaire forms (Appendix A). During the course of the interview, observations will be made to identify any potential areas or issues of concern or the presence of any odors, and if sampling appears necessary, identify potential sampling points and general building characteristics. The questionnaire is also used to identify potential sources and activities that may interfere with sampling results. The questionnaire will specifically address the activities of the occupant's (e.g., smoking, work place activities) that may contribute to indoor air concentrations of volatile chemicals.

The responses to the questionnaire will be evaluated and a determination will be made as to whether additional investigation is required.

2.2.4. Chemical Inventory

The chemical inventory complements the identification of the building factors affecting soil vapor intrusion. The chemical inventory will identify the occurrence and use of chemicals and products throughout the building. These products can be used to develop an indoor environmental profile. A separate inventory should be prepared for each room on the floor being tested as well as any other indoor areas physically connected to the areas being tested. Inventories will include product names, chemical ingredients, or both. If possible, photographs of the products should be taken of the location and condition of the inventoried products and the photographic records should be indexed with the inventory records. The products inventory can also be used to document odors and if possible portable vapor monitoring equipment measurements should be taken and recorded. A product inventory will be repeated prior to each round of testing at the building. If available, the volatile ingredients should be recorded for each product. If the ingredients are not listed on the label, record the manufacturer's name and address or phone number if available. The product inventory form is presented in Attachment A.

2.2.5. Water Table Conditions and Vapor Intrusion Assessment Approach

Sub-slab soil vapor sampling is intended to evaluate the potential for vapor intrusion. However, there are circumstances where collection of sub-slab soil vapor samples may not be feasible if the water table is near, at, or above the elevation of a buildings foundation slab. An evaluation of the water table elevation relative to the building slab should be made before attempting to install a sub-slab vapor sampling point.

If the water table is found to be sufficiently below the building slab and sub-slab vapor sampling can be performed, then the following Low Water Table Scenario should be followed.

2.2.5.1. Low Water Table Scenario

If the water table elevation is lower than the basement slab, then the following samples should be collected.

- Sub-slab soil vapor samples
- Indoor air samples from basement level
- Indoor air samples from main living space (First floor)
- Outdoor ambient air sample

If the water table is deemed to be at too high of an elevation to allow sub-slab vapor sampling, then alternate means of evaluating the potential for vapor intrusion must be employed. If a building has a groundwater sump, the sump should be evaluated to determine if there is water present in the sump and if that water is representative of groundwater or if the water is stagnant. If water in the sump represents groundwater, then a sample from the sump should be collected. The High Water Scenario below summarizes the methods to evaluate potential vapor intrusion if sub-slab vapor sampling cannot be conducted due to high groundwater conditions.

2.2.5.2. High Water Table Scenario

If the water table elevation is higher than the basement slab, then the following tasks should be performed.

- Determine if a sump pump is present and actively pumping water.
- If sump is actively pumping, collect a sample of groundwater from the sump.
- Collect an indoor air sample from basement level.
- Collect an indoor air sample from main living space (first floor).
- Identify exterior soil vapor sample location near foundation (outside of foundation backfill) and preferably beneath a surrogate vapor cap (e.g. paved driveway, patio).
- Collect soil vapor samples from exterior soil vapor location
- Collect an outdoor ambient air sample.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945.

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Attachments

Attachment A - NYSDOH Center for Environmental Health's Indoor Air Quality Questionnaire and Building Inventory Form

5. Contact

Chris Berotti

ATTACHMENT A

Off-Site Property Sampling Documentation Form

Property Location/Address: ______________________________

Property: _____________________________

Sampling Date: _____________________________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Preparer's Name: ________________________________ Date/Time Prepared: ______________

Preparer's Affiliation: ________________________________ Phone No.: __________________

Purpose of Investigation:____

1. OCCUPANT Interviewed: Yes ☐ No ☐

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

Number of Occupants/persons at this location _______ Age of Occupants__________________

2. OWNER OR LANDLORD (Check if same as occupant __) Interviewed: Yes ☐ No ☐

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

3. CONTACT NAME (Check if same as Occupant ____, Owner ____)

Last Name: _____________________________ First Name: ____________________________

Address: ____

County: _______________________

Home Phone: ___________________________ Office Phone: __________________________

4. PROPERTY LOCATION: ____

Relative to Site:

Direction ________ Direction to Nearest Cross Street: _________

Distance ________ Distance to Nearest Cross Street: _________

Surrounding Land Use:

North: ________________ East: ________________

South: ________________ West: ________________

Property Location/Address: ____________________________
Property: ___________________________
Sampling Date: ___________________________

5. PROPERTY BOUNDARIES

Delineate the boundaries of the property (on a separate project map, outline property location, private well location, septic/leachfield location, groundwater flow, compass direction, windrose.)

6. BUILDING CONSTRUCTION

Type of Building (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _________________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ______________________________________

Does it include residences (i.e., multi-use)? Yes ☐ No ☐

If yes, how many? ______

Other characteristics:

Number of floors______ Building age______

Is the building insulated? Yes ☐ No ☐ How air tight? Tight / Average / Not Tight

Construction Material ____________________________________

7. BASEMENT AND CONSTRUCTION CHARACTERISTICS

Does the building have a basement and/or crawl space, or is it slab-on-grade construction?

____

Describe the construction of the basement/crawl space (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor surface:	uncovered	covered	covered with ____________	
e. Concrete floor:	unsealed	sealed	sealed with _____________	
	unpainted	painted	painted with ____________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with _____________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	

Does your basement have a sump? Yes ☐ No ☐

Is, is there water in the sump? Yes ☐ No ☐

Describe sump conditions:____

____

Have you observed standing water in your basement? Yes ☐ No ☐

If so, what is the frequency of this observation? _____________During rain events? ☐

Have you observed sheen atop the standing water? Yes ☐ No ☐

Basement/Lowest level depth below grade: ________(feet)

Are there any cracks in the floor of your basement? Yes ☐ No ☐

Description: ____

____

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

Description: ____

____

What activities occur in the finished basement?

Description: ____

____

Approximately how many hours per day (or week) do you spend in your basement? __________

8. HEATING, VENTING AND AIR CONDITIONING

Type of heating system(s) used in building: (Circle all that apply – note primary)

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Hot Air Circulation	Hot Water Baseboard	Steam Radiation
Electric Baseboard	Heat Pump	Wood Stove
Space Heaters	Radiant Floor	Outdoor wood boiler
Unvented Kerosene Heater	Other _____________________________	

The primary type of fuel used is:

Fuel Oil	Natural Gas	Electric
Kerosene	Propane	Solar
Wood	Coal	Other? ___________________

Time of use of each type of heating? ____

Domestic hot water tank fueled by: ____

Boiler/furnace located in: Basement Outdoors Main Floor Other_______________

Air conditioning: Central Air Window units Open Windows None

Are there air distribution ducts present? Yes ☐ No ☐

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

Type of insulation (e.g. blown, fiber, etc.)? ____

Does building have energy efficient windows (e.g. double paned) Yes ☐ No ☐

Was weather-stripping recently added/upgraded? Yes ☐ No ☐

Particleboard used in construction? Yes ☐ No ☐

9. OCCUPANCY

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

Level	General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage)
Basement	____
1st Floor	____
2nd Floor	____
3rd Floor	____
4th Floor	____

10. BULK PETROLEUM STORAGE

Aboveground storage tank on the property Yes ☐ No ☐

If yes, how old is tank? _______________ Condition? __________________

Last inspected? _______________ Location: ____________________

Describe conduits to building (type, location, and entry portal condition): _________________

____

Underground storage tank on the property. Yes ☐ No ☐

If yes, how old is tank? _______________ Condition? __________________

Last inspected? _______________ Location: ____________________

Describe conduits to building (type, location, and entry portal condition): _________________

____

11. WATER AND SEWAGE

Water Supply:

Public Water Drilled Well Driven Well Dug Well Other ______________

Is there use of groundwater water for irrigation purposes? Yes ☐ No ☐

Sewage Disposal:

Public Sewer Septic Tank Leach Field Dry Well Other ______________

12. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Yes ☐ No ☐

If not, is there a separate garage or carport? Yes ☐ No ☐

b. Does the garage have a separate heating unit? Yes ☐ No ☐ NA ☐

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)

Yes □ No □ NA □ Please specify__________________

Is gasoline stored in the garage? Yes □ No □

Quantity? ________________

d. Has the building ever had a fire? Yes □ No □

When?_________________

e. Is a kerosene or unvented gas space heater present? Yes □ No □

Where? ________________

f. Is there a workshop or hobby/craft area? Yes □ No □

Where & Type? ________________

g. Is there smoking in the building? Yes □ No □

How frequently? _______________

h. Have cleaning products been used recently? Yes □ No □

When & Type? ________________

i. Have cosmetic products been used recently? Yes □ No □

When & Type? ________________

j. Has painting/staining been done in the last 6 months? Yes □ No □

Where & When? _______________

Is house paint stored inside? Yes □ No □

Where? _______________

k. Is there new carpet, drapes or other textiles? Yes □ No □

Where & When? _______________

l. Have air fresheners been used recently? Yes □ No □

When & Type? ________________

m. Is there a kitchen exhaust fan? Yes □ No □

If yes, where vented?____________

n. Is there a bathroom exhaust fan? Yes □ No □

If yes, where vented?____________

o. Is there a clothes dryer? Yes □ No □

If yes, is it vented outside? Yes □ No □

p. Has there been a pesticide/chemical fertilizer application? Yes □ No □

Property Location/Address: ______________________________
Property: _____________________________
Sampling Date: _____________________________

When & Type?____

Conducted by Owner or Private Yard Service ___________________________

Is yard waste/trash burned on-site? Yes ☐ No ☐

Do any of the building occupants use solvents at work? Yes ☐ No ☐

(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Yes ☐ No ☐

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, Use dry-cleaning regularly (weekly) No

Use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Yes ☐ No ☐

Date of Installation: ____________

Is the system active or passive? Active ☐ Passive ☐

Are there any recent/past improvements to building? Yes ☐ No ☐

Interior painting? ____

Any landscaping improvements that involved bringing fill on site? Yes ☐ No ☐

Other ____

Approximately when (how long ago) did these improvements occur? ______________

Does anyone living here engage in any of the following activities or hobbies?

a. Art projects (e.g. oil painting, ceramics, pottery, stained glass, metal sculpture)

Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

Property Location/Address: ______________________________
Property: ______________________________
Sampling Date: ______________________________

b. Furniture refinishing Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

c. Model building(e.g. planes,boats,cars) Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

d. Gardening Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

e. Automotive work Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

f. Ammunition reloading Yes ☐ No ☐

Name: ____________________________ Age: _________ Sex: _____________

Name: ____________________________ Age: _________ Sex: _____________

Is there a wood burning stove? Yes ☐ No ☐

If so, how frequently is it used?

____

____

Is there a barbeque grill? Yes ☐ No ☐

If so, how frequently is it used? What is the type of fuel?

____

____

Has the building ever had fumigation? Yes ☐ No ☐

Property Location/Address: ______________________________
Property: ____________________________
Sampling Date: ____________________________

If so, when and how frequently? Type?

____

____

13. ODOR SUMMARY

Have the occupants observed any unusual odors? _____________________________________

____

____

____

____

History of odor observation – date of onset, duration, severity, etc.

____

____

____

____

____

____

____

14. PRODUCT INVENTORY

Record the specific products found in building that have the potential to affect indoor air quality on the attached product inventory form.

15. INDOOR SKETCH

Draw a plan view sketch (on grid paper) of the basement, first floor, and any other floor where sampling was conducted in the building as well as any outdoor sample locations. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Property Location/Address: ____________________________
Property: ___________________________
Sampling Date: ___________________________

Product Inventory
Off-Site Property Sampling Documentation
Soil Vapor Intrusion Investigation

Property Address:	**Performed by:**
Date of Inventory:	**Field Instrument Make & Model:**

Location	Product Description	Size (units)	Condition *	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y/N

Notes

* Describe the condition of the product containers as Unopened (UO), Used (U), or Deteriorated (D)

** Photographs of the front and back of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

STANDARD OPERATING PROCEDURE
SG-002 Soil Vapor Sample Collection

1. Objective

This procedure outlines the general steps to collect soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary soil vapor probes should be installed using the procedures outlined below. All soil vapor probes should be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe points.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North);
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Soil Vapor Point Installation Specifications

Each soil vapor point should be constructed as follows:

- Six-inch stainless steel Geoprobe® AT86 series Permanent Implants (soil vapor screens) or equivalent and threaded to an (expendable) stainless steel anchor point.
- The implants should be fitted with inert Teflon or stainless steel tubing of laboratory or food grade quality.
- The annular space surrounding the vapor screen interval and a minimum of 6-inches above the top of the screen should be filled with a porous backfill

material (e.g., glass beads or coarse silica sand) to create a sampling zone 1 foot in length.

For temporary points, a hydrated bentonite surface seal should be created at the surface to minimize infiltration. For permanent points, the additional measures described below should be included.

- The soil vapor points should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet (or to grade, whichever is smaller) to prevent ambient air infiltration.
- If needed, the remainder of the borehole should be backfilled with clean material.
- A protective casing should be set around the top of the point tubing and grouted in place to the top of the bentonite to minimize infiltration of water or ambient air, as well as to prevent accidental damage to the soil vapor point.
- The tubing top should be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

2.3. Soil Vapor Sample Collection

Soil vapor samples should be collected as indicated in the work plan and in accordance with applicable state or federal guidance documents. Specifically, samples from the points should be collected as follows:

- Permanent soil vapor points should not be sampled or purged for a minimum of 24 hours after installation. Temporary points may be purged and sampled immediately following installation.
- Document pertinent field conditions prior to sampling as described above.
- A suction pump should be used to remove a minimum of three implant volumes from the soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples should be collected for volatile organic compounds (VOCs) in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate should not exceed 0.2 liters per minute.
- A helium tracer gas should be used to identify any potential migration or short circuiting of ambient air during sampling as described below.
- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing

laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.

- Connect the tubing from the soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample should be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data should be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the soil vapor probe seal and assess the potential for introduction of ambient air into the soil vapor sample.

A tracer gas evaluation should be conducted on the each temporary soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent soil vapor probe during the initial sampling event and a minimum of 10% of the soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

Retain the tracer gas around the sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.

- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber should have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber should have a gas-tight fitting or sealable penetration to allow the soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that should be pre-calibrated to extract soil vapor at a rate of no more than 0.2 liters per minute. Purge the tubing using the pump. Calculate the volume of air in the tubing and probe and purge one to three tubing/probe volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation should be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary.

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred, however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-003 Sub-slab Soil Vapor Collection

1. Objective

This procedure outlines the general steps to collect sub-slab soil vapor samples. The site-specific Sampling and Analysis Work Plan should be consulted for proposed sample locations, sample depths, and sampling duration.

2. Execution

Permanent and temporary sub-slab soil vapor probes will be installed using the procedures outlined below. All sub-slab soil vapor probes will be installed using a direct-push drill rig (e.g., Geoprobe® or similar), hand auger, or manually using a slide hammer.

2.1. Document Field Conditions

Document pertinent field conditions prior to installation of any probe locations.

- Record weather information (precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for the past 24 to 48 hours. Record the indoor conditions (temperature, heating/cooling system active, windows open/closed, etc.).
- Measure the differential pressure at the building. Measure the indoor and outdoor barometric pressure using a high resolution device. Where possible, measure the sub-slab barometric pressure at the sampling point.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Indoor floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, heating, ventilating and air conditioning (HVAC) system air supply and return registers, compass orientation (North), footings that create separate foundation sections, and any other pertinent information should be completed;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas.
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sub-Slab Soil Vapor Point Installation Specifications

Each sub-slab soil vapor point will be constructed as follows:

- Drill an approximately 3/8-inch hole through the slab. If necessary, advance the drill bit 2-3 inches into the sub-slab material to create an open cavity.
- Using dedicated inert Teflon or stainless steel tubing of laboratory or food grade quality, insert the inlet of the tubing to the specified depth below the slab. For permanent installation, only stainless steel tubing and fittings will be used.
- For permanent point installations, the annular space surrounding the vapor probe tip will be filled with a porous backfill material (e.g., glass beads or coarse silica sand) to cover 1-inch of the above the tip of the probe.
- Seal the annular space between the hole and the tubing using an inert non-shrinking sealant such as melted 100% beeswax, permagum grout, putty, etc. For permanent installations, cement may be used.
- For permanent points, a protective casing will be set around the top of the point tubing and grouted in place minimize infiltration of water or ambient air, as well as to prevent accidental damage to he permanent point.
- The tubing top will be fitted with a Swagelok® and cap to prevent moisture and foreign material from infiltrating the tubing.

In cases where sub-slab sampling is impractical or infeasible, a surrogate location (attached garage, concrete patio, asphalt driveway, etc.) may be used if it is representative of sub-slab conditions. In surrogate locations, the vapor sampling point may be installed in accordance with SOP SG-002 Soil Vapor Collection.

2.3. Sub-Slab Soil Vapor Sample Collection

Sub-slab soil vapor samples will be collected as indicated in the site-specific Sampling and Analysis Work Plan and in accordance with state or Federal guidance documents. Specifically, sub-slab samples from the points will be collected as follows:

- Document pertinent field conditions prior to sampling as described above.
- A suction pump will be used to remove one to three implant volumes from the sub-slab soil vapor points prior to sampling. Include the volume of any additional tubing added to affix sampling equipment and the annular space between the probe and the native material if sand or glass beads were used.
- The purge rate shall not exceed 0.2 liters per minute.
- Samples will be collected in an individually laboratory certified clean 1-liter SUMMA® canister (or equivalent) using a certified flow controller calibrated for the anticipated sample duration (4 minutes). The regulator flow rate will not exceed 0.2 liters per minute.
- A helium tracer gas will be used to identify any potential migration or short circuiting of ambient air during sampling as described below.

- Remove the protective brass plug from the canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of-custody form for each sample.
- Connect the tubing from the sub-slab soil vapor probe to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- Monitor the vacuum pressure in the canister routinely during sampling.
- Stop sample collection when the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, the sample will be rejected and collected again in a new canister.
- Record the final vacuum pressure and close the canister valve. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Samples will be analyzed for volatile organic compounds (VOCs) and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.
- All laboratory analytical data will be validated by a data validation professional in accordance with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, January 2005 and the USEPA Region II Standard Operating Procedure (SOP) for the Validation of Organic Data modified to accommodate the USEPA Method TO-15 and natural gas analysis by ASTM D-1945.

2.4. Tracer Gas Evaluation

The tracer gas evaluation provides a means to evaluate the integrity of the sub-slab soil vapor probe seal and assess the potential for introduction of indoor air into the sub-slab soil vapor sample. A tracer gas evaluation should be conducted on the each temporary sub-slab soil vapor probe to be sampled in a sampling event. A tracer gas evaluation should be conducted on the each permanent sub-slab soil vapor probe during the initial sampling event and a minimum of 10% of the sub-slab soil vapor probes during subsequent sampling events.

The following tracer gas evaluation procedure uses helium as a tracer gases which can be measured through laboratory analysis or by a portable detector.

- Retain the tracer gas around the sub-slab sample probe by filling an air-tight chamber (such as a plastic bucket) positioned over the sample location.
- Make sure the chamber is suitably sealed to the ground surface.
- Introduce the tracer gas into the chamber. The chamber will have tubing at the top of the chamber to introduce the tracer gas into the chamber and a valved fitting at the bottom to let the ambient air out while introducing tracer gas. Close the valve after the chamber has been enriched with tracer gas at concentrations >10%.
- The chamber will have a gas-tight fitting or sealable penetration to allow the sub-slab soil vapor sample probe tubing to pass through and exit the chamber.
- After the chamber has been filled with tracer gas, attach the sample probe tubing to a pump that will be pre-calibrated to extract sub-slab soil vapor at a rate of no more than 0.2 lpm. Purge the tubing using the pump. Calculate the volume of air in the tubing and purge one to three tubing volumes prior collecting an analytical sample or using a portable device to measuring the tracer gas concentration.
- Samples collected from vapor points during a tracer gas evaluation will be analyzed for VOCs and naphthalene via modified USEPA modified Method TO-15 and helium via ASTM D-1945.
- Alternately, a tracer gas detector may be used to verify the presence of the tracer gas in the chamber by affixing it to the valve fitting at the bottom of the chamber. The tracer gas detector may also be used to measure the tracer gas concentration in the pump exhaust during purging. If used, then record the tracer gas concentrations in the chamber and in the soil vapor sample.
- Based on the concentrations of the tracer gas detected during analysis or direct measurement, determine whether additional gas tracer evaluations are necessary:

If the evaluation on a probe indicates a high concentration of tracer gas in the sample (>10% of the concentration of the tracer gas in the chamber), then the surface seal is not sufficient and requires improvement via repair or replacement prior to commencement subsequent sample collection.

A non-detectable level of tracer gas is preferred; however, if the evaluation on a probe indicates a low potential for introduction of ambient air into the sample (<10% of the concentration of the tracer gas in the chamber), then proceed with the soil vapor sampling. While lower concentrations of tracer gas are acceptable, the impact of the detectable leak on sample results should be evaluated in the sampling report.

3. References

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Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, dated October 2006.

4. Contact

Chris Berotti

STANDARD OPERATING PROCEDURE

SG-004 Ambient Air Sample Collection

1. Objective

Describe procedures to collect ambient air samples. The site-specific Work Plan should be consulted for proposed sample locations and sampling duration.

2. Execution

2.1. Document Field Conditions

Document pertinent field conditions prior to sample collection:

- Record weather information, if available (such as precipitation, temperature, barometric pressure, relative humidity, wind speed, and wind direction) at the beginning of the sampling event. Record substantial changes to these conditions that may occur during the course of sampling. The information may be measured with on-site equipment or obtained from a reliable source of local measurements (e.g., a local airport). Data should be obtained for at least the past 12 hours.
- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified.
- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (North).
- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

2.2. Sample Collection

- Samples should be collected in laboratory-certified clean SUMMA® canister (or equivalent) using a flow controller calibrated for the anticipated sample duration (1-hour, 8-hour, etc.). The regulator flow rate should not exceed 0.2 liters per minute.
- Place the canister at the sampling location. If the sample is collected from breathing height (e.g., 3 to 5 feet above ground), then mount the canister on a stable platform such that the sample inlet should be at the proper height.
- Remove the protective brass plug from canister. Connect the pre-calibrated flow controller to the canister.
- Record the identification numbers for the canister and flow controller.
- Record the initial canister pressure on the vacuum gauge (check equipment-specific instructions for taking this measurement). A canister with a significantly different pressure than originally recorded by the testing laboratory should not be used for sampling. Record these numbers and values on the chain-of custody form for each sample.

- Connect the tubing to the flow controller.
- Open the valve on the canister. Record the time that the valve was opened (beginning of sampling) and the canister pressure on the vacuum gauge.
- Photograph the canister and the area surrounding the canister.
- If possible, monitor the vacuum pressure in the canister routinely during sampling. During monitoring, note the vacuum pressure on the gauge.
- Stop sample collection after the scheduled duration of sample collection but make sure that the canister still has a minimum amount of vacuum remaining. Check with the laboratory supplying the canister and flow controller for the ideal final vacuum pressure. Typically, the minimum vacuum is between 2 and 5 inches of mercury, but not zero. If there is no vacuum remaining, call the laboratory and discuss the sample viability with them. Determine whether another sample will be taken after sharing the laboratory's opinion with your project manager.
- Record the final vacuum pressure and close the canister valves. Record the date and time that sample collection was stopped.
- Remove the flow controller from the canister and replace the protective brass plug.
- Attach labels/tags (sample name, time/date of sampling, etc.) to the canister as directed by the laboratory.
- Place the canister and other laboratory-supplied equipment in the packaging provided by the laboratory.
- Enter the information required for each sample on the chain-of-custody form, making sure to include the identification numbers for the canister and flow controller, and the initial and final canister pressures on the vacuum gauge.
- Include the required copies of the chain-of-custody form in the shipping packaging, as directed by the laboratory. Maintain a copy of the chain-of-custody for the project file.
- Deliver or ship the samples to the laboratory as soon as practical.

3. References

USEPA modified Method TO-15 and helium via ASTM D-1945

Section 2.7.1 of the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006.*

4. Contacts

Chris Berotti
Bill Simons

Section 13

Quality Control – Quality Assurance (QA)

STANDARD OPERATING PROCEDURE

QA-001 Equipment Decontamination

1. Objective

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

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

2. Execution

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

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

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

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

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

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

3. Limitations

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

4. References

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

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

5. Contacts

Brian Conte
Bill Simons

STANDARD OPERATING PROCEDURE

QA-002 Field Quality Control Samples

1. Objective

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

2. Execution

2.1. Trip blanks

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

2.2. Equipment blanks

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

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

2.3. Field Duplicates

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

2.4. Matrix-Spike samples (MS/MSD)

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

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

2.5. Typical QA/QC Frequency

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

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

3. Limitations

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

4. References

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

U.S. Environmental Protection Agency Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final, April, 1990.

5. Contact

Brian Conte
Pat King

Section 14

Technical Report Production (RP)

STANDARD OPERATING PROCEDURE

RP-001 Technical Project Delivery

1. Objective

Describe the technical project delivery process.

The technical project delivery process outlined below begins at the start of a project and is intended to help focus the goals and objectives and the approach for completion of the project. The technical project delivery process involves numerous staff and resources, and a systematic approach should improve technical quality and streamline the entire process. This technical project delivery process should begin after the contract has been signed and scope of work has been confirmed with client and/or regulatory agency.

Much of the material covered in this standard operating procedure (SOP) is referenced to GEI's Project Delivery Model (PDM) Revised August 2009. This manual should be consulted in concert with this SOP.

2. Plan

2.1. Project Team Alignment

Identify, align and commit the full range of individuals who will be responsible for executing the project tasks and activities.

- Project Manager (PM)
- Lead Author (LA) / Assistant Project Manager / Project Engineer / Project Scientist
- Senior Review Team (SRT) / In-House Consultant (IHC) / Technical Reviewer (TR)
- Task/Phase/Discipline Leads
- Project Technical and Support Staff

2.2. Plan Checklist

The Plan Checklist identifies the project planning elements of a complete and comprehensive Project Delivery Plan.

- Read and understand contract with terms and conditions
- Read and understand Scope of Work
- Clarify project deadlines, responsibilities, and deliverables
- Compare proposed level of effort to individual effort
- Establish individual team responsibilities
- Identify Project Subcontractors
    - Identify key subcontractor contact information
    - Discuss scheduling field work

    - Provide with signed approved subcontractor purchase order
- Review prior client and project correspondence (e.g. notes from meetings) - critical to understanding client needs
- Identify client contact and preferred means of communication
- Identify similar projects/reports prepared by GEI or others
- Identify key guidance documents used for project

2.3. Project Delivery Plan

The Project Delivery Plan describes and documents the resources, tools, and processes that the project team will use to successfully deliver the project to achieve the project goals and objectives. A complete and comprehensive project plan should consider the following elements:

- Goals/Objectives
- Definition/Scope
- Deliverables
- Team/Resources
- Budget
- Schedule/Milestones
- Quality
- Risk
- Health and Safety
- Document Management
- Change Management
- Communication

3. Execute

3.1. Project Kick-off and Goal Setting Meeting

Prior to getting underway with Project Execution, the Project Kick-off activity is focused on understanding the Project Delivery Plan (scope, schedule, budget, etc.).

- Highlight project scope details including:
    - Goals and objectives
    - Deliverables
    - Schedule
    - Roles and responsibilities of team members
    - Similar project deliverables
- Provide location of background information (e.g. contracts and scopes of study)
- Discuss team's workloads and other project commitments
- Identify hard-to-meet goals or project deadlines

- Discuss site and project Health and Safety Issues
- Discuss presentation of tables and figures

3.2. Evaluate Project Performance / Quality Management

Regularly review project performance, measured against the Project Delivery Plan and identified project goals and objectives. Evaluate performance at least monthly. Review project processes, procedures, controls, and documentation per GEI Quality Assurance Program, Client and contract requirements, and industry standards. At a minimum, assess:

- Scope completion vs. cost-to-date (e.g. percent complete vs. percent spent).
- Actual schedule vs. planned schedule.
- Status of deliverables.
- Status of Accounts Receivable and Accounts Payable.
- Under- or over-estimates of required task efforts.
- Out-of-scope work and scope creep.
- Real-time review and feedback to project team.

3.2.1. Project Execution / Data Collection

- Monitor data collection activities
- Document all field deviations and subsequent corrections from scope of work for inclusion into report
- Document any discussions with regulators, client, or site personnel that may affect the conclusions or interpretation of data
- Notify client of any deviations or unexpected findings
- Monitor collection of sub-contractor data (e.g. survey data)

3.2.2. Data Quality Objectives

- Provide laboratory contacts and preferred method of communication
- Establish approximate dates of data collection
- Discuss analytical reporting (e.g. should electronic version be submitted directly to laboratory)
- Provide locations and copies of quality assurance documents prepared for the project (e.g. quality assurance project plan (QAPP))
- Discuss amount and type of data to be generated (e.g. number of samples and matrices)
- Determine if outside validation of data is required or necessary
- Define laboratory reporting requirements. Are they sufficient to meet data quality objectives
- Identify analytical parameters with expedited hold times
- Identify all applicable regulatory standards
- Need to generate interim data reports to update client

3.2.3. Data Presentation – Reports and Figures

- Provide drafting with materials for creation of figures and plates
- Confirm the presentation of exceedances (e.g. bold and shade)
- Confirm the presentation of qualified data (e.g. "J" flags)
- Discuss legend and notes section to be provided in tables and figures
- Provide timetable for completion of tables and figures
- Provide tables and figures to part icipants prior to conceptual model presentation

3.3. Deliverables

During this phase the Lead Author(s) prepar e the document in consultation with the PM. Project team should consult with th e IHC as needed prior to submittal of draft review.

- Discuss salient points of investigation - "what is the story" to be told in the report
- Provide any perceived data gaps and how they will be addressed in report
- Provide deviations from original work plan and why they were made
- Highlight any inconsistencies with data (e.g. lack of spatial trend in data)
- Everyone involved should agree to the conceptual model

3.3.1. Technical Review

- The Lead Author provides a complete report (tables, figures, text, appendices – all in final form) to the PM for a detailed review.
- After review by the PM, the Lead Aut hor incorporates the PM's input and provides the complete report to the TR / IH C, if necessary, for a technica l review.
- Once the changes suggested by the TR / IHC have been agreed upon by the PM and the TR/ IHC, the changes are m ade and a c omplete revised draft is provided to the PM
- The PM reviews the final doc ument prior to submittal to the client to ensure that their objectives for documents have been met. These objectives include:
    - Re-review contract and scope of work
    - Consistency of analysis and writing
    - No overstatement of conclusions

4. Limitations

- Deadline dates should be provided to the Word Processing (WP) staff and any changes to the date (pushed back or forward) should be communicated.
- Report checklist or an e-mail wit h precise instructions should be provide d to WP as early as poss ible (See Attachment A - Report Che cklist – for various examples). A report checklist fa cilitates a thorough understanding of what is needed by the WP staff. Providing more deta il up front will make it easier for the WP staff to complete their part of the process.

- Tables should be given to WP staff well in advance (this enables the lead author, or delegate to review the tables one last time before final printing and creating a PDF version). They need to have enough time to format them (which can be very time consuming), and if needed, convert the table to PDF and bookmark them correctly.
- Don't forget to notify CADD of any CADD-related project needs.
- Reports that have many copies/or CDs will take time to produce. WP must be given ample enough time to produce. PM's should take the time to discuss timing with the WP staff. Let them know how detailed a review of the text is required (i.e. just a spell check, quick format check or a thorough proofread including a thorough check on the acronyms and grammar). The creation of a PDF does not necessarily take very long, but in lengthy reports, pulling in the tables, figures and appendices can take some time, especially if the whole PDF needs extensive bookmarking.
- Inform WP by providing the file path to where your documents are located. IN order to be sure your documents are saved in the proper location in the WPROC directory, it is beneficial if you can provide the WP staff with the location of where you want your files saved in the WPROC directory. Only one copy should be held on the network ; do not request to keep a copy elsewhere on the network, and with multiple drafts please confer with WP as to what drafts (electronically) can be deleted, if any.

5. Reference

GEI's Project Delivery Model (PDM) Revised August 2009

6. Attachment

Attachment A - Report Checklist Example

7. Contact

Andrea Hippler
Pat King

REPORT CHECKLIST

Project Manager and Key Staff:	
Project Info:	Client: / Name of Report:
	Project: / Phase: / Task:
Date/Time Due to Client:	**Primary Mailing Address:**
No. of Copies:	File: / Original / Client / Personal: / Total:
Document Version:	"Draft" on ☐ off ☐ "Privileged & Confidential" on ☐ off ☐
Tables:	Yes ☐ No ☐ / Comment:
Figures:	Yes ☐ No ☐ / Comment:
Plates:	Yes ☐ No ☐ / Comment:
Appendices:	Yes ☐ No ☐ / Comment:
CAD Status	Date Submitted: / Completed / Yes ☐ No ☐
Blue Separator Pages Within Appendix and/or Tables:	Yes ☐ No ☐
Appendices:	Will be supplied ☐ / Use From a Previous Version of Report ☐
	Electronic Only ☐ / Specify Report:
Scan/PDF:	Text: Yes ☐ No ☐
	Tables: Yes ☐ No ☐
	Figures: Yes ☐ No ☐
	Plates: Yes ☐ No ☐
	Data for Appendices: Yes ☐ No ☐
PDF Links	Yes ☐ No ☐
Transmittal:	Cover Letter: / Transmittal Form: / E-Mail:
GBC or Binder:	GBC ☐ 3-Ring Binder ☐ Binder Clip ☐ Staple ☐
Any Color Printing? (Text, Tables, Figures) Specify:	Yes ☐ No ☐ / Text ☐ Tables ☐ Figures ☐ Plates ☐
Mail Delivery Type:	Regular Mail ☐ / Overnight ☐ AM Delivery ☐
	Fax ☐ Ground ☐ / Email ☐ Saturday Delivery ? ☐
Specify Level of Editorial Review:	
Additional Staff Review and Comments	

REQUIRED SIGNATURES	INITIAL	Additional Address (cc and/or bcc list)
Technical Review		
In-House Consultant Review[1]		
Editor		
Production		
Final Review		

STANDARD OPERATING PROCEDURE

RP-002 Laboratory Data Review Procedures

1. Objective

Reviewing laboratory data before they are used for analysis is an important step in quality assurance. GEI defines four levels of data review based on the needs of the project. Attachment A outlines the four levels of data review and indicates the data package requirements for each level.

Analytical data for all projects should undergo a Level 1 review in order to verify that the analytical results provided by the laboratory are of a consistent minimal level of data completeness. Most projects will benefit from a Level 2 review and is encouraged for all project work.

A Level 1 data review can be performed by most staff by following the guidelines below in Section 2.2. A higher level of data review may be required for your project and you should check with the project manager to define these requirements. Each level of data review requires certain laboratory deliverables that need to be defined before samples are sent to the laboratory so the reviewer has the tools they need to complete the review.

Laboratories utilize quality assurance and quality control (QA/QC) results to document the quality of the analytical data they submit. Although the laboratories strive to meet all QC requirements, due to complex sample matrices and other laboratory limitations, it is not unusual for laboratory reports to contain QC non-conformances. The chances of every analyte passing all of the QC criteria are remote and not expected. The Level 2 review will reveal the QC non-conformances, which in many cases, do not affect the usability of the analytical data for the intended use. In these cases, the end user of the data can have the confidence that the quality of the data is appropriate for the intended purpose.

In a small percentage of cases, the review will reveal QC non-conformance that will affect the usability of the data. In these cases, the end-user can avoid making decisions that are not technically supported and may not be fully protective of human health and the environment.

2. Execution

2.1. Quality Assurance

Quality Assurance (QA) is an important component for all projects. A formal Quality Assurance Project Plan (QAPP) may or may not be required for your project and you should check with the project manager if you do not already have the below information in a QAPP or in the work plan. In general, these QA components are important for all projects:

- Project team (including QA/QC manager)
- Samples summary table (including QA samples)
- Required analyte tables to include the Project Quantitation Limits (PQLs) and Project Action Limits (ALs) for all project matrices

- Analytical parameters summary table
- Data review level requirements
- Laboratory data quality objectives
- Laboratory deliverable level description.

2.2. Level 1 (Completeness Check)

The laboratory data package is reviewed for the compliance of sample receipt conditions and analytical results using the Level 1 review sheet (Attachment B).

- Review the reported analytical results in comparison to those requested on the chain-of-custody (COC) to ensure that all analyses were performed. Verify that analysis dates are present and appropriate units are reported. Notify the Project Manager if there were discrepancies between the requested analyses and those reported by the laboratory.
- Compare the required analyte lists to those reported in the data package. Notify the Project Manager if the analyte reporting requirements were not met.
- If dilutions were performed and analyses were not combined by the laboratory, the over calibration range (E) results are to be replaced with the dilution (D) results in order to report all results within the calibration range while reporting the lowest quantitation limits.

2.3. Level 2 (Reduced Data Deliverable Review)

This review builds on the completeness check conducted in Level 1. The Level 2 review of the data package consists of the Level 1 review plus the verification and validation checks for the compliance of the sample-related QC using the appropriate Level 2 review sheets (Attachment C).

- Items listed in the Level 1 review.
- The holding times, laboratory and field blanks, surrogate recoveries, MS/MSD and/or laboratory duplicate results, laboratory control samples, and field duplicates are reviewed according to GEI's Level 2 Data Review Procedures dated June 2013 (or more current revision) and findings are summarized in a data review memo and results table.

2.4. Level 3 and 4 Level (Data Validation)

Full data deliverable packages are reviewed according to validation requirements specified in the project QAPP or appropriate USEPA Region or State guidelines.

Level 3 and Level 4 review require the expertise of a chemist with combined laboratory and data validation experience. State agencies often determine the years of experience required.

An "external party" or "third-party" data validator may be required for your project and you should check with your state agency to assign a GEI staff or subcontractor to meet these requirements.

EPA defines "external party(ies)" as "*organizations that are not part of the immediate laboratory that generates the analytical data*." (EPA, 2009)

NYSDEC DER-10 Appendix 2B section 2.0(a)2 defines personnel requirements as a person pre-approved by DER. It also defines third party data validation as potentially necessary (e.g. pending litigation), (NYSDEC, 2010). GEI data validators have been members of project teams in many NYSDEC-approved work plan documents in the past 10+ years.

3. State-specific Levels of Data Review

Each state agency overseeing your project may have specific requirements. The following link includes links to forms and procedures for how to conduct data review for specific states, if required.

http://geiconnections/operations/Operations/JUNE 2011 - Atlantic and New England Standard Operating Procedures (Environmental)/Section_14 - Technical Report Production (RP)/

4. References

New York Department of Environmental Conservation Analytical Service Protocol, Exhibit A, Summary of Requirements (July 2005).

State of Connecticut Department of Environmental Protection, Laboratory Quality Assurance and Quality Control, Data Quality Assessment and Data Usability Evaluation Guidance Document (December 2010).

U.S. Environmental Protection Agency [USEPA] Office of Emergency and Remedial Response, 1990, Quality assurance/quality control guidance for removal activities: EPA/540/G-90/004, Sampling QA/QC Plan and Data Validation Procedures Interim Final (April 1990).

USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (December 1996).

USEPA Region 2 Guidelines for Evaluating Inorganic Analyses (December 2012).

USEPA Region 2 Guidelines for Evaluating Organic Analyses (December 2013).

USEPA National Functional Guidelines for Organic Methods Review (June 2008).

USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (November 2008).

U.S. Environmental Protection Agency, Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, EPA 540-R-08-005 (January 2009).

USEPA National Functional Guidelines for Inorganic Methods Review (January 2010).

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

5. Attachments

Attachment A – Levels of Data Review (defined by GEI)
Attachment B – Level 1 Data Review Cover Sheet
Attachment C – Level 2 Data Review SOP and checklists

6. Contact

Lorie Mackinnon

SOP RP-002 - Attachment A

Data Review Matrix

Level of Data Review	What/How is done?	What quality assurance components are needed if a QAPP is required?	What laboratory deliverables are required?	Who can perform the review?	How long does it take per sample?
Level 1	• Results requested on the COC are reported in the package. • All analytical parameters are reported (Data Completeness).	• Project team • Samples summary table (including QA samples • Project Quantitation Limits and Action level criteria table • Analytical parameters summary table • Data review level requirements • Laboratory deliverable level description	• Analytical results, SDG narrative, chains-of-custody	• Most staff	• 5 minutes per sample for large packages
Level 2	• Review includes the following: Data Completeness, Holding times, Method/Field/Trip Blanks, Surrogate recoveries, MS/MSD and/or laboratory duplicate results, Laboratory control sample (LCS), and Field duplicate review.	• Same as Level 1	• Analytical results, SDG narrative, chains-of-custody, method blank results, surrogate recoveries, MS/MSD and/or laboratory duplicate results, and LCS results.	• Staff trained with data review SOP	• 5-10 minutes per test/per sample for large data packages. This depends on the number of tests per sample.
Level 3	• Review is done according to validation guidelines as specified in QAPP. Review includes the following (if applicable): Data Completeness, Sample preservation/Holding times, GC/MS or ICP Tunes, Initial and continuing calibrations, Interference check samples (ICP), Surrogate recoveries, Method/Instrument/Field/Trip Blanks, MS/MSD and/or laboratory duplicate results, Laboratory control samples (LCS), Internal standards, Serial dilutions (ICP), Moisture content, Dual column precision (GC), Quantitation limit requirements, Target compound identification, Sample Quantitation, Field duplicates, and data assessment if multiple analyses (re-analyses or dilutions) are reported for a sample.	• Same as Level 1	• Same as Level 2, and additionally all QC results and raw data.	• Chemist with combined laboratory and data validation experience • Staff with data validation experience • Data validators identified in a state-approved QAPP • Check with your state's "external party" or "third-party" reviewer requirements. In most cases, GEI data validators meet these requirements if they are not affiliated with the laboratory and do not have project-level cost performance responsibilities.	• 30 minutes per analytical group (VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals, or general chemistry) per sample for large packages.
Level 4	• Level 3 review performed. • In addition, laboratory raw data is verified with calculations performed in all subsets of review (ex. Surrogate recovery, calibration results, MS/MSD, etc.).	• Same as Level 1	• Same as Level 2, and additionally all QC results and raw data, all laboratory logbook pages (standards prep, refrigeration logs, etc.) are required.	• Same as Level 3	• 60 minutes per analytical group (VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals, or general chemistry) per sample for large packages.

SOP RP-002 - Attachment B

Level 1 Data Review Cover Sheet

Data Reviewed By:	Date:
Project Title:	Project Number:
Laboratory:	Laboratory Job Number:
Project Manager:	

Chain of Custody (COC) Present and complete (Y/N): ______________________

Case Narrative Present (Y/N): _______________________

All requested Analyses Performed (Y/N): _____________________

If all required analyses were not performed, does the narrative or COC explain the discrepancies between the requested and reported analyses? (Example: Bottle broken in shipment, etc.)

____

____

____

____

If all required analyses were not performed, has the project manager been notified (Y/N): _____

Did the laboratory report multiple dilution analyses for any samples (Y/N)? _________________

If yes, list the affected samples/analytes: ____

____

____

____

Replace the over calibration range (E) results with those from the dilution (D) for the affected samples when possible.

Does a Quality Assurance Project Plan (QAPP) exist for this project (Y/N)? _________________

If yes, have the required analytes been reported (Y/N):

Have the required quantitation limits been met (Y/N):

List any QAPP analyte list or project quantitation limit (PQL) criteria which were not met:

____

____

____

____

____

If required analytes were not reported or PQLs were exceeded, has the project manager been notified (Y/N): ____

1. Objective

The overall objective of reviewing analytical data is to provide a quality control (QC) check on the data and the laboratory. A review of the laboratory narrative and analytical data package is performed in an effort to summarize the QC nonconformances and their effect on the quality and its usability for project objectives.

Review forms have been developed for each group of analyses, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and inorganics (metals/cyanide).

2. Execution

1. Fill out all of the information listed on the cover sheet and select one data review form for each analysis.

2. Record the method used for analysis on the appropriate form.

3. Review the data package chain-of-custody (COC) and laboratory narrative to answer the following questions:

    i. Were all requested analyses performed? If no, does the narrative or COC explain the discrepancies between the reported and requested analyses? If all of the required analyses were not performed, the project manager should be contacted.

    ii. Was the cooler temperature upon receipt at the laboratory acceptable? If no, was ice present? If ice was present and the time of transit was minimal, the cooler was not able to reach the acceptable temperature before receipt at the laboratory and the samples were not impacted.

4. Review the sample reporting forms for the extraction (if applicable) and analysis dates. Determine if the holding time criteria were met for each analysis/matrix by calculating the days between the sample collection date and extraction or analysis date. Mark the "Exceedance" box with the appropriate response. If the criteria have not been met for any sample, record the sample ID in the "affected samples" box and the exceedance (in days). The bias will be low (-) for this QC exceedance.

5. Review the associated method blanks and any field or trip blanks submitted with the samples. If analytes are detected in any of the associated laboratory method blanks, field, or trip blanks:

    i. List the blank ID, associated samples, analytes, and contaminant levels detected.
    ii. Calculate the blank action level for each contaminant. For uncommon contaminants, the action level (AL) is determined by multiplying the detected contamination by 5. For common contaminants, the action level is determined by multiplying the detected contamination by 10. Common contaminants are listed on the review checklist for each method.
    iii. Review the associated samples for possible contamination and qualifications. For example, if chromium was detected in the method blank at 5 ug/L, the action level would be calculated to be 25ug/L. Reviewing the associated samples, detected chromium results which were less than 25ug/L would be attributed to laboratory contamination. If the sample chromium result is less than the reporting limit, the result is reported as non-detect (U) at the reporting limit. If the sample chromium result is greater than the reporting limit but less than the AL of 25, the chromium result is reported as non-detect (U) at the value at which it was detected.
    iv. Record those sample IDs in the "Affected Samples" column on the data review checklist.

6. If present, review the reported matrix spike/matrix spike duplicate (MS/MSD) results. If the MS/MSD is not performed on a project sample review is not necessary, as the QC results would only apply to the specific sample (organics) or a specific matrix, type, etc. (inorganics).

    i. For an organic project-specific MS/MSD, compare the reported recoveries and relative percent differences (RPDs) to the limits specified by the laboratory. The affected sample is the sample which the MS/MSD was performed on, only. Record this sample ID on the review checklist. List the compounds and recoveries/RPDs outside of the control limits on the checklist form.

        - If a compound recovery is below the control limits, the positive or non-detect result for this compound would be affected and biased low.
        - If a compound recovery is above the control limits, the result would only be affected if detected in the sample and would be biased high.

- If the MS/MSD RPD is above the control limits, the result would only be affected if detected in the sample, and the direction of the bias is indeterminate.
- If any recovery is less than 10, and the sample compound result is not detected in the sample, this result is rejected (R) and cannot be considered usable for data objectives. If detected, the result would be usable for project objectives and biased low.

ii. For an inorganic project-specific MS/MSD, compare the reported recoveries and RPDs to those limits specified in the review checklist. The affected samples are all those of a similar matrix in the laboratory job or sample batch. Note the matrix and job number of the associated samples on the review checklist. List the analytes and recoveries/RPDs outside of the control limits on the checklist form.

- If an analyte recovery is below the control limits, all the positive or non-detect results for this analyte in the sample batch would be affected and biased low.
- If an analyte recovery is above the control limits, only associated positive results would be affected and biased high.
- If the MS/MSD RPD is above the control limits, only associated positive results would be affected, and the direction of the bias is indeterminate.
- If any recovery is less than 10, all associated non-detect results for this analyte would be rejected (R) and cannot be considered usable for data objectives. Any detected results for this analyte in the batch would be usable for project objectives and biased low.

Note the bias (low/- for recoveries less than the control limits, high/+ for recoveries greater than the control windows) on the review sheet. Bias cannot be determined for the MS/MSD RPD exceedance.

7. Review the reported laboratory control samples (LCS) or blank spikes (BS) recoveries. Compare the recoveries to the limits specified on the method review checklist. If the criteria were not met, record the LCS ID, associated samples, analytes, and recoveries which did not meet the specified criteria.

i. If an analyte recovery is below the control limits, all associated positive and non-detect analyte results are affected.

ii. If an analyte recovery is above the control limits, only associated positive results are affected. Non-detect results are not affected.

iii. If an analyte recovery is less than 10, associated non-detect analyte results are rejected (R) and cannot be considered usable for data objectives. Associated positive results are usable for project objectives and biased low.

Note the bias (low/- for recoveries less than the control limits, high/+ for recoveries greater than the control windows) on the review sheet.

8. Review any project specific laboratory duplicate (if performed) analysis RPDs. If the duplicate is not performed on a project sample review is not necessary, as the QC results would only apply to the specific sample (organics) or a specific matrix, type, etc. (inorganics). Compare the RPDs to the limits specified on the method review checklist. If the criteria were not met, record the duplicate sample ID, associated samples, analytes, and RPDs which did not meet the specified criteria. Bias cannot be determined for the duplicate RPD exceedance.

   i. For an organic project-specific duplicate, compare the reported RPDs to the limits specified by the laboratory. The affected sample is the sample on which the duplicate analysis is performed. Record this sample ID on the review checklist. List the compounds RPDs outside of the control limits on the checklist form.

   ii. For an inorganic project-specific duplicate, compare the reported RPDs to those limits specified in the review checklist. The affected samples are all those of a similar matrix in the laboratory job or batch. Note the matrix and job number of the associated samples on the review checklist. List the analytes RPDs outside of the control limits on the checklist form.

9. Review the surrogate recoveries for the appropriate analyses. Compare the surrogate recoveries to the limits listed in the review checklist criteria box. If the criteria were not met, record the affected sample, surrogate, recovery, and associated qualifier (if required see below).

   i. For SVOC analyses, action is required only if more than one surrogate is recovered outside of control limits in each fraction (acid or base/neutral). If one SVOC surrogate recovery criteria is not met, record the sample, surrogate, recovery, and no action required.

ii. For pesticide or PCB analyses, action is required only if a surrogate is recovered outside of control limits on both columns. If a pesticide/PCB surrogate recovery criteria is not met on one column only, record the sample, surrogate, recovery, and no action required.

iii. If any VOC surrogate recovery, two or more SVOC surrogate recoveries, or dual-column pesticide or PCB surrogate recovery criteria are not met, evaluation is performed as follows.

- For surrogate recoveries less than the control limits, positive and non-detect samples results are affected and may be biased low.
- For surrogate recoveries greater than the control limits, positive compound results, only, are affected and biased high.
- If any surrogate recovery is less than 10, associated non-detect analyte results are rejected (R) and cannot be considered usable for data objectives. Associated positive are usable for project objectives and are biased low.

Note the bias (low/- for recoveries less than the control limits, high/+ for recoveries greater than the control windows) on the review sheet.

10. Identify field duplicate pairs (if collected) and calculate the detected analyte RPDs. Identify the field duplicate pair on the method review checklist. Compare the RPDs to the limits specified on the method review checklist. If the criteria were not met, record the affected analytes and RPDs. The affected samples are the sample and field duplicate only. Bias cannot be determined for the field duplicate RPD exceedance.

11. Review the reporting limits for each sample. Determine if the reporting limits have been elevated due to sample dilutions, reduced sample preparation weights, increased extract volumes, or high level analyses because of matrix interference, the presence of non-target analytes, or the high concentrations of target analytes. If the reporting limits have been elevated for any samples, note the sample ID, dilution factor, and reason.

12. Verify that all solid (soil/sediments) samples were reported on a dry weight basis. Review sample moisture content. If moisture content is greater than 70, sample results should be considered estimates with indeterminate bias. If samples were not reported on a dry weight basis, the laboratory should be contacted for a data package resubmittal.

13. If issues related to the laboratory arise during review of the data, the reviewer must contact the laboratory and resolve the issues. The issues, resolution, and laboratory contact must be noted on the bottom of the cover sheet. The issues may include resubmittal of data sheets or QC data, explanations for sample dilutions or laboratory footnotes, inquires with regard to compounds detected or not detected.

3. References

USEPA National Functional Guidelines for Organic Methods Review (June 2008), U.S. Environmental Protection Agency.

USEPA National Functional Guidelines for Inorganic Methods Review (January 2010), U.S. Environmental Protection Agency.

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

SOP RP-002 - Attachment C

Level 2 Data Review Cover Sheet

Data Reviewed By:	Date:
Project Title:	Project Number:
Laboratory:	Laboratory Job Number:

Chain of Custody - Present and complete (Y/N): ____________________

All Requested Analyses Performed (Y/N): _____________________

Case narrative Present (Y/N): ______________________

Data have been reviewed in consideration of the criteria specified in the USEPA National Functional Guidelines for Superfund Organic Methods Data Review, USEPA-540-R-08-01, June 2008 and the USEPA National Functional Guidelines for Superfund Inorganic Methods Data Review, USEPA-540-R-10-011 (January 2010).

The following footnotes were used to qualify the project data (Circle footnote letters):

A	The result is estimated due to exceedance of holding time criteria.
B	The reported result is attributed to sampling or laboratory contamination.
C+ / C-	The result has a high bias / low bias due to surrogate recovery above upper / below lower control limits.
F+ / F-	The result has a high bias / low bias due to matrix spike recovery above upper / below lower control limits.
G	The result is estimated due to duplicate precision outside control limits.
J	The reported result is below the laboratory reporting limit and is estimated.
K+ / K-	The result has a high bias / low bias due to blank spike or laboratory control sample recovery above upper / below lower control limits.
R	The result is **Rejected**.

There were no qualifications (Circle if applicable).

Sample Number(s)	Affected Compounds/Analyte(s)	Quality Control Nonconformance (Footnote letter)	High/Low Bias

SOP RP-002 - Attachment C

Level 2 VOC Data Review Checklist

Data Reviewed By:	Date:
Project Title:	Project Number:
Laboratory:	Laboratory Job Number:

Parameter	**Criteria**	**Exceedance (Y/N)**		**Affected Samples**
Cooler Temperature	4° Celsius +/- 2°			
Sample Receipt Condition or Laboratory Noted Nonconformances	Notes:			
Holding Time	Aqueous, 14 days Soil/Sediment, 14 days if preserved. Soil Encore/ Unpreserved, 48 hours[2]			
Method Blanks/ID	Associated Samples	Analyte/Level Detected	Action Level[1]	Validated Sample Results (result value and qualifier)
Field/Trip Blanks/ID	Associated Samples	Analyte/Level Detected	Action Level [1]	
MS/MSD Results (list those performed on project samples only)	Recoveries/RPDs within laboratory control windows <10% recovery; associated nondetects (NDs) rejected			
Surrogates	Recoveries within laboratory control windows <10% recovery; associated NDs rejected			
Laboratory Control Samples	Recoveries within laboratory control windows <10% recovery; associated NDs rejected			
Field Duplicates Pair ID:	Aqueous RPDs <30 Soil RPDs <50	See separate worksheet for detected compounds/RPDs. Compound RPD Exceedances		

[1] The action level is calculated as 10x the maximum blank concentration detected for common contaminants (acetone, methylene chloride, and 2-butanone) or 5x the maximum blank concentration detected for each non-common contaminant.

[2] For unpreserved solid VOC samples must be analyzed or frozen within 48 hours. If frozen, samples must be analyzed within 14 days of collection. Encore samples must be prepared within 48 hours and analyzed within 14 days of collection.

SOP RP-002 - Attachment C

Level 2 SVOC Data Review Checklist

Data Reviewed By: ______________________ Date: ______________________

Project Title: ______________________ Project Number: ______________________

Laboratory: ______________________ Laboratory Job Number: ______________________

Parameter	Criteria	Exceedance (Y/N)		Affected Samples
Cooler Temperature	4° Celsius +/- 2°			
Sample Receipt Condition or Laboratory Noted Non-conformances	Notes:			
Holding Time	7 days (aqueous) or 14 days (solid) to extraction; 40 days extraction to analysis.			
Method Blanks/ID	Associated Samples	Analyte/Level Detected	Action level [1]	
Field Blanks/ID	Associated Samples	Analyte/Level Detected	Action level [1]	
MS/MSD Results (list those performed on project samples only)	Recoveries/RPDs within laboratory control windows <10% recovery; associated nondetects (NDs) rejected			
Surrogates (Action required only if more than one surrogate is outside of control limits)	Recoveries within laboratory control windows <10% recovery; associated NDs rejected			
Laboratory Control Samples	Recoveries within laboratory control windows <10% recovery; associated NDs rejected			
Field Duplicates Pair ID:	Aqueous RPDs <30 Soil RPDs <50	See separate worksheet for detected compounds/RPDs. Compound RPD Exceedances:		

[1] The action level is calculated as 10x the maximum blank concentration detected for common contaminants (phthalates) or 5x the maximum blank concentration detected for each non-common contaminant.

SOP RP-002 - Attachment C

Level 2 Pesticide and PCB Data Review Checklist

Data Reviewed By: Date:

Project Title: Project Number:

Laboratory: Laboratory Job Number:

Parameter	Criteria	Exceedance (Y/N)		Affected Samples
Cooler Temperature	4o Celsius +/- 2o			
Sample Receipt Condition or Laboratory Noted Nonconformances	Notes:			
Holding Time	7 days (aqueous) or 14 days (solid) to extraction; 40 days extraction to analysis.			
Method Blanks/ID	Associated Samples	Analyte/Level Detected	Action level 1	
Field Blanks/ID	Associated Samples	Analyte/Level Detected	Action level 1	
MS/MSD Results (list those performed on project samples only)	Recoveries/RPDs within laboratory control windows <10% recovery; associated nondetects (NDs) rejected			
Surrogates	Recoveries within laboratory control windows <10% recovery; associated NDs rejected			
Laboratory Control Samples	Recoveries within laboratory control windows <10% recovery; associated NDs rejected			
Dual Column Analysis	RPDs <40%			
Field Duplicates Pair ID:	Aqueous RPDs <30 Soil RPDs <50	See separate worksheet for detected compounds/RPDs. Compound RPD Exceedances:		

[1] The action level is calculated as 5x the maximum blank concentration detected for each contaminant.

SOP RP-002 - Attachment C

Level 2 Inorganic Data Review Checklist

Data Reviewed By:	Date:
Project Title:	Project Number:
Laboratory:	Laboratory Job Number:

Parameter	Criteria	Exceedance (Y/N)		Affected Samples
Cooler Temperature	4° Celsius +/- 2°			
Sample Receipt Condition or Laboratory Noted Nonconformances	Notes:			
Holding Time	Metals 180 days Mercury 28 days Cyanide 14 days			
Method Blanks/ID	Associated Samples	Analyte/Level Detected	Action level [1]	
Field Blanks/ID	Associated Samples	Analyte/Level Detected	Action level [1]	
MS/MSD Results	Recoveries 75-125% Aqueous RPDs <20 Soil RPDs <35 <10% recovery; nondetect results (NDs) rejected			
Duplicates (if applicable)	Aqueous RPDs <20 [2] Soil RPDs <35 [3]			
Laboratory Control Samples	AQ: 80-120 Soil: Within Vendors Limits <10%; NDs rejected			
Field Duplicates Pair ID:	Aqueous RPDs <30 Soil RPDs <50	See separate worksheet for detected analytes and RPDs. Analyte RPD Exceedances:		

[1] The action level is calculated as 5x the maximum blank concentration detected for each contaminant.

[2] For aqueous samples, if concentration of both samples >5x RL, RPD<20; if one or both samples <5x RL; difference ± RL.

[3] For soil samples, if concentration of both samples >5x RL, RPD<35; if one or both samples <5x RL; difference ± 2xRL.

Appendix C

Community Air Monitoring Program

Appendix 1A
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

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

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

Appendix D

Construction Health and Safety Plan

GEI Consultants

Consulting
Engineers and
Scientists

Construction Health and Safety Plan (CHASP)

180 East 156th Street, Bronx, New York
BCP# C203291

Submitted to:

Concourse Village West Owner LLC
40 Fulton Street, 12th Floor
New York, NY 10038

Submitted by:
GEI Consultants, Inc., P. C.
110 Walt Whitman Road
Huntington Station, NY 11746
631.760.9300

March 2017
Project 1700655

Table of Contents

Appendices

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1. Background Information

1.1 General

Engineer/Contractor Guido Subotovsky
Concourse Village West Owner LLC
40 Fulton Street, 12th Floor
New York, New York 10038

Project Name Concourse Village West Apartments-NORTH
Site No. C203291
180 East 157th Street
Bronx, New York

This Construction Health and Safety Plan (CHASP) establishes policies and procedures to protect Concourse Village West Owner LLC personnel from the potential hazards posed by the activities at the 180 East 157th Street, located in the Bronx, New York (**Appendix A –** Site-Specific Information).

Reading of and adherence to the CHASP is required of all onsite Concourse Village West Owner LLC personnel. Subcontractors for this project will be required to develop their own CHASP for protection of their employees, but at a minimum must adhere to applicable requirements set forth in this CHASP. Additionally, federal, state and local representatives, as well as Concourse Village West Owner LLC representatives may be required to sign and adhere to this CHASP, depending on the nature of their presence onsite during activities conducted by Concourse Village West Owner LLC.

The plan identifies measures to minimize accidents and injuries, which may result from project activities, emergencies, or during adverse weather conditions. Activities performed under this CHASP will comply with applicable parts of the United States Occupational Health and Safety Administration (OSHA) Regulations, primarily 29 Code of Federal Regulations (CFR) Parts 1910 and 1926.

Included in **Appendix A** is a route to the nearest medical facility to the site with directions and contact information. **Appendix B** and **Appendix C** detail the signs, symptoms, care and procedures to both cold and heat stress, respectively. **Appendix D** contains the safety data sheet. **Appendix E** contains the incident reporting form to be filled out in the event of an injury, accident or near-miss onsite.

1.2 Property Description

The Site is located at 180 East 156th Street, Bronx, New York and is identified as Block 2458 and Lot 35 on the New York City Tax Map.

1.3 Site Activities

The remedial elements will be the same for both sites with the exception that the extent of excavation required for each site may differ.

1. Remedial Design

   A remedial design program will be implemented to provide the details necessary for the construction, operation, optimization, maintenance, and monitoring of the remedial program. Green remediation principals and techniques will be implemented to the extent feasible in the design, implementation, and site management of the remedy as per DER-31. The major green remediation components are as follows:

   - Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
   - Reducing direct and indirect greenhouse gases and other emissions;
   - Increasing energy efficiency and minimizing use of non-renewable energy;
   - Conserving and efficiently managing resources and materials;
   - Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
   - Maximizing habitat value and creating habitat when possible;
   - Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
   - Integrating the remedy with the end use where possible and encouraging green and sustainable re-development.
   - Additionally, to incorporate green remediation principles and techniques to the extent feasible in the future development at this site, and to be consistent with the requirements of an e-designation by New York City, any future on-site buildings will include, at a minimum, a 20-mil water/vapor barrier to improve energy efficiency as an element of construction.

2. Excavation

   The existing on-site buildings will be demolished and materials which can’t be beneficially reused on-site will be taken off-site for proper disposal in order to implement the remedy. Excavation and off-site disposal of all on-site soils which exceed Track 2 Restricted Residential Soil Cleanup Objectives (SCOs), as defined by 6 NYCRR Part 375-6.8 in the upper 15 feet will be performed. Up to 8,641 cubic yards of soil is anticipated to be removed from Lot 35 and a combined 8,189 cubic yards of soil will be removed from Lots 49 and 13. Excavation and removal of any underground storage tanks (USTs), fuel dispensers, underground piping or other structures associated with a source of contamination.

3. Backfill

If necessary, clean fill meeting the requirements of 6 NYCRR Part 375-6.8(d) will be brought in to establish the designed grades at the site.

4. Institutional Control

Imposition of an institutional control in the form of an environmental easement for the controlled property which will:

- Require the remedial party or site owner to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);
- Allow the use and development of the controlled property for restricted residential, commercial or industrial use as defined by Part 375-1.8(g), although land use is subject to local zoning laws;
- Restrict the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYCSDOH; and
- Require compliance with the Department approved Site Management Plan

5. Site Management Plan

A Site Management Plan is required, which includes the following:

- An Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:
  - Institutional Controls: The Environmental Easement discussed in Paragraph 4 above.
  - Engineering Controls: None

- This plan includes, but may not be limited to:
  - an Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination descriptions of the provisions of the environmental easement including any land use, or groundwater use restrictions;
  - a provision for evaluation of the potential for soil vapor intrusion for any occupied buildings on the site, including provisions related to soil vapor intrusion;
  - maintaining site access controls and Department notification; and
  - the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls

A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but may not be limited to: monitoring for vapor intrusion for any occupied existing or future buildings on the site, as may be required by the Institutional and Engineering Control Plan discussed above.

As previously stated the remedial elements will be the same for both sites with the exception that the extent of excavation required for each site may differ. The proposed remedial and development actions will consist of the following:

1. Implementation of a Community Air Monitoring Program (CAMP) for particulates and VOCs.
2. Selection of NYSDEC Track 2 Restricted Residential Use SCOs.
3. Complete a Waste Characterization Study to identify the disposal facility for soil disposal.
4. Installation of sheeting and shoring to enable excavation of on-Site soils.
5. Demolition of all Site structures and removal of concrete and asphalt surfaces to access soils.
6. Excavation and removal of soil and fill exceeding Restricted Residential SCOs – the proposed excavation will extend 15 ft bgs.
7. Screening for indications of contamination (by visual means, odor, and monitoring with photoionization detector [PID]) of all excavated soil during any intrusive Site work.
8. Appropriate off-Site disposal of all material removed from the Site in accordance with all federal, state, and local rules and regulations for handling, transport, and disposal. Waste

disposal facilities will be selected based on the data that has been collected to date and Waste Classification soil sampling. Based on the requirements of the selected facilities, additional soil waste characterization samples may be collected and analyzed as needed to obtain approval for soil disposal.

9. Collection and analysis of endpoint samples. Site-wide to evaluate the performance of the remedy and inform the need for further excavation with respect to attainment of Track 2 RRSCOs. If endpoint samples do not meet RRSCOs further excavation will be completed until they are met.
10. If needed, clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) will be brought in to replace the excavated soil and establish the designed grades at the Site. On-Site soil which does not exceed the above-noted excavation criteria (RRSCOs) or the protection of groundwater SCOs for any constituent may be used anywhere on-Site, including below the water table to back fill the excavation areas and regrade the Site.
11. All responsibilities associated with the Remedial Action, including permitting requirements and pretreatment requirements, will be addressed in accordance with all applicable federal, state and local rules and regulations.
12. Submission of a Final Engineering Report (FER) that describes remedial activities, certifies remedial requirements were achieved, and lists any deviations from this RAWP, if applicable.

Remedial activities will be performed at the Site in accordance with this RAWP and the Department-issued Decision Document. All deviations from this RAWP and/or the Decision Document will be promptly reported to NYSDEC for approval and fully explained in the FER. If USTs are encountered they should be properly registered/closed out as per 6 NYCRR Part 375-1.12€.

1.4 Hazard/Risk Analysis

1.4.1 Physical Hazards

Physical hazards associated with heavy equipment operations may be present during site activities. These activities would require the use of heavy equipment by subcontractors such as a backhoe or a drill rig, which is associated with, but not limited to, the following hazards:

- bodily injuries
- slipping, tripping or falling
- heavy lifting
- caught in-between injuries

- struck by injuries
- cold/heat stress
- noise

1.4.2 Fire and Explosion

Fire extinguishers are located on heavy equipment operating onsite and within any work vehicles onsite. All fires should be reported to 911 emergency services. The Construction Management (CM) Contractor and the Construction Health & Safety Officer (CHSO) will determine if it is necessary to shut down site work for the day due to fire related issues.

1.4.3 Cold Stress

During the winter months, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, and poor judgment. The procedures to be followed regarding the avoidance of cold stress are provided in **Appendix B –** Cold Stress Guidelines.

1.4.4 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70ºF. The procedures to be followed are provided in **Appendix C –** Heat Stress Guidelines.

1.4.5 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, generators, and other equipment associated with earthwork tasks. Site workers who will perform suspected or established high noise tasks and operations shall wear hearing protection. Other workers who do not need to be in proximity of the noise should distance themselves from the equipment generating the noise.

1.4.6 Hand and Power Tools

In order to complete the various tasks for the project, personnel will use hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Work gloves, safety glasses, and hard hats will be worn by the operating personnel at all times when using hand and power tools. Ground Fault Circuit Interrupter (GFCI)-equipped circuits will be used for all power tools.

The CM Contractor is responsible for the safe condition of tools and equipment used by employees but the employees have the responsibility for properly using and maintaining tools.

Saw blades, knives, or other tools be directed away from aisle areas and other employees working in close proximity. Knives and scissors must be sharp. Dull tools can be more hazardous than sharp ones.

Appropriate personal protective equipment (PPE), e.g., safety goggles, gloves, etc., should be worn due to hazards that may be encountered while using portable power tools and hand tools. Floors must be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools.

Around flammable substances, sparks produced by iron and steel hand tools can be a potential ignition source. Where this hazard exists, spark-resistant tools made from brass, plastic, aluminum, or wood will provide for safety.

The following general precautions should be observed by power tool users:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
- All observers should be kept at a safe distance away from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. The worker should not hold a finger on the switch button while carrying a plugged-in tool.
- Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance.
- The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts.
- All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use."

Staff and subcontractors should follow all associated OSHA standards (29 CFR 1926), the most updated of which can be found at http://www.osha.gov. OSHA standards supersede any guidelines stated within this CHASP.

1.4.7 Slips, Trips, and Falls

Working in and around the site will pose slip, trip and fall hazards due to slippery surfaces. Excavation at the sites will cause uneven footing in the trenches and around the spoil piles. Employees will wear proper footwear (i.e. steel toe/shank boots) and will employ good work practice and housekeeping procedures to minimize the potential for slips, trips, and falls.

1.4.8 Manual Lifting

Manual lifting of objects and equipment may be required. Failure to follow proper lifting technique can result in back injuries and strains. Site workers should use power equipment to lift heavy loads whenever possible and should evaluate loads before trying to lift them (i.e., they should be able to easily tip the load and then return it to its original position). Carrying heavy loads with a buddy and proper lifting techniques include:

1) make sure footing is solid
2) make back straight with no curving or slouching
3) center body over feet
4) grasp the object firmly and as close to your body as possible
5) lift with legs
6) turn with your feet, don’t twist

1.4.9 Projectile Objects, Debris and Overhead Dangers

Overhead dangers, including but not limited to falling debris and equipment, can occur while heavy machinery is in operation or work is taking place overhead. Staff will be instructed to maintain a minimum distance from large overhead operations. Staff must also maintain proper communication with heavy equipment operators and their handlers, especially if work necessitates their presence beyond the minimum safe distance. Additionally, employees should be cognizant of low-hanging overhead power lines, as these can snag on vehicles entering and exiting the site. Vehicles that are large enough to damage overhead power lines require spotters when entering and exiting the site. Proper PPE will be worn at all times during these types of activities including steel-toed or equivalent boots, safety vests and hard hats.

1.4.10 Heavy Equipment Operation

Heavy equipment may be present onsite. Staff should be cautious when working near or operating heavy equipment, and maintain a safe distance from the equipment. Personnel should maintain eye contact with the vehicle spotter or operator before traversing any paths that may cross that of the machinery. Safety vests are to be worn when working near operating heavy equipment.

1.4.11 Confined Spaces

If any work in confined spaces is required, it will be performed in accordance with 29 CFR 1910.146 (effective April 15, 1993), as applicable. Copies of the standards will be kept on file in the CM Contractor's main office, if work in confined spaces will be performed. Confined space work will not be performed without first notifying and receiving approval from the CM, if applicable.

1.4.12 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. OSHA illumination requirements will be followed when work is taking place inside the buildings. All exterior site activities at the site will occur during daylight hours. However, if yard areas are used after dark they will be equipped with illumination that meets or exceeds requirements specified in 29 CFR 1926.56, Illumination.

1.4.13 Lockout/Tagout

Site personnel will assume that all electrical equipment at surface and overhead locations is energized, until the equipment has been designated as de-energized by a representative from the utility company. If the equipment cannot be de-energized, work will stop and the CM and appropriate contacts will be consulted. The CM will notify the client prior to working adjacent to this equipment, and will verify that the equipment is energized or de-energized in the vicinity of the work being conducted.

All power lines which have been indicated to be de-energized must be locked out, such that the lines cannot be energized when personnel are working near them. The lines shall not be unlocked and re-energized until the CM notifies the client that they have completed work in the area and that all personnel are clear of the area. Client representatives will thoroughly familiarize personnel with site-specific lockout/tagout procedures during the site orientation, if applicable.

If power lines cannot be de-energized, the CM will consult with utility safety personnel to determine the safe working distance from the energized line. Work tasks will only commence after determination that a safe working distance can be maintained and all personnel working in the area have been informed of the limitation.

1.4.14 Fall Hazards

Fall hazards exist onsite in several areas. Workers must follow all safeguards for fall protection as defined in OSHA 29 CFR 1926, Subpart M-Fall Protection. In general, workers should use the following guidelines:

- Use at least one of the following whenever employees are exposed to a fall of 6 feet or more above a lower level:
    - Guardrail Systems
    - Safety Net Systems
    - Personal Fall Arrest Systems
- Cover or guard floor holes as soon as they are created during new construction.
- For existing structures, survey the site before working and continually audit as work continues. Guard or cover any openings or holes immediately.
- Construct all floor-hole covers so they will effectively support two times the weight of employees, equipment, and materials that may be imposed on the cover at any one time. Floor-hole covers are to be secured so they are not moved off of the hole and labeled so workers are aware what is under the cover.
- In general, it is better to use fall *prevention* systems, such as guardrails, than fall *protection* systems, such as safety nets or fall arrest devices, because they provide more positive safety means.
- Construct all scaffolds according to the manufacturer's instructions and 29 CFR 1926.451.
- Install guardrail systems along all open sides and ends of platforms.
- Use at least one of the following for scaffolds more than 10 feet above a lower level:
    - Guardrail Systems
    - Personal Fall Arrest Systems
- Provide safe access to scaffold platforms [*For additional information, see Scaffold Access*].
- Do not climb cross-bracing as a means of access.
- Guard all protruding ends of steel rebar with rebar caps or wooden troughs, *or*
- Bend rebar so exposed ends are no longer upright.
- When employees are working at any height above exposed rebar, fall protection/ prevention is the first line of defense against impalement.

1.4.15 Ladder Safety

Portable ladders must be safely positioned each time they are used. Staff and subcontractors should follow all associated OSHA standards (CFR 1926.1053), the most updated of which can be found at http://www.osha.gov. OSHA standards supersede any guidelines stated within this CHASP.

1.4.16 Scaffolding Safety

Scaffolding presents significant fall hazards and various types of scaffolds may be present onsite. Staff and subcontractors should follow all associated OSHA standards (CFR 1926 Subpart L – Scaffolds), the most updated of which can be found at http://www.osha.gov.

1.4.17 Welding

The intense light associated with welding operations can cause serious and sometimes permanent eye damage if operators do not wear proper eye protection. Additionally, sparks from the welding process present a risk to the employee conducting welding and nearby employees. Any flammable or combustible materials that may be exposed to sparks or other heat sources must be protected or relocated to prevent fire hazards. Fire extinguishers will be located in areas where welding or hot work will be taking place. Staff must wear helmets that comply with ANSI Z49.1, with filter lenses that comply with ANSI Z87.1. Boots must comply with ASTM F2412 and ASTM F2413 for fire resistance. Welding operators must also wear flame-resistant welder's gloves.

Several chemicals may be used in the process of welding. Staff must be aware of the variety of chemicals used, and must possess appropriate welding training to perform welding activities. Additionally, compressed gas cylinders used in welding must be stored, placed and transported according to OSHA standards. Staff and subcontractors should follow all associated OSHA standards (CFR 1926), the most updated of which can be found at http://www.osha.gov.

1.4.18 Asbestos-Containing Material

Although the site does not contain asbestos-containing materials (ACM), workers should be aware of the risks associated with asbestos exposure. Chronic exposure to asbestos may cause asbestosis and mesothelioma. The primary route of exposure for asbestos is inhalation during the disturbance and/or removal of asbestos from pipe insulation and cement pipes.

Asbestos is strictly regulated under OSHA 29 CFR 1910.1001/1926.1101. Employees that may be potentially exposed to ACM must participate in a medical surveillance program, have specific training in the hazards and controls of exposure to asbestos and wear respirators with high efficiency particulate (HEPA) filters. All work must be conducted in demarcated regulated areas to minimize the number of people within the exposure area. Employers must conduct air sampling and provide signs and labels regarding the presence of asbestos. Staff and subcontractors should follow all associated OSHA standards (CFR 1926), the most updated of which can be found at http://www.osha.gov.

The potential hazards for this project are listed in the following Activity Hazard Analysis and Site Hazards sections.

SITE HAZARDS	
Potential Hazard	**Control Measures**
Construction Safety	▪ Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. Coordinate hand signals with operators. ▪ Stay Alert! Pay attention to equipment backup alarms and swing radii. ▪ Wear a high visibility vest when working near equipment or motor vehicle traffic. ▪ Position yourself in a safe location when filling out logs and talking with the contractor. ▪ Notify the contractor immediately if any problems arise. ▪ Do not stand or sit under suspended loads or near any pressurized equipment lines. ▪ Do not use cellular telephones near operating equipment. ▪ Follow general traffic safety guidelines

SITE HAZARDS	
Potential Hazard	**Control Measures**
Scaffolding Safety and Power Tools	▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart L - Scaffolds. ▪ Do not use impact tools (i.e. chisels, hammers) with mushroomed heads. ▪ Do not use wooden-handled tools if the handle is damaged, splintered, lose or cracked. ▪ Inspect, maintain and replace tools as needed. ▪ Do not use wrenches if jaws are sprung. ▪ Tools should be directed away from aisles, other employees and trafficked areas. ▪ Wear appropriate PPE when using tools. ▪ Floors must be kept clean and as dry as possible to prevent slips, trips an falls around tools. ▪ Never carry a tool by the cord or hose. ▪ Never yank the cord or the hose to disconnect it from the receptacle. ▪ Keep cords and hoses away from heat, oil, and sharp edges. ▪ Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters. ▪ All observers should be kept at a safe distance away from the work area. ▪ Secure work with clamps or a vise, freeing both hands to operate the tool. ▪ Avoid accidental starting. The worker should not hold a finger on the switch button while carrying a plugged-in tool. ▪ Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories. ▪ Be sure to keep good footing and maintain good balance. ▪ The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts. ▪ All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use." ▪ Keep all tools in good condition with regular maintenance. ▪ Use the right tool for the job. ▪ Examine each tool for damage before use. ▪ Operate according to the manufacturer's instructions. ▪ Provide and use the proper protective equipment.
Heavy Equipment Operation	▪ Maintain awareness of location of equipment. ▪ Subcontractor use of a spotter for equipment operation. ▪ Safety vest is to be worn around all operating equipment. ▪ Maintain eye contact with the operator. ▪ Stay out of the swing radii of the apparatus.
Slips, Trips, Falls	▪ Keep trafficked areas clear of debris and tools. Keep work areas and traffic areas dry.
Lock Out/Tag Out	▪ Maintain contact with utility to determine if energized lines or equipment has been de-energized ▪ Follow OSHA Lock Out/Tag Out requirements in 29 CFR 1910.147.
Welding	▪ Wear appropriate PPE (welding helmet, apron, fire-resistant gloves and boots, leggings) as needed. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart J – Welding and Cutting.

SITE HAZARDS	
Potential Hazard	**Control Measures**
Fire	▪ Keep fire extinguishers in working order by inspecting on a regular basis. ▪ Keep the appropriately rated and sized fire extinguishers on site as specified by 29 CFR 1926.150. ▪ Keep flammable materials away from ignition sources. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart F – Fire Protection and Prevention and NPFA standards. ▪ Wear appropriate PPE when working around flammable materials.
Ladder Safety	▪ Follow safety guidelines for safe ladder use. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926.1053.
Fall Hazards	▪ Use appropriate fall protection at heights of 6 feet or greater. ▪ Avoid working in areas with a drop off of more than 2 feet. ▪ Erect appropriate barriers and guard rails. ▪ Wear appropriate fall protection PPE. ▪ Mark fall hazards so they are visible to employees. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart M – Fall Protection.
Physical Injury	▪ Wear work boots in good condition with non-slip soles. ▪ Maintain good visibility of the work area. ▪ Avoid walking on uneven or debris ridden ground surfaces. ▪ Use proper lifting techniques. Ask fellow worker for help.
Noise	▪ Wear hearing protection when near loud noises. ▪ Wear hearing protection whenever you need to raise your voice above normal conversational speech due to a loud noise source; this much noise indicates the need for protection.
Vehicular Traffic	▪ Wear traffic safety vest at all times. ▪ Use cones, flags, barricades, and caution tape to define work area. ▪ Use a "spotter" to locate oncoming vehicles. ▪ Use vehicle to block work area. ▪ Engage police detail if needed.
Utilities	▪ Check that contactor has cleared underground utilities before any intrusive activities, and that contractor has coordinate with utility locating services, property owner(s) or utility companies. ▪ Utilities are to be considered live or active until documented otherwise. ▪ For overhead utilities within 50 feet, have contractor determine with the utility company the appropriate safe distance. Minimum distance for clearance is based on voltage of the line. ▪ An observer will be established when operating drilling rigs near overhead utilities.

ACTIVITY HAZARDS		
Activity	**Potential Hazards**	**Protective Equipment**
Entering Construction Site	Heavy equipment, dust, noise.	Hardhat, reflective safety vest, steel-toed, steel-shank boots, safety glasses, protective leather work gloves, and earplugs. Follow general traffic safety guidelines. Employ dust suppression controls (i.e. watering) to keep dust levels down to prevent inhalation of excavated materials.
General Construction (Foundation Work, Earthwork, Soil Vapor Barrier System Installation)	Heavy equipment, dust, noise. Contact with excavated soils.	Hardhat, reflective safety vest, steel-toed, steel-shank boots, safety glasses, protective leather work gloves, and earplugs. Follow general traffic safety guidelines. Employ dust suppression controls (i.e. watering) to keep dust levels down to prevent inhalation of excavated materials.
Personal Protective Equipment (PPE) is the *initial level of protection* based on the activity hazards and Site conditions which have been identified.		

1.5 Evaluation of Potential Chemical Hazards

The characteristics of potential compounds at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this CHASP should reduce the potential for exposure to the compounds discussed below. **Table 1-1** presents chemical data regarding potential exposure and monitoring for the chemical types listed below.

Potential exposure to contaminants at the Site included encounters with groundwater, soil and soil vapor.

1.5.1 Soil Chemistry

Soil/fill samples collected during both Phase II remedial investigations were compared to 6 NYCRR Part 375 Unrestricted Use and Restricted Use Restricted-Residential Soil Cleanup Objectives (SCOs).

<u>Soils for Lot 35 (Concourse Village West Apartments North)</u>:

- The VOC, Acetone was detected at multiple depths to maximum of 1.0 mg/kg (B-15 at 6 ft to 8 ft).
- SVOCs including benzo(a)anthracene (maximum 27.1 mg/kg) in B-15 (at 14 ft to 16 ft), benzo(a)pyrene (maximum 4.9 mg/kg in B-15 at 14 ft to 16 ft), benzo(b)fluoranthene (maximum 6.4 mg/kg), chrysene (maximum 18.3 mg/kg), dibenzo(a,h)anthracene

(maximum 2.3 mg/kg), indeno(1,2,3-cd)pyrene (maximum 3.9 mg/kg), and benzo(k)fluoranthene (maximum 5.9 mg/kg) were detected above Restricted Residential Use SCO.

- No Pesticides or Polychlorinated Biphenyls (PCBs) were detected at levels above Unrestricted Use SCOs or Restricted Residential Use SCOs.
- The metals Barium (maximum 2,040 mg/kg in B-19 at 6 ft to 8 ft), Copper (maximum 1,460 mg/kg in B-18 at 14 ft to 16 ft), Lead (at 2,790 mg/kg in B-18 at 14 ft to 16 ft, at 1,520 mg/kg in B-13 at 6 ft to 8 ft, and at 1,660 mg/kg in B-17 at 14 ft to 16 ft depths), and Mercury (maximum 2.87 mg/kg in B-13 at 6 ft to 8 ft) were detected above the Restricted Residential Use SCOs. The metals Nickel (maximum 33.8 mg/kg), Selenium (maximum 30 mg/kg), and Zinc (maximum 465 mg/kg) were detected at levels above Unrestricted Use SCOs.
- Overall, elevated metals were detected widespread in all samples at various depths. Elevated SVOCs were detected in boring B-15 at 14 ft to 16-ft depths.

<u>Soils for Lot(s) 13 and 49 (Concourse Village West Apartments South)</u>:

- The VOC, Acetone was detected at multiple depths exceeding Unrestricted Use SCOs. No other VOCs were detected in the samples collected for analysis.
- SVOCs including benzo(a)anthracene (maximum 22.6 mg/kg), benzo(a)pyrene (maximum 20.8 mg/kg), benzo(b)fluoranthene (maximum 21.3 mg/kg), benzo(k)fluoranthene (maximum 25.5 mg/kg), chrysene (maximum 24.9 mg/kg), dibenzo(a,h)anthracene (maximum 6.8 mg/kg), Indeno(1,2,3-cd)pyrene (maximum 8.09 mg/kg) exceeded Restricted Residential Use SCOs. Highest concentrations of SVOCs were detected in B-11 (6 ft to 8 ft depth). Other locations with high SVOCs included borings at B4 (0 ft to 2 ft, and 14 ft to 16 ft), B-11 (6 ft to 8 ft), and B-22 (6 ft to 8 ft depths).
- No Pesticides were detected at levels above Unrestricted Use SCOs or Restricted Residential Use SCOs. Total PCBs were detected above Unrestricted Use SCOs at a concentration of 0.29 mg/kg.
- The metals Barium (maximum 647 mg/kg in B-10 at 0 ft to 2 ft), Copper (maximum 476 mg/kg in B-10 at 0 ft to 2 ft), Lead (maximum 2,250 mg/kg in B-10 at 0 ft to 2 ft), and Mercury (maximum 3.1 mg/kg in B-21 at 0 ft to 2 ft) were detected above the Restricted Residential Use SCOs. The metals Nickel (maximum 33.8 mg/kg), Selenium (maximum 5.39 mg/kg), and Zinc (maximum 716 mg/kg) were detected at levels above Unrestricted Use SCOs. Elevated metals were in detected in borings B-3 and B-4 (14 ft to 16 ft), and B-10 (0 ft to 2 ft).

1.5.2 Groundwater Chemistry

Data collected during the RI is sufficient to delineate the distribution of contaminants in groundwater at the Site. A summary table of data for chemical analyses performed on groundwater samples is included in **Table 2**. Groundwater concentrations exceeding Ambient Water Quality Standards (AWQS) are shown on **Figure 5.1 and 5.2**. Groundwater laboratory analytical data reports are included in **Appendix F**.

Groundwater Lot 35 (Concourse Village West Apartments-NORTH C203291):

- The following VOCs were detected on Lot 35 at levels above their respective NYSDEC TOGS Standards: 1,2,4-Trimethylbenzene (maximum 180 µg/L in GW-7); 1,3,5-Trimethylbenze (maximum 35 µg/L in GW-7); Ethyl Benzene (maximum 130 µg/L in GW-7); Isopropylbenzene (maximum 32 µg/L in GW-7); n-Butylbenzene (maximum 15 µg/L in GW-7); n-Propylbenzene (maximum 36 µg/L in GW-7); o-Xylene (maximum 14 µg/L in GW-7); p & m- Xylenes (maximum 200 µg/L in GW-7); and p-Isopropyltoluene (maximum 6.4 µg/L in GW-7).

- The following SVOCs were detected on Lot 35 at levels above their respective NYSDEC TOGS Standards: Benzo(a)anthracene (maximum 0.1 µg/L in GW-7); Benzo(a)pyrene (maximum 0.2 µg/L in GW-7); Benzo(b)fluoranthene (maximum 0.2 in GW-7 µg/L); Benzo(k)fluoranthene (maximum 0.2 µg/L in GW-7); Chrysene (maximum 0.1 in GW-7 µg/L); Indeno(1,2,3-cd)pyrene (maximum 0.1 µg/L in GW-7); and Pyrene (maximum 199 µg/L in GW-8).

- The metals Manganese, Selenium, and Sodium were detected at concentrations above their respective NYSDEC TOGS Guidance Values but are considered naturally occurring or related to road salt application and are not contaminants of concern for this site.

Groundwater on Lots 13 and 49 (Concourse Village West Apartments-SOUTH C203092)

- The following VOCs were detected on Lot 49 at levels above their respective NYSDEC TOGS Standards (Note: no groundwater samples were acquired from lot 13 due to drill rig limitations and refusal): 1,2,3-Trimethylbenzene (maximum 240 µg/L in GW-3); 1,3,5-Trimethylbenze (maximum 45 µg/L in GW-3); Ethyl Benzene (maximum 150 µg/L in GW-3); Isopropylbenzene (maximum 36 µg/L in GW-7); n-Butylbenzene (maximum 22 µg/L in GW-3); n-Propylbenzene (maximum 48 µg/L in GW-3); o-Xylene (maximum 12 µg/L in GW-3); p & m- Xylenes (maximum 230 µg/L in GW-3); and sec-Butylbenzene (maximum 6.3 µg/L in GW-3).

- The following SVOCs were detected on Lot 35 at levels above their respective NYSDEC TOGS Standards: Benzo(a)anthracene (maximum 0.116 µg/L in GW-3); Benzo(a)pyrene (maximum 0.232 µg/L in GW-3); Benzo(b)fluoranthene (maximum 0.200 µg/L in GW-3); Benzo(k)fluoranthene (maximum 0.200 µg/L in GW-3); Chrysene (maximum 0.147 µg/L in GW-3); and Indeno(1,2,3-cd)pyrene (maximum 0.105 µg/L in GW-3) and total Xylenes (maximum 240 µg/L in GW-3).

- The metals Manganese, Selenium, and Sodium were detected at concentrations above their respective NYSDEC TOGS Guidance Values but are considered naturally occurring or related to road salt application and are not contaminants of concern for this site.

1.5.3 Soil Vapor Chemistry

Soil vapor samples collected during the investigation were reviewed against the soil vapor/indoor air Matrix 1 and Matrix 2 in the NYSDOH Soil Vapor Decision Matrices.

<u>Soil Vapor at Lot 35 (Concourse Village West Apartments North)</u>:

- Several petroleum related and chlorinated VOCs were detected at low concentrations. Petroleum related VOCs (BTEX) were detected slightly elevated at a maximum concentration of 1539 µg/m^3 and included benzene (48 µg/m^3), ethyl benzene (29 µg/m^3), o-Xylene (52 µg/m^3), p- & m- Xylenes (110 µg/m^3), and Toluene (1,300 µg/m^3). Other VOCs detected included acetone at maximum concentration of 10 µg/m^3 and chloroform at µg/m^3. Chlorinated PCE was detected at a maximum concentration of 40 µg/m^3. PCE concentrations are below their monitoring level range established by NYSDOH decision matrix.

<u>Lot(s) 13 and 49 (Concourse Village West Apartments South)</u>:

- Several chlorinated VOCs were detected at low concentrations. Other VOCs detected included acetone at maximum concentration of 36 µg/m^3. Chlorinated compounds included 1,1,1-Trichloroethane (maximum 22 µg/m^3), Carbon tetrachloride (24 µg/m^3), Tetrachloroethene (56 µg/m^3), and trichloroethylene (15 µg/m^3). Concentrations of PCE and 1,1,1 Trichloroethane (TCA) are below the NYSDOH decision matrix and do not require monitoring. Carbon tetrachloride and TCE were detected above their monitoring range established by NYSDOH.

1.5.4 Asbestos-Containing Materials

As asbestos containing materials (ACM) have not been identified onsite, they are not currently monitored for at the site. However, in the course of earthwork, staff should be cognizant of potential ACM and report any suspected ACM to the CM Contractor and the CHSO, who will then determine the appropriate course of action.

1.5.5 Polychlorinated Biphenyls

As PCBs have not been identified onsite above their respective SCGs, they are not considered a potential concern at the site.

1.6 Biological Hazards

During the course of the project, there is a potential for workers to come into contact with biological hazards such as animals, insects and plants. Workers will be instructed in hazard recognition, health hazards, and control measures during site-specific training.

1.6.1 Animals

During the conduct of site operations, wild animals such as stray dogs or cats, raccoons, and mice may be encountered. Workers will use discretion and avoid all contact with wild animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed animal control technician.

1.6.2 Insects

Insects, including bees, wasps, hornets, and spiders, may be present at the site making the chance of a bite possible. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life-threatening condition. Any individuals who have been bitten or stung by an insect should notify the SSO. The following is a list of preventive measures:

- Apply insect repellent prior to performing any field work and as often as needed throughout the work shift.
- Wear proper protective clothing (work boots, socks and light colored pants).
- Field personnel who may have insect allergies should have bee sting allergy medication onsite and should provide this information to the SSO prior to commencing work.

1.6.3 Tick Borne Illnesses

Lyme disease is caused by infection from a deer tick that carries a spirochete. During the painless tick bite, the spirochete may be transmitted into the bloodstream that could lead to the worker contracting Lyme disease.

Lyme disease may cause a variety of medical conditions including arthritis, which can be treated successfully if the symptoms are recognized early and medical attention is received. Treatment with antibodies has been successful in preventing more serious symptoms from developing. Early signs may include a flu-like illness, an expanding skin rash, and joint pain. If left untreated, Lyme disease can cause serious nerve or heart problems, as well as a disabling type of arthritis.

Symptoms can include a stiff neck, chills, fever, sore throat, headache, fatigue and joint pain. This flu-like illness is out of season, commonly happening between May and October when ticks are most active. A large expanding skin rash may develop around the area of the bite. More than one rash may occur. The rash may feel hot to the touch and may be painful. Rashes vary in size, shape, and color, but often look like a red ring with a clear center. The outer edges expand in size. It's easy to miss the rash and the connection between the rash and a tick bite. The rash develops from three days to as long as a month after the tick bite. Almost one third of those with Lyme disease never get the rash.

Joint or muscle pain may be an early sign of Lyme disease. These aches and pains may be easy to confuse with the pain that comes with other types of arthritis. However, unlike many other types of arthritis, this pain seems to move or travel from joint to joint.

Lyme disease can affect the nervous system. Symptoms include stiff neck, severe headache, and fatigue usually linked to meningitis. Symptoms may also include pain and drooping of the muscles on the face, called Bell's Palsy. Lyme disease may also mimic symptoms of multiple sclerosis or other types of paralysis.

The disease can also cause serious, but reversible heart problems, such as irregular heartbeat. Finally, Lyme disease can result in a disabling, chronic type of arthritis that most often affects the knees. Treatment is more difficult and less successful in later stages. Often, the effects of Lyme disease may be confused with other medical problems.

It is recommended that personnel check themselves when in areas that could harbor deer ticks, wear light color clothing and visually check themselves and their buddy when coming from wooded or vegetated areas. If a tick is found biting an individual, the PM should be contacted immediately. The tick can be removed by pulling gently at the head with tweezers. The affected area should then be disinfected with an antiseptic wipe. The employee will be offered the option for medical treatment by a physician, which typically involves prophylactic antibiotics. If personnel feel sick or have signs similar to those above, they should notify the PM immediately.

The deer tick can also cause **Babesiosis**, an infection of the parasite Babesia Microti. Symptoms of Babesiosis may not be evident, but may also include fever, fatigue and hemolytic anemia lasting from several days to several months. Babesiosis is most commonly diagnosed in the elderly or in individuals whose immune systems are compromised.

Ehrlichiosis is a tick-borne disease which can be caused by either of two different organisms. Human monocytic ehrlichiosis (HME) is caused by *Ehrlichia chaffeensis*, which is transmitted by the lone star tick (*Amblyomma americanum*). Human granulocytic anaplasmosis (HGA), previously known as human granulocytic ehrlichiosis (HGE), is caused by *Anaplasma phagocytophilia*, which is transmitted by the deer tick (*Ixodes scapularis*).

In New York State, most cases of ehrlichiosis have been reported on Long Island and in the Hudson Valley. Ehrlichiosis is transmitted by the bite of infected ticks, including the deer tick and the lone star tick. The symptoms of HME and HGE are the same and usually include fever, muscle aches, weakness and headache. Patients may also experience confusion, nausea, vomiting and joint pain. Unlike Lyme disease or Rocky Mountain spotted fever, a rash is not common. Infection usually produces mild to moderately severe illness, with high fever and headache, but may occasionally be life-threatening or even fatal. Symptoms appear one to three weeks after the bite of an infected tick. However, not every exposure results in infection.

Rocky Mountain spotted fever (RMSF) is a tick-borne disease caused by a rickettsia (a microbe that differs somewhat from bacteria and virus). Fewer than 50 cases are reported annually in New York State. In the eastern United States, children are infected most frequently, while in the western United States, disease incidence is highest among adult males. Disease incidence is directly related to exposure to tick-infested habitats or to infested pets. Most of the cases in New York State have occurred on Long Island. RMSF is characterized by a sudden onset of moderate to high fever (which can last for two or three weeks), severe headache, fatigue, deep muscle pain, chills and rash. The rash begins on the legs or arms, may include the soles of the feet or palms of the hands, and may spread rapidly to the trunk or rest of the body. Symptoms usually appear within two weeks of the bite of an infected tick.

*(Information on Ehrlichiosis, Babesiosis, and Rocky Mountain Spotted Fever was derived from the New York State Department of Health).

1.6.4 Wasps and Bees

Wasps (hornets and yellow-jackets) and bees (honeybees and bumblebees) are common insects that may pose a potential hazard to the field team if work is performed during spring, summer or fall. Bees normally build their nests in the soil. However, they use other natural holes such as abandoned rodent nests or tree hollows. Wasps make a football-shaped, paper-like nest either below or above the ground. Yellow-jackets tend to build their nests in the ground but hornets tend to build their nests in trees and shrubbery. Bees are generally more mild-mannered than wasps and are less likely to sting. Bees can only sting once while wasps are capable of stinging multiple times because of a barbless stinger. Wasps sting when they feel threatened. By remaining calm and not annoying wasps by swatting, you lessen the chance of being stung.

Wasps and bees inject a venomous fluid under the skin when they sting. The venom causes a painful swelling that may last for several days. If the stinger is still present, carefully remove it with tweezers. Some people may develop an allergic reaction (i.e. anaphylactic shock) to a wasp or bee sting. If such a reaction develops, seek medical attention at once. Employees should inform the SSO if they are allergic to bees or wasps, and inform the SSO if an epi-pen is required treatment and the location of the pen.

1.6.5 Plants

The potential for contact with poisonous plants exists when performing field work in undeveloped and wooded areas. Poison ivy, sumac, and oak may be present onsite. Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety "down." Poison sumac has white, "hairy" berry clusters. Poison oak can be present as a sparingly branched shrub. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches. Prophylactic application of Tecnu may prevent the occurrence of exposure symptoms. Post exposure over the counter products are available and should be identified at the local pharmacist. Susceptible individuals should be identified to the PM.

Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. If a field worker believes they have contacted one of these plants, immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.

1.7 Sun Exposure

Employees are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 15, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should wear safety glasses that offer protection from UVA/UVB rays.

1.8 Personal Safety

Field activities have the potential to take site workers into areas which may pose a risk to personal safety. The following website (source) has been researched to identify potential crime activity in the area of the project:

http://www.nyc.gov/html/nypd/html/crime_prevention/crime_statistics.shtml

Type of Crime	Subject Property and Vicinity	New York City Total*
Murder	4	333
Rape	12	1,352
Robbery	151	16,539
Felony Assault	225	20,207
Burglary	134	16,765
Grand Larceny	393	43,862

*New York City Total includes values from the 121st Precinct

2014 crime statistics from this website report that the 121st Precinct, which is closest to the subject property, is shown above in comparison to the current New York City total.

To protect yourself, take the following precautions:

- If deemed necessary, use the buddy system (teams of a minimum of two persons present);
- Let the Site Safety Officer (SSO) know when you begin work in these areas and when you leave;
- Call in regularly;
- Pay attention to what is going on around you; and
- If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly, but safely.

Site workers must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If site workers encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the SSO and CHSO of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders is essential. At least one charged and otherwise functioning cell phone to facilitate emergency communications will be on site.

2. Community Air Monitoring Plan

Concourse Village West Owner LLC will implement a Community Air Monitoring Plan (CAMP) in compliance with Appendix 1 of DER-10. Concourse Village West Owner LLC will contract with GEI Consultants, Inc., P. C. to implement the plan. Please see the body of the report of the Remedial Action Work Plan for full details outlining our CAMP efforts.

3. Project Personnel/Responsibilities and Lines of Authority

Site Personnel		
Nicholas Recchia	Project Manager (PM)	Office: 631-759-2973 Cell: 516-395-8763
Thomas Johansen	Site Safety Officer (SSO), Field Representative (FR)	Office: 631-759-2976 Cell: 516-519-2872
Stephanie Cobleigh	Construction Manager (CM)	Office: 212-414-9414 Cell: 917-639-9400

Lines of Authority will be as follows:

Onsite – The CM Contractor will have responsibility for safety of its employees during the work performed at the site. The Field Representative (FR) will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. The FR will be available for communication with the SSO and CM and with the client representative. The FR and/or SSO may change due to the nature of work being conducted onsite.

3.1 Construction Manager (CM)

Responsibilities of the CM include the following:

- Verifies implementation of the CHASP
- Conducts periodic inspections and documents these in the field book
- Participates in incident investigations
- Verifies the CHASP has the required approvals before any site work is conducted
- Verifies that the client and/or CM site manager is informed of project changes, which require modifications of the CHASP
- Has overall responsibility for project health and safety
- Acts as the primary point of contact with the client for site related activities and coordination with non-project related site operations
- Overseeing of performance of project tasks as outlined in the scope of work
- Plans field work using appropriate safe procedures and equipment
- Verifies and documents current OSHA construction training compliance for all construction trades
- Verifies that subcontractors acknowledge and sign the projects CHASP

3.2 Construction Health and Safety Officer (CHSO)

The CHSO is a qualified health and safety professional with experience in construction activities. Responsibilities of the CHSO include the following:

- Serves as the primary contact to review health and safety matters that may arise
- Approves revised or new safety protocols for field operations
- Coordinates revisions of this CHASP with field personnel
- Coordinates upgrading or downgrading of PPE with the site manager
- Leads the investigation of all accidents/incidents
- Provide the necessary training of subcontractor trade field crews in accordance with OSHA regulations and provides proof of training to the SSO prior to subcontractor trade personnel entering the site

3.3 Site Safety Officer (SSO)

Responsibilities of the SSO include the following:

- Verifies that the CHASP is implemented and that all health and safety activities identified in the HASP are conducted and/or implemented
- Verifies that field work is scheduled with adequate personnel and equipment resources to complete the job safely and enforces site health and safety rules
- Verifies that adequate communications between trade crews and emergency response personnel is maintained during emergency situations
- Verifies that field site personnel are adequately trained and qualified to work at the site and that proper PPE is utilized
- Report all accidents/incidents to the CHSO and CM
- Stop work if necessary
- Identifies operational changes which require modifications to the CHASP and ensures that the procedure modifications are implemented and documented through changes to the CHASP, with CHSO approval
- Determines upgrades or downgrades of PPE based on site conditions and/or real-time monitoring results with CHSO approval
- Reports to the CHSO and provides summaries of field operations and progress

3.4 Field Representative (FR)

The FR is responsible for carrying out field work on a monthly, quarterly, or as-needed basis. Responsibilities of the FR include:

- Conducts routine safety inspection of the work area
- Documenting occurrences of unsafe activity and what actions were taken to rectify the situation
- Reports any unsafe or potentially hazardous conditions to the SSO and CM
- Maintains familiarity of the information, instructions, and emergency response actions contained in the CHASP
- Complies with rules, regulations and procedures set forth in the CHASP
- Prevents admittance to work site by unauthorized personnel
- Inspects all tools and equipment, including PPE, prior to use and documents inspection on the daily safety meeting form or in the appropriate field book
- Verifies that monitoring instruments are calibrated
- Stops work if necessary

4. Subcontractors

The CM Contractor may subcontract with various companies to conduct various work onsite on an as-needed basis. Contact information for these subcontractors will be available when such work is being conducted.

The CM Contractor requires its subcontractors to work in a responsible and safe manner. Subcontractors for this project may be required to develop their own CHASP for protection of their employees and must adhere to applicable requirements set forth in this CHASP.

5. Emergency Contact List

<table>
<tr><th colspan="3">EMERGENCY INFORMATION</th></tr>
<tr><td colspan="2">Important Phone Numbers</td><td>Directions to:
Lincoln Medical and Mental Health Center
234 E. 149th Street
Bronx, NY 10451</td></tr>
<tr><td>Police</td><td>911</td><td rowspan="5">▪ Head southwest on Concourse Village W toward E 153rd St.
▪ Continue onto E 153rd St.
▪ Turn left onto Grand Concourse
▪ Turn left onto E 149thSt.
▪ Turn right onto Park Ave.

Refer to Hospital Route Map in Appendix A.</td></tr>
<tr><td>Fire Department</td><td>911</td></tr>
<tr><td>Ambulance</td><td>911</td></tr>
<tr><td>Mobile Health Clinic
2488 Grand Concourse #210
Bronx, NY 10458</td><td>(212) 695-5122</td></tr>
<tr><td>Local Hospital:
Lincoln Medical and Mental Health Center</td><td>(718) 579-5016</td></tr>
<tr><td>Project Manager</td><td>Nicholas Recchia</td><td>Office: 631-759-2973
Cell: 516-395-8763</td></tr>
<tr><td>Developer/Contractor</td><td>Stephanie Cobleigh</td><td>Office: 212-414-9414</td></tr>
</table>

6. Training Program

6.1 Hazard Communication

In accordance with 29 CFR 1926, site workers shall, at the time of job assignment, have received hazard communication training. All hazardous materials used on the site will be properly labeled, stored, and handled. SDSs will be attached to this report and available to onsite staff.

6.2 Onsite Safety Briefings

Other onsite personnel will be given health and safety briefings by a FR to assist personnel in safely conducting work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. These safety briefing will be documented on a daily safety briefing form or other appropriate media.

7. Medical Support

In case of minor injuries, onsite care shall be administered with the Site first aid kit. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger.

Section 5 and **Appendix A** contain detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. Field personnel will carry a cellular telephone.

8. Personal Protective Equipment

PPE required for each level of protection is as follows.

Safety Equipment	Level A	Level B	Level C	Level D
Hard hats with splash shields or safety glasses			•	•
Steel-toe boots with overboots as appropriate for work being performed and materials handled			•	•
Protective Leather Work Gloves or Chemical-resistant gloves as needed			•	•
Reflective Vest			•	•
Half- or full-face respirators with HEPA cartridges as approved by the CHSO as needed			•	
Long Pants	•	•	•	•
Welding Helmet				•
Welding Gloves, apron, leggings (as needed)				•
Flame-resistant boots for welding				•

PPE can include hardhats, safety glasses or face shields, steel toe/steel shank boots, hearing protection, nitrile gloves, and leather gloves as necessary.

OSHA Requirements for PPE

All PPE used during the course of this field investigation must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1 1968
Respiratory	29 CFR 1910.134	ANSI Z88.1 1980
Head	29 CFR 1910.135	ANSI Z89.1 1969
Foot	29 CFR 1910.136	ANSI Z41.1 1999 or ASTM F-2412-2005, and ASTM F-2413-2005
CFR = Code of Federal Regulations ANSI = American National Standards Institute ASTM = American Society For Testing and Materials		

Any onsite personnel who have the potential to don a respirator must have a valid fit test certification and documentation of medical clearance. The CHSO will maintain such information on file for onsite personnel. The CM will obtain such information from the subcontractor's site supervisor prior to the initiation of any such work. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency;
- IDLH concentrations; and
- If contaminant levels exceed designated use concentrations.

For most work conducted at the site, Level D PPE will include long pants, hard hats, safety glasses with side shields, and steel toe safety boots with steel shanks. The CHSO will determine if site works deems an upgrade in PPE. The use of respirators is not anticipated.

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the work zone and this CHASP will be revised with oversight of the CHSO, personnel will not re-enter the work zone until conditions allow.

9. Supplemental Contingency Plan Procedures

9.1 Fire

In the event of a fire, all personnel will evacuate the area. The FR will contact the local fire department and report the fire. Notification of evacuation will be made to the client, the CM and the CHSO. The FR or appropriate staff member will account for subcontractor personnel and report their status to the CM.

9.2 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 30 mph, heavy rains or snow squalls, thunderstorms, hurricanes, and lightning storms. If severe weather is approaching, the decision to evacuate staff and subcontractor personnel from the site is the responsibility of the FR. Notification of evacuation will be made to the Project Manager, the Construction Project Manager and the CHSO. The FR will account for onsite staff and report their status to the CM. If safe, work can resume 30 minutes after the last flash of lightening or clap of thunder.

9.3 Spills or Material Release

If a hazardous waste spill or material release occurs, the SSO or their representative, if safe, will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS, if applicable, for the material spilled or released
- Source of the release or spillage of hazardous material
- An estimate of the quantity released and the rate at which it is being released
- The direction in which the spill or air release is moving
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result
- Potential for fire and/or explosion resulting from the situation
- Estimates of area under influence of release

If the spill or release is determined to be within the onsite emergency response capabilities, the SSO will ensure implementation of the necessary remedial action. If the release is beyond the capabilities of the site personnel, all personnel will be evacuated from the immediate area and the local fire department will be contacted. The SSO will notify the CM and the CHSO.

9.4 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the work site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the site.

10. Decontamination Procedures

10.1 Personnel Decontamination Station

As needed, a personnel decontamination station where workers can drop equipment and remove PPE will be set up as needed by the Contractor. The PPE area will be equipped with basins for water and detergent, and trash bag(s) or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a portable sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.).

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate container) and disposed of in an approved facility.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with all applicable state and federal regulations.

10.2 Decontamination Equipment Requirements

If heavily contaminated soils are encountered during intrusive work, the following equipment, as needed, will be in sufficient supply to implement decontamination procedures for equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handle soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol
- Liquid detergent and paper towels
- Plastic trash bags

11. Construction Health and Safety Plan Sign-Off

All personnel conducting site activities must read this Construction Health and Safety Plan, be familiar with its requirements, and agree to its implementation.

All other personnel onsite for regulatory, observational and other activities not directly associated with site activities must read this Health and Safety Plan for hazard communication purposes.

Once the Construction Health and Safety Plan has been read, complete this sign-off sheet, and return it to the Project Manager.

Site Name:

180 East 156th Street, Bronx, NY

Activity:

- Building demolition
- Foundation excavation, loading and removal of site soils
- Site grading
- Building construction

I have received and read the Construction Health and Safety Plan, been briefed on it, and agree to its implementation.

Name	Signature	Date	Company

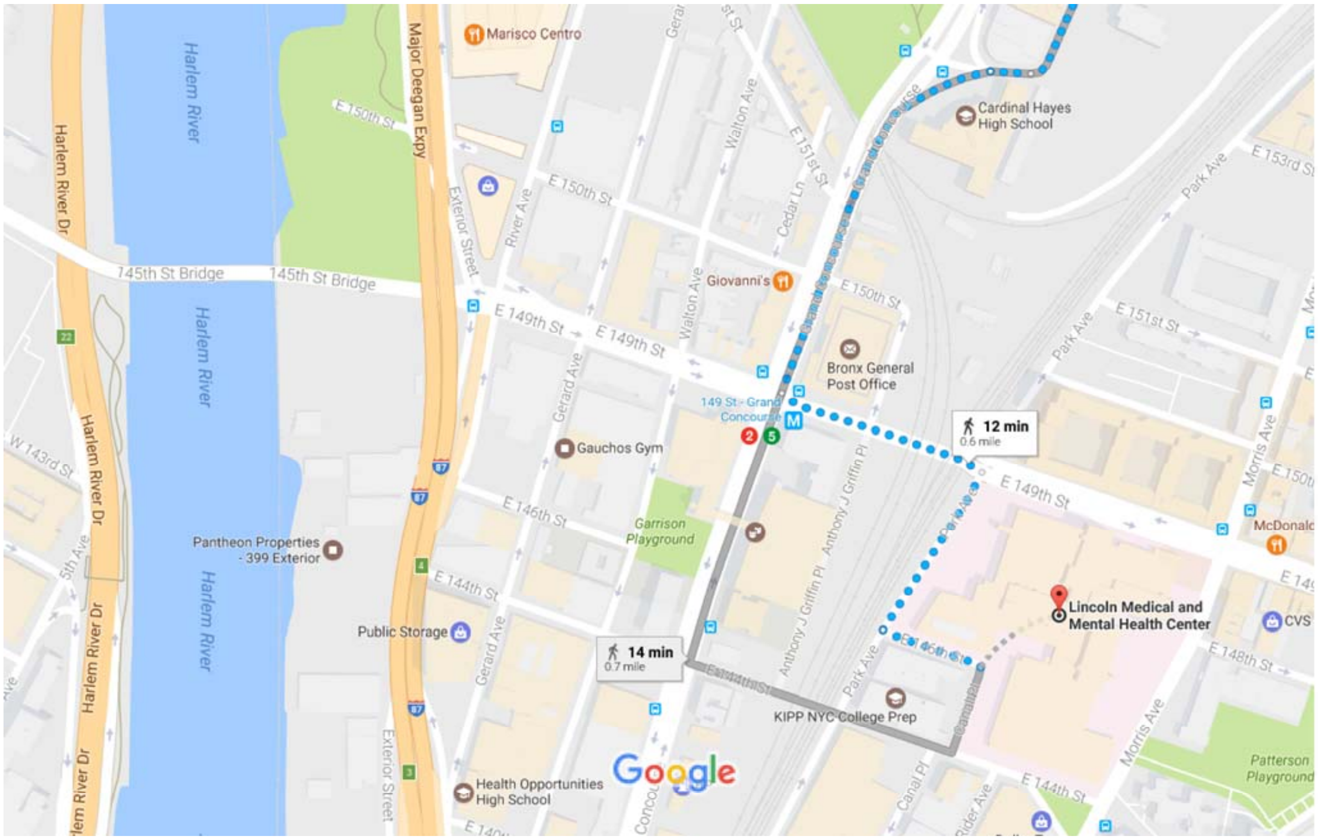
APPENDIX A

SITE-SPECIFIC INFORMATION

Google Maps

741 Concourse Village West, Bronx, NY to Lincoln Medical and Mental Health Center (also applies for 180 East 156th Street, Bronx, NY)

Walk 0.6 mile, 12 min



Map data ©2017 Google 200 ft

741 Concourse Village W
Bronx, NY 10451

Use caution - may involve errors or sections not suited for walking

1. Head southwest on Concourse Village W toward E 153rd St — 390 ft
2. Continue onto E 153rd St — 112 ft
3. Turn left onto Grand Concourse — 0.2 mi
4. Turn left onto E 149th St — 0.1 mi
5. Turn right onto Park Ave — 0.1 mi

6. Turn left onto E 146th St

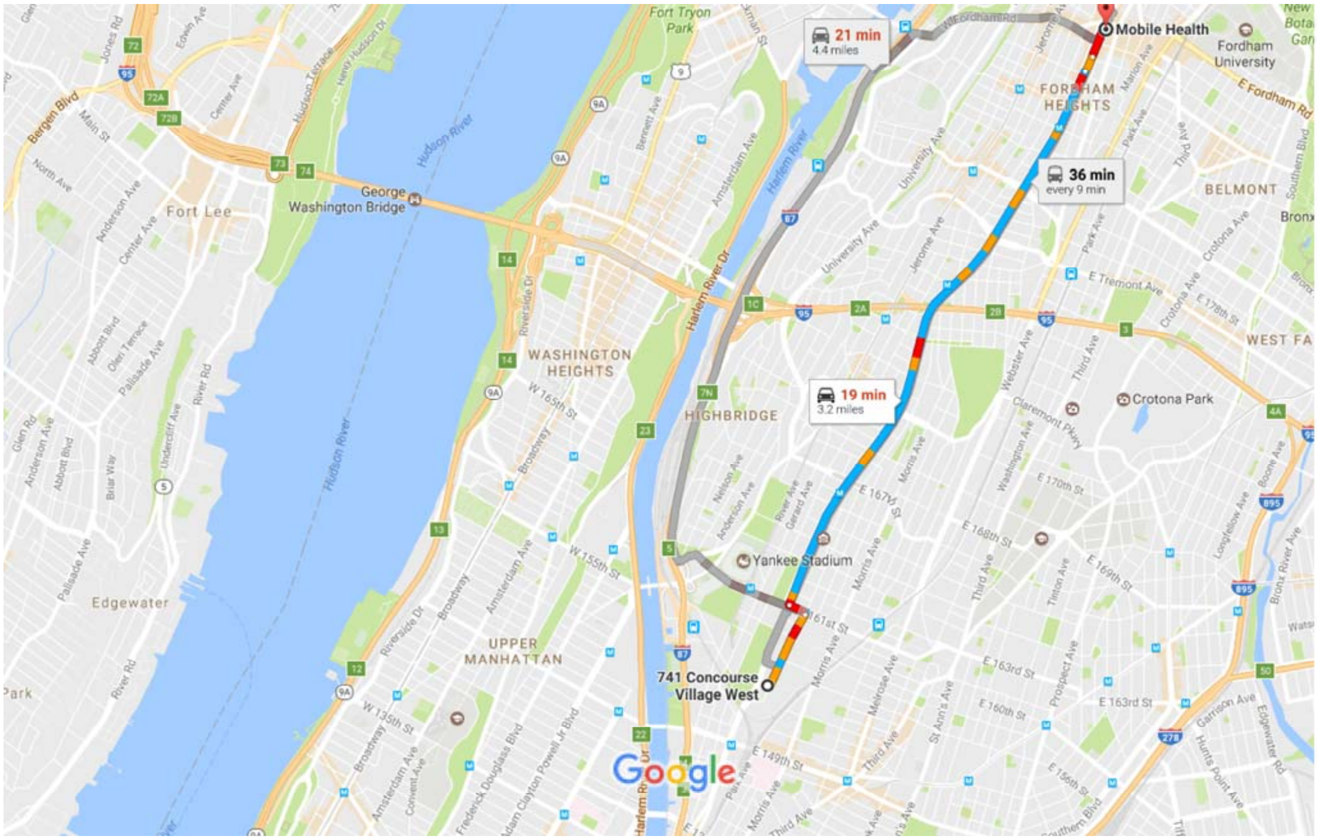
292 ft

Lincoln Medical and Mental Health Center

234 E 149th St, Bronx, NY 10451

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps 741 Concourse Village West, Bronx, NY to Mobile Health (also applies for 180 East 156th Street, Bronx, NY) Drive 3.2 miles, 19 min



Map data ©2017 Google 2000 ft

741 Concourse Village W

Bronx, NY 10451

1. Head northeast on Concourse Village W toward E 156th St

0.3 mi

2. Turn left onto E 161st St

466 ft

3. Turn right onto Grand Concourse

2.6 mi

4. Exit to stay on Grand Concourse

374 ft

5. Keep right to stay on Grand Concourse

Destination will be on the right

0.1 mi

Mobile Health

2488 Grand Concourse #210, Bronx, NY 10458

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

APPENDIX B

COLD STRESS GUIDELINES

Cold Stress Guidelines

	Symptoms	What to do
Mild Hypothermia	▪ Body Temp 98-90°F ▪ Shivering ▪ Lack of coordination, stumbling, fumbling hands ▪ Slurred speech ▪ Memory loss ▪ Pale, cold skin	▪ Move to warm area ▪ Stay active ▪ Remove wet clothes and replace with dry clothes of blankets ▪ Cover the head ▪ Drink warm (not hot) sugary drink
Moderate Hypothermia	▪ Body temp 90-86°F ▪ Shivering stops ▪ Unable to walk or stand ▪ Confused irrational	▪ All of the above, plus: ▪ Call 911 ▪ Cover all extremities completely ▪ Place very warm objects, such as hot packs on the victim's head, neck, chest and groin
Severe Hypothermia	▪ Body temp 86-78°F ▪ Severe muscle stiffness ▪ Very sleepy or unconscious ▪ Ice cold skin ▪ Death	▪ Call 911 ▪ Treat victim very gently ▪ Do not attempt to re-warm
Frostbite	▪ Cold, tingling, stinging or aching feeling in the frostbitten area, followed by numbness ▪ Skin color turns red, then purple, then white or very pale skin ▪ Cold to the touch ▪ Blisters in severe cases	▪ Call 911 ▪ Do not rub the area ▪ Wrap in soft cloth ▪ If help is delayed, immerse in warm, not hot, water
Trench Foot	▪ Tingling, itching or burning sensation ▪ Blisters	▪ Soak feet in warm water, then wrap with dry cloth bandages ▪ Drink a warm sugary drink

APPENDIX C

HEAT STRESS GUIDELINES

HEAT STRESS GUIDELINES			
Form	**Signs & Symptoms**	**Care**	**Prevention[3]**
Heat Rash	Tiny red vesicles in affected skin area. If the area is extensive, sweating can be impaired.	Apply mild lotions and cleanse the affected area.	Cool resting and sleeping areas to permit skin to dry between heat exposures
Heat Cramps	Spasm, muscular pain (cramps) in stomach area and extremities (arms and legs).	Provide replacement fluids with minerals (salt) such as Gatorade.	Adequate salt intake with meals[1] ACCLIMATIZATION[2]
Heat Exhaustion	Profuse sweating, cool (clammy) moist skin, dizziness, confusion, pale skin color, faint, rapid shallow breathing, headache, weakness, muscle cramps.	Remove from heat, sit or lie down, rest, replace lost water with electrolyte replacement fluids (water, Gatorade) take frequent sips of liquids in amounts greater than required to satisfy thirst.	ACCLIMATIZATION[2] Adequate salt intake with meals 1 only during early part of heat season. Ample water intake, frequently during the day
Heat Stroke	HOT Dry Skin. Sweating has stopped. Mental confusion, dizziness, nausea, severe headache, collapse, delirium, coma.	HEAT STROKE IS A MEDICAL EMERGENCY - Remove from heat. - COOL THE BODY AS RAPIDLY AS POSSIBLE by immersing in cold (or cool) water, or splash with water and fan. Call for Emergency Assistance. Observe for signs of shock.	ACCLIMATIZATION[2] Initially moderate workload in heat (8 to 14 days). Monitor worker's activities.

Footnotes:

1) American diets are normally high in salt, sufficient to aid acclimatization. However, during the early part of the heat season, (May, June), one extra shake of salt during one to two meals per day may help, so long as this is permitted by your physician. Check with your personal physician.

2) ACCLIMATIZATION - The process of adapting to heat is indicated by worker's ability to perform hot jobs less fluid loss, lower concentrations of salt loss in sweat, and a reduced core (body) temperature and heart rate.

3) Method to Achieve Acclimatization - Moderate work or exercise in hot temperatures during early part of heat season. Adequate salt (mineral) and water intake. Gradually increasing work time in hot temperatures. Avoid alcohol. Normally takes 8 to 14 days to achieve acclimatization. Lost rapidly, if removed from strenuous work (or exercise) in hot temperature for more than approximately five days.

APPENDIX D

SAFETY DATA SHEET (SDS)

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

ALCONOX

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**	
CHEMICAL FAMILY NAME:	Detergent.	
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications	
U.N. NUMBER:	Not Applicable	
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material	
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.	
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA	
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada**	800-255-3924
	International calls	813-248-0585
BUSINESS PHONE:	914-948-4040	
DATE OF PREPARATION:	May 2011	
DATE OF LAST REVISION:	February 2008	

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS	CANADA (WHMIS) SYMBOLS	EUROPEAN and (GHS) Hazard Symbols
Non-Regulated		Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):
Eye Irritant Category 2A

Hazard Statement(s):
H319: Causes serious eye irritation

Precautionary Statement(s):
P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):
[Xi] Irritant

MATERIAL SAFETY DATA SHEET

ALCONOX®

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

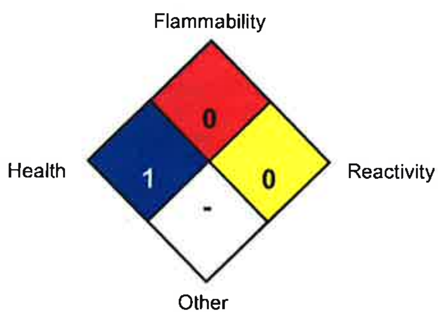
RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

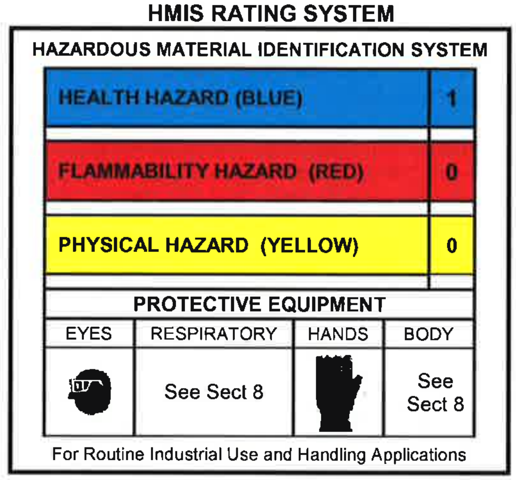
FLASH POINT: Not Flammable
AUTOIGNITION TEMPERATURE: Not Applicable
FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS: As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact: Not Sensitive.
Explosion Sensitivity to Static Discharge: Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM



Hazard Scale: **0** = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.
SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

MATERIAL SAFETY DATA SHEET

ALCONOX®

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:
THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes   Chronic Health: No   Fire: No   Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett   Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

APPENDIX E

INCIDENT REPORT FORM

Safety Briefing Log

GEI Consultants

Project Number:	**Project Name:**
Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing.

TOPICS COVERED (check all those covered):

☐ General PPE Usage	☐ Confined Space	☐ Excavation Safety
☐ Hearing Conservation	☐ Slips, Trips, Falls	☐ Confined Space
☐ Respiratory Protection	☐ Heat Stress	☐ Traffic Safety
☐ Personal Hygiene	☐ Cold Stresses	☐ Changes to the HASP
☐ Exposure Guidelines	☐ Site Control	☐ Initial Review of Hazard Evaluation
☐ Decon Procedures	☐ Work Zones	☐ Other (Specify):
☐ Emergency Procedures (include route to hospital)	☐ Lockout/Tagout	☐ Other (Specify):

Personnel Sign-in List

Printed Name	Signature	Company Name

Project Safety Briefing Form

Project Number:	**Project Name:**	
Date:	**Time:**	**Project Manager:**
Briefing Conducted by:		**Signature:**

This sign-in log documents the project specific-briefing conducted in accordance with the HASP and GEI H&S policy. GEI personnel who perform work on site are required to attend the Project briefing and to acknowledge it's receipt. Applicable health and safety SOPs are also required to be reviewed in this briefing and attached as an appendix to the HASP. Prior to the start of the project **or upon the start of a new on-site project team member**, this form must be completed. Please email this completed form to Health&SafetyCommittee@geiconsultants.com.

TOPICS COVERED (check all those covered):

☐	General PPE Usage	☐	Excavation Safety	☐	SOP:
☐	Hearing Conservation	☐	Confined Space	☐	SOP:
☐	Respiratory Protection	☐	Traffic Safety	☐	SOP:
☐	Personal Hygiene	☐	Changes to the HASP	☐	SOP:
☐	Exposure Guidelines	☐	Site Control	☐	SOP:
☐	Decon Procedures	☐	Work Zones	☐	SOP:
☐	Emergency Procedures (include route to hospital)	☐	Lockout/Tagout	☐	SOP:
		☐	Review of Hazard Evaluation	☐	SOP:
☐	Confined Space			☐	SOP:
☐	Slips, Trips, Falls	☐	Other (Specify):	☐	SOP:
☐	Heat Stress	☐	Other (Specify):	☐	SOP:
☐	Cold Stress	☐	Other (Specify):	☐	SOP:

Personnel Sign-in List

Printed Name	**Signature**

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

GEI Consultants

Accident/Incident Report Form

SECTION A — ACCIDENT/INCIDENT DETAILS

EMPLOYEE INFORMATION:	OTHER INJURED (IF APPLICABLE):
Name: ______	**Name:** ______
Home Address: ______ (Street Address, City, State, Zip Code)	**Home Address:** ______ (Street Address, City, State, Zip Code)
Contact Information: ( ) ______ Primary ( ) ______ Secondary	**Contact Information:** ( ) ______ Primary ( ) ______ Secondary
Date of Birth: ______	**Date of Birth:** ______
Date of Hire: ______	**Date of Hire:** ______
Branch: ______	**Branch:** ______
Supervisor: ______	**Supervisor:** ______

Date and Time Accident/Incident	Date and Time Reported	LOCATION OF INCIDENT/ACCIDENT
____ /____ /____ Month Day Year	____ /____ /____ Month Day Year	**Project Name:** ______
____ A.M. ____ P.M.	____ A.M. ____ P.M.	**Client and Location:** ______ or ______ **Office Location:** ______

INCIDENT TYPE: (Check All That Applies)	WITNESS INFORMATION
☐ **Personal Injury/Illness**	**Name:** ______
☐ **Vehicle Accident**	**Contact Number:** ______
☐ **Property Damage**	**Company:** ______
☐ **Environmental Spill**	
☐ **Other**	

WHAT HAPPENED TO THE INJURED PARTY: ☐First Aid Administered ☐Refused Treatment/Transport ☐Transported to Hospital ☐Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: ______ Phone: ______

Name Street Address City State Zip Code

SECTION B — PERSONAL INJURY

Cause of Injury: ______

Part of Body Injured: ______ Multiple Injuries: ☐Y ☐N

Was PPE worn when injured? : ☐Y ☐N What PPE was worn? ______

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

GEI Consultants

Accident/Incident Report Form

SECTION C — AUTO ACCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: ______________________

Department: ______________________

Driver's License Number: ______________________

DOB: ____/____/____ State: ______________________

Description of Vehicle: License Plate Number: __________

Make: ________ Model: ________ Year:_____ Color:________

Owner: ______________________

Name of Other Driver: ______________________

Driver's License Number: ______________________

State: ______________________

Description of Vehicle: License Plate Number: __________

Make: _______ Model:______ Year:_____ Color:________

Insurance Carrier: ______________________

Policy Number: ______________Ph. Number:______________

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): ______________________

Cause of Damage(s): ______________________

Type of Chemical Released (if known): ______________________

Quantity of Chemical Released: ______________________

Spill Measures Employed: ______________________

SECTION E — NATURE OF ACCIDENT/INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

I hereby certify that the above information is true and correct to my understanding of this accident/incident.

Employee/Preparer's Name ______________________ **Date and Time** ______________________

NEAR MISS REPORT

A near miss is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee work habits, improper use of equipment, or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential accidents/incidents immediately. Please complete this form as a means to report these near-miss situations. <u>Send a copy of the completed form to the Project Manager, Regional Health and Safety Officer and the Corporate Health and Safety Officer.</u>

Location: _____ Site Name: _____

Date: _____ Time: _____ ☐ a.m. ☐ p.m.

Weather conditions, site operations taking place during near miss. _____

Please check all appropriate conditions:

☐ Unsafe Act ☐ Unsafe equipment

☐ Unsafe Condition ☐ Unsafe use of equipment

Description of incident or potential hazard: _____

Employees or sub-contractors involved if applicable._____

Employee Signature ______________________________ Date _____

Print Name _____

NEAR MISS INVESTGATION

Description of the near-miss condition: _____
Causes (primary & contributing) _____
Corrective action taken (Remove the hazard, replace, repair, or retrain in the proper procedures for the task) _____
Actions not yet taken_____

Signed: ________________________________ Date Completed: _____

Print Name
Not completed for the following reason: ______Date:_____

GEI Consultants

Consulting
Engineers and
Scientists

Construction Health and Safety Plan (CHASP)

702 Grand Concourse and 741 Concourse Village West
Bronx, New York
BCP# C203292

Submitted to:

Concourse Village West Owner LLC
40 Fulton Street, 12th Floor
New York, NY 10038

Submitted by:
GEI Consultants, Inc., P. C.
110 Walt Whitman Road
Huntington Station, NY 11746
631.760.9300

September 2017
Project 1700655

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Appendices

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1. Background Information

1.1 General

Engineer/Contractor Guido Subotovsky
Concourse Village West Owner LLC
40 Fulton Street, 12th Floor
New York, New York 10038

Project Name Concourse Village West Apartments-SOUTH
Site No. C203292
702 Grand Concourse and 741 Concourse Village West
Bronx, New York

This Construction Health and Safety Plan (CHASP) establishes policies and procedures to protect Concourse Village West Owner LLC personnel from the potential hazards posed by the activities at the 702 Grand Concourse, and 741 Concourse Village West site located in the Bronx, New York (**Appendix A** – Site-Specific Information).

Reading of and adherence to the CHASP is required of all onsite Concourse Village West Owner LLC personnel. Subcontractors for this project will be required to develop their own CHASP for protection of their employees, but at a minimum must adhere to applicable requirements set forth in this CHASP. Additionally, federal, state and local representatives, as well as Concourse Village West Owner LLC representatives may be required to sign and adhere to this CHASP, depending on the nature of their presence onsite during activities conducted by Concourse Village West Owner LLC.

The plan identifies measures to minimize accidents and injuries, which may result from project activities, emergencies, or during adverse weather conditions. Activities performed under this CHASP will comply with applicable parts of the United States Occupational Health and Safety Administration (OSHA) Regulations, primarily 29 Code of Federal Regulations (CFR) Parts 1910 and 1926.

Included in **Appendix A** is a route to the nearest medical facility to the site with directions and contact information. **Appendix B** and **Appendix C** detail the signs, symptoms, care and procedures to both cold and heat stress, respectively. **Appendix D** contains the safety data sheet.

Appendix E contains the incident reporting form to be filled out in the event of an injury, accident or near-miss onsite.

1.2 Property Description

The Site is located at 702 Grand Concourse and 741 Concourse Village West in the Bronx, New York and is identified as Block 2458 and Lots 13, 35, & 49 on the New York City Tax Map.

1.3 Site Activities

The remedial elements will be the same for both sites with the exception that the extent of excavation required for each site may differ.

1. Remedial Design

   A remedial design program will be implemented to provide the details necessary for the construction, operation, optimization, maintenance, and monitoring of the remedial program. Green remediation principals and techniques will be implemented to the extent feasible in the design, implementation, and site management of the remedy as per DER-31. The major green remediation components are as follows:

   - Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
   - Reducing direct and indirect greenhouse gases and other emissions;
   - Increasing energy efficiency and minimizing use of non-renewable energy;
   - Conserving and efficiently managing resources and materials;
   - Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
   - Maximizing habitat value and creating habitat when possible;
   - Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
   - Integrating the remedy with the end use where possible and encouraging green and sustainable re-development.
   - Additionally, to incorporate green remediation principles and techniques to the extent feasible in the future development at this site, and to be consistent with the requirements of an e-designation by New York City, any future on-site buildings will include, at a minimum, a 20-mil water/vapor barrier to improve energy efficiency as an element of construction.

2. Excavation

   The existing on-site buildings will be demolished and materials which can't be beneficially reused on-site will be taken off-site for proper disposal in order to implement the remedy. Excavation and off-site disposal of all on-site soils which exceed Track 2 Restricted Residential Soil Cleanup Objectives (SCOs), as defined by 6 NYCRR Part 375-6.8 in the upper 15 feet will be performed. Up to 8,641 cubic yards of soil is anticipated to be removed from Lot 35 and a combined 8,189 cubic yards of soil will be removed from Lots 49 and 13. Excavation and removal of any underground storage tanks (USTs), fuel dispensers, underground piping or other structures associated with a source of contamination.

3. Backfill

   If necessary, clean fill meeting the requirements of 6 NYCRR Part 375-6.8(d) will be brought in to establish the designed grades at the site.

4. Institutional Control

   Imposition of an institutional control in the form of an environmental easement for the controlled property which will:

   - Require the remedial party or site owner to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);
   - Allow the use and development of the controlled property for restricted residential, commercial or industrial use as defined by Part 375-1.8(g), although land use is subject to local zoning laws;
   - Restrict the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYCSDOH; and
   - Require compliance with the Department approved Site Management Plan

5. Site Management Plan

   A Site Management Plan is required, which includes the following:

   - An Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the site and details the steps and media-specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:

  - Institutional Controls: The Environmental Easement discussed in Paragraph 4 above.
  - Engineering Controls: None
  - This plan includes, but may not be limited to:
    - an Excavation Plan which details the provisions for management of future excavations in areas of remaining contamination descriptions of the provisions of the environmental easement including any land use, or groundwater use restrictions;
    - a provision for evaluation of the potential for soil vapor intrusion for any occupied buildings on the site, including provisions related to soil vapor intrusion;
    - maintaining site access controls and Department notification; and
    - the steps necessary for the periodic reviews and certification of the institutional and/or engineering controls

A Monitoring Plan to assess the performance and effectiveness of the remedy. The plan includes, but may not be limited to: monitoring for vapor intrusion for any occupied existing or future buildings on the site, as may be required by the Institutional and Engineering Control Plan discussed above.

As previously stated the remedial elements will be the same for both sites with the exception that the extent of excavation required for each site may differ. The proposed remedial and development actions will consist of the following:

1. Implementation of a Community Air Monitoring Program (CAMP) for particulates and VOCs.
2. Selection of NYSDEC Track 2 Restricted Residential Use SCOs.
3. Complete a Waste Characterization Study to identify the disposal facility for soil disposal.
4. Installation of sheeting and shoring to enable excavation of on-Site soils.
5. Demolition of all Site structures and removal of concrete and asphalt surfaces to access soils.
6. Excavation and removal of soil and fill exceeding Restricted Residential SCOs – the proposed excavation will extend 15 ft bgs.

7. Screening for indications of contamination (by visual means, odor, and monitoring with photoionization detector [PID]) of all excavated soil during any intrusive Site work.
8. Appropriate off-Site disposal of all material removed from the Site in accordance with all federal, state, and local rules and regulations for handling, transport, and disposal. Waste disposal facilities will be selected based on the data that has been collected to date and Waste Classification soil sampling. Based on the requirements of the selected facilities, additional soil waste characterization samples may be collected and analyzed as needed to obtain approval for soil disposal.
9. Collection and analysis of endpoint samples. Site-wide to evaluate the performance of the remedy and inform the need for further excavation with respect to attainment of Track 2 RRSCOs. If endpoint samples do not meet RRSCOs further excavation will be completed until they are met.
10. If needed, clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) will be brought in to replace the excavated soil and establish the designed grades at the Site. On-Site soil which does not exceed the above-noted excavation criteria (RRSCOs) or the protection of groundwater SCOs for any constituent may be used anywhere on-Site, including below the water table to back fill the excavation areas and regrade the Site.
11. All responsibilities associated with the Remedial Action, including permitting requirements and pretreatment requirements, will be addressed in accordance with all applicable federal, state and local rules and regulations.
12. Submission of a Final Engineering Report (FER) that describes remedial activities, certifies remedial requirements were achieved, and lists any deviations from this RAWP, if applicable.

Remedial activities will be performed at the Site in accordance with this RAWP and the Department-issued Decision Document. All deviations from this RAWP and/or the Decision Document will be promptly reported to NYSDEC for approval and fully explained in the FER. If USTs are encountered they should be properly registered/closed out as per 6 NYCRR Part 375-1.12€

1.4 Hazard/Risk Analysis

1.4.1 Physical Hazards

Physical hazards associated with heavy equipment operations may be present during site activities. These activities would require the use of heavy equipment by subcontractors such as a backhoe or a drill rig, which is associated with, but not limited to, the following hazards:

- bodily injuries
- slipping, tripping or falling
- heavy lifting
- caught in-between injuries
- struck by injuries
- cold/heat stress
- noise

1.4.2 Fire and Explosion

Fire extinguishers are located on heavy equipment operating onsite and within any work vehicles onsite. All fires should be reported to 911 emergency services. The Construction Management (CM) Contractor and the Construction Health & Safety Officer (CHSO) will determine if it is necessary to shut down site work for the day due to fire related issues.

1.4.3 Cold Stress

During the winter months, workers may be exposed to the hazards of working in cold environments. Potential hazards in cold environments include frostbite, trench foot or immersion foot, hypothermia as well as slippery surfaces, brittle equipment, and poor judgment. The procedures to be followed regarding the avoidance of cold stress are provided in **Appendix B –** Cold Stress Guidelines.

1.4.4 Heat Stress

A heat stress prevention program will be implemented when ambient temperatures exceed 70ºF. The procedures to be followed are provided in **Appendix C –** Heat Stress Guidelines.

1.4.5 Noise

Noise is a potential hazard associated with the operation of heavy equipment, power tools, pumps, generators, and other equipment associated with earthwork tasks. Site workers who will perform suspected or established high noise tasks and operations shall wear hearing protection. Other workers who do not need to be in proximity of the noise should distance themselves from the equipment generating the noise.

1.4.6 Hand and Power Tools

In order to complete the various tasks for the project, personnel will use hand and power tools. The use of hand and power tools can present a variety of hazards, including physical harm from being struck by flying objects, being cut or struck by the tool, fire, and electrocution. Work gloves, safety glasses, and hard hats will be worn by the operating personnel at all times when using hand and power tools. Ground Fault Circuit Interrupter (GFCI)-equipped circuits will be used for all power tools.

The CM Contractor is responsible for the safe condition of tools and equipment used by employees but the employees have the responsibility for properly using and maintaining tools.

Saw blades, knives, or other tools be directed away from aisle areas and other employees working in close proximity. Knives and scissors must be sharp. Dull tools can be more hazardous than sharp ones.

Appropriate personal protective equipment (PPE), e.g., safety goggles, gloves, etc., should be worn due to hazards that may be encountered while using portable power tools and hand tools. Floors must be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools.

Around flammable substances, sparks produced by iron and steel hand tools can be a potential ignition source. Where this hazard exists, spark-resistant tools made from brass, plastic, aluminum, or wood will provide for safety.

The following general precautions should be observed by power tool users:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters.
- All observers should be kept at a safe distance away from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. The worker should not hold a finger on the switch button while carrying a plugged-in tool.
- Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance.
- The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts.
- All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use."

Staff and subcontractors should follow all associated OSHA standards (29 CFR 1926), the most updated of which can be found at http://www.osha.gov. OSHA standards supersede any guidelines stated within this CHASP.

1.4.7 Slips, Trips, and Falls

Working in and around the site will pose slip, trip and fall hazards due to slippery surfaces. Excavation at the sites will cause uneven footing in the trenches and around the spoil piles. Employees will wear proper footwear (i.e. steel toe/shank boots) and will employ good work practice and housekeeping procedures to minimize the potential for slips, trips, and falls.

1.4.8 Manual Lifting

Manual lifting of objects and equipment may be required. Failure to follow proper lifting technique can result in back injuries and strains. Site workers should use power equipment to lift heavy loads whenever possible and should evaluate loads before trying to lift them (i.e., they should be able to easily tip the load and then return it to its original position). Carrying heavy loads with a buddy and proper lifting techniques include:

1) make sure footing is solid
2) make back straight with no curving or slouching
3) center body over feet
4) grasp the object firmly and as close to your body as possible
5) lift with legs
6) turn with your feet, don’t twist

1.4.9 Projectile Objects, Debris and Overhead Dangers

Overhead dangers, including but not limited to falling debris and equipment, can occur while heavy machinery is in operation or work is taking place overhead. Staff will be instructed to maintain a minimum distance from large overhead operations. Staff must also maintain proper communication with heavy equipment operators and their handlers, especially if work necessitates their presence beyond the minimum safe distance. Additionally, employees should be cognizant of low-hanging overhead power lines, as these can snag on vehicles entering and exiting the site. Vehicles that are large enough to damage overhead power lines require spotters when entering and exiting the site. Proper PPE will be worn at all times during these types of activities including steel-toed or equivalent boots, safety vests and hard hats.

1.4.10 Heavy Equipment Operation

Heavy equipment may be present onsite. Staff should be cautious when working near or operating heavy equipment, and maintain a safe distance from the equipment. Personnel should maintain eye contact with the vehicle spotter or operator before traversing any paths that may cross that of the machinery. Safety vests are to be worn when working near operating heavy equipment.

1.4.11 Confined Spaces

If any work in confined spaces is required, it will be performed in accordance with 29 CFR 1910.146 (effective April 15, 1993), as applicable. Copies of the standards will be kept on file in the CM Contractor's main office, if work in confined spaces will be performed. Confined space work will not be performed without first notifying and receiving approval from the CM, if applicable.

1.4.12 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. OSHA illumination requirements will be followed when work is taking place inside the buildings. All exterior site activities at the site will occur during daylight hours. However, if yard areas are used after dark they will be equipped with illumination that meets or exceeds requirements specified in 29 CFR 1926.56, Illumination.

1.4.13 Lockout/Tagout

Site personnel will assume that all electrical equipment at surface and overhead locations is energized, until the equipment has been designated as de-energized by a representative from the utility company. If the equipment cannot be de-energized, work will stop and the CM and appropriate contacts will be consulted. The CM will notify the client prior to working adjacent to this equipment, and will verify that the equipment is energized or de-energized in the vicinity of the work being conducted.

All power lines which have been indicated to be de-energized must be locked out, such that the lines cannot be energized when personnel are working near them. The lines shall not be unlocked and re-energized until the CM notifies the client that they have completed work in the area and that all personnel are clear of the area. Client representatives will thoroughly familiarize personnel with site-specific lockout/tagout procedures during the site orientation, if applicable.

If power lines cannot be de-energized, the CM will consult with utility safety personnel to determine the safe working distance from the energized line. Work tasks will only commence after determination that a safe working distance can be maintained and all personnel working in the area have been informed of the limitation.

1.4.14 Fall Hazards

Fall hazards exist onsite in several areas. Workers must follow all safeguards for fall protection as defined in OSHA 29 CFR 1926, Subpart M-Fall Protection. In general, workers should use the following guidelines:

- Use at least one of the following whenever employees are exposed to a fall of 6 feet or more above a lower level:
    - Guardrail Systems
    - Safety Net Systems
    - Personal Fall Arrest Systems

- Cover or guard floor holes as soon as they are created during new construction.
- For existing structures, survey the site before working and continually audit as work continues. Guard or cover any openings or holes immediately.
- Construct all floor-hole covers so they will effectively support two times the weight of employees, equipment, and materials that may be imposed on the cover at any one time. Floor-hole covers are to be secured so they are not moved off of the hole and labeled so workers are aware what is under the cover.
- In general, it is better to use fall *prevention* systems, such as guardrails, than fall *protection* systems, such as safety nets or fall arrest devices, because they provide more positive safety means.
- Construct all scaffolds according to the manufacturer's instructions and 29 CFR 1926.451.
- Install guardrail systems along all open sides and ends of platforms.
- Use at least one of the following for scaffolds more than 10 feet above a lower level:
    - Guardrail Systems
    - Personal Fall Arrest Systems

- Provide safe access to scaffold platforms [*For additional information, see Scaffold Access*].
- Do not climb cross-bracing as a means of access.
- Guard all protruding ends of steel rebar with rebar caps or wooden troughs, *or*
- Bend rebar so exposed ends are no longer upright.

- When employees are working at any height above exposed rebar, fall protection/ prevention is the first line of defense against impalement.

1.4.15 Ladder Safety

Portable ladders must be safely positioned each time they are used. Staff and subcontractors should follow all associated OSHA standards (CFR 1926.1053), the most updated of which can be found at http://www.osha.gov. OSHA standards supersede any guidelines stated within this CHASP.

1.4.16 Scaffolding Safety

Scaffolding presents significant fall hazards and various types of scaffolds may be present onsite. Staff and subcontractors should follow all associated OSHA standards (CFR 1926 Subpart L – Scaffolds), the most updated of which can be found at http://www.osha.gov.

1.4.17 Welding

The intense light associated with welding operations can cause serious and sometimes permanent eye damage if operators do not wear proper eye protection. Additionally, sparks from the welding process present a risk to the employee conducting welding and nearby employees. Any flammable or combustible materials that may be exposed to sparks or other heat sources must be protected or relocated to prevent fire hazards. Fire extinguishers will be located in areas where welding or hot work will be taking place. Staff must wear helmets that comply with ANSI Z49.1, with filter lenses that comply with ANSI Z87.1. Boots must comply with ASTM F2412 and ASTM F2413 for fire resistance. Welding operators must also wear flame-resistant welder's gloves.

Several chemicals may be used in the process of welding. Staff must be aware of the variety of chemicals used, and must possess appropriate welding training to perform welding activities. Additionally, compressed gas cylinders used in welding must be stored, placed and transported according to OSHA standards. Staff and subcontractors should follow all associated OSHA standards (CFR 1926), the most updated of which can be found at http://www.osha.gov.

1.4.18 Asbestos-Containing Material

Although the site does not contain asbestos-containing materials (ACM), workers should be aware of the risks associated with asbestos exposure. Chronic exposure to asbestos may cause asbestosis and mesothelioma. The primary route of exposure for asbestos is inhalation during the disturbance and/or removal of asbestos from pipe insulation and cement pipes.

Asbestos is strictly regulated under OSHA 29 CFR 1910.1001/1926.1101. Employees that may be potentially exposed to ACM must participate in a medical surveillance program, have specific training in the hazards and controls of exposure to asbestos and wear respirators with high efficiency particulate (HEPA) filters. All work must be conducted in demarcated regulated areas to minimize the number of people within the exposure area. Employers must conduct air sampling and provide signs and labels regarding the presence of asbestos. Staff and subcontractors should follow all associated OSHA standards (CFR 1926), the most updated of which can be found at http://www.osha.gov.

The potential hazards for this project are listed in the following Activity Hazard Analysis and Site Hazards sections.

SITE HAZARDS	
Potential Hazard	**Control Measures**
Construction Safety	▪ Identify yourself and your work location to heavy equipment operators, so they may incorporate you into their operations. Coordinate hand signals with operators. ▪ Stay Alert! Pay attention to equipment backup alarms and swing radii. ▪ Wear a high visibility vest when working near equipment or motor vehicle traffic. ▪ Position yourself in a safe location when filling out logs and talking with the contractor. ▪ Notify the contractor immediately if any problems arise. ▪ Do not stand or sit under suspended loads or near any pressurized equipment lines. ▪ Do not use cellular telephones near operating equipment. ▪ Follow general traffic safety guidelines

SITE HAZARDS	
Potential Hazard	**Control Measures**
Scaffolding Safety and Power Tools	▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart L - Scaffolds. ▪ Do not use impact tools (i.e. chisels, hammers) with mushroomed heads. ▪ Do not use wooden-handled tools if the handle is damaged, splintered, lose or cracked. ▪ Inspect, maintain and replace tools as needed. ▪ Do not use wrenches if jaws are sprung. ▪ Tools should be directed away from aisles, other employees and trafficked areas. ▪ Wear appropriate PPE when using tools. ▪ Floors must be kept clean and as dry as possible to prevent slips, trips an falls around tools. ▪ Never carry a tool by the cord or hose. ▪ Never yank the cord or the hose to disconnect it from the receptacle. ▪ Keep cords and hoses away from heat, oil, and sharp edges. ▪ Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits and cutters. ▪ All observers should be kept at a safe distance away from the work area. ▪ Secure work with clamps or a vise, freeing both hands to operate the tool. ▪ Avoid accidental starting. The worker should not hold a finger on the switch button while carrying a plugged-in tool. ▪ Tools should be maintained with care. They should be kept sharp and clean for the best performance. Follow instructions in the user's manual for lubricating and changing accessories. ▪ Be sure to keep good footing and maintain good balance. ▪ The proper apparel should be worn. Loose clothing, ties, or jewelry can become caught in moving parts. ▪ All portable electric tools that are damaged shall be removed from use and tagged "Do Not Use." ▪ Keep all tools in good condition with regular maintenance. ▪ Use the right tool for the job. ▪ Examine each tool for damage before use. ▪ Operate according to the manufacturer's instructions. ▪ Provide and use the proper protective equipment.
Heavy Equipment Operation	▪ Maintain awareness of location of equipment. ▪ Subcontractor use of a spotter for equipment operation. ▪ Safety vest is to be worn around all operating equipment. ▪ Maintain eye contact with the operator. ▪ Stay out of the swing radii of the apparatus.
Slips, Trips, Falls	▪ Keep trafficked areas clear of debris and tools. Keep work areas and traffic areas dry.
Lock Out/Tag Out	▪ Maintain contact with utility to determine if energized lines or equipment has been de-energized ▪ Follow OSHA Lock Out/Tag Out requirements in 29 CFR 1910.147.
Welding	▪ Wear appropriate PPE (welding helmet, apron, fire-resistant gloves and boots, leggings) as needed. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart J – Welding and Cutting.

SITE HAZARDS	
Potential Hazard	**Control Measures**
Fire	▪ Keep fire extinguishers in working order by inspecting on a regular basis. ▪ Keep the appropriately rated and sized fire extinguishers on site as specified by 29 CFR 1926.150. ▪ Keep flammable materials away from ignition sources. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart F – Fire Protection and Prevention and NPFA standards. ▪ Wear appropriate PPE when working around flammable materials.
Ladder Safety	▪ Follow safety guidelines for safe ladder use. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926.1053.
Fall Hazards	▪ Use appropriate fall protection at heights of 6 feet or greater. ▪ Avoid working in areas with a drop off of more than 2 feet. ▪ Erect appropriate barriers and guard rails. ▪ Wear appropriate fall protection PPE. ▪ Mark fall hazards so they are visible to employees. ▪ Follow OSHA Construction Safety Requirements 29 CFR 1926 Subpart M – Fall Protection.
Physical Injury	▪ Wear work boots in good condition with non-slip soles. ▪ Maintain good visibility of the work area. ▪ Avoid walking on uneven or debris ridden ground surfaces. ▪ Use proper lifting techniques. Ask fellow worker for help.
Noise	▪ Wear hearing protection when near loud noises. ▪ Wear hearing protection whenever you need to raise your voice above normal conversational speech due to a loud noise source; this much noise indicates the need for protection.
Vehicular Traffic	▪ Wear traffic safety vest at all times. ▪ Use cones, flags, barricades, and caution tape to define work area. ▪ Use a "spotter" to locate oncoming vehicles. ▪ Use vehicle to block work area. ▪ Engage police detail if needed.
Utilities	▪ Check that contactor has cleared underground utilities before any intrusive activities, and that contractor has coordinate with utility locating services, property owner(s) or utility companies. ▪ Utilities are to be considered live or active until documented otherwise. ▪ For overhead utilities within 50 feet, have contractor determine with the utility company the appropriate safe distance. Minimum distance for clearance is based on voltage of the line. ▪ An observer will be established when operating drilling rigs near overhead utilities.

ACTIVITY HAZARDS		
Activity	**Potential Hazards**	**Protective Equipment**
Entering Construction Site	Heavy equipment, dust, noise.	Hardhat, reflective safety vest, steel-toed, steel-shank boots, safety glasses, protective leather work gloves, and earplugs. Follow general traffic safety guidelines. Employ dust suppression controls (i.e. watering) to keep dust levels down to prevent inhalation of excavated materials.
General Construction (Foundation Work, Earthwork, Soil Vapor Barrier System Installation)	Heavy equipment, dust, noise. Contact with excavated soils.	Hardhat, reflective safety vest, steel-toed, steel-shank boots, safety glasses, protective leather work gloves, and earplugs. Follow general traffic safety guidelines. Employ dust suppression controls (i.e. watering) to keep dust levels down to prevent inhalation of excavated materials.
Personal Protective Equipment (PPE) is the *initial level of protection* based on the activity hazards and Site conditions which have been identified.		

1.5 Evaluation of Potential Chemical Hazards

The characteristics of potential compounds at the Site are discussed below for information purposes. Adherence to the safety and health guidelines in this CHASP should reduce the potential for exposure to the compounds discussed below. **Table 1-1** presents chemical data regarding potential exposure and monitoring for the chemical types listed below.

Potential exposure to contaminants at the Site included encounters with groundwater, soil and soil vapor.

<u>Soils for Lot(s) 13 and 49 (Concourse Village West Apartments South):</u>

- The VOC, Acetone was detected at multiple depths exceeding Unrestricted Use SCOs. No other VOCs were detected in the samples collected for analysis.
- SVOCs including benzo(a)anthracene (maximum 22.6 mg/kg), benzo(a)pyrene (maximum 20.8 mg/kg), benzo(b)fluoranthene (maximum 21.3 mg/kg), benzo(k)fluoranthene (maximum 25.5 mg/kg), chrysene (maximum 24.9 mg/kg), dibenzo(a,h)anthracene (maximum 6.8 mg/kg), Indeno(1,2,3-cd)pyrene (maximum 8.09 mg/kg) exceeded Restricted Residential Use SCOs. Highest concentrations of SVOCs were detected in B-11 (6 ft to 8 ft depth). Other locations with high SVOCs

included borings at B4 (0 ft to 2 ft, and 14 ft to 16 ft), B-11 (6 ft to 8 ft), and B-22 (6 ft to 8 ft depths).

- No Pesticides were detected at levels above Unrestricted Use SCOs or Restricted Residential Use SCOs. Total PCBs were detected above Unrestricted Use SCOs at a concentration of 0.29 mg/kg.
- The metals Barium (maximum 647 mg/kg in B-10 at 0 ft to 2 ft), Copper (maximum 476 mg/kg in B-10 at 0 ft to 2 ft), Lead (maximum 2,250 mg/kg in B-10 at 0 ft to 2 ft), and Mercury (maximum 3.1 mg/kg in B-21 at 0 ft to 2 ft) were detected above the Restricted Residential Use SCOs. The metals Nickel (maximum 33.8 mg/kg), Selenium (maximum 5.39 mg/kg), and Zinc (maximum 716 mg/kg) were detected at levels above Unrestricted Use SCOs. Elevated metals were in detected in borings B-3 and B-4 (14 ft to 16 ft), and B-10 (0 ft to 2 ft).

1.5.1 Groundwater Chemistry

Data collected during the RI is sufficient to delineate the distribution of contaminants in groundwater at the Site. A summary table of data for chemical analyses performed on groundwater samples is included in **Table 2**. Groundwater concentrations exceeding Ambient Water Quality Standards (AWQS) are shown on **Figure 5.1 and 5.2**. Groundwater laboratory analytical data reports are included in **Appendix F**.

<u>Groundwater on Lots 13 and 49 (Concourse Village West Apartments-SOUTH C203092)</u>

- The following VOCs were detected on Lot 49 at levels above their respective NYSDEC TOGS Standards (Note: no groundwater samples were acquired from lot 13 due to drill rig limitations and refusal): 1,2,3-Trimethylbenzene (maximum 240 µg/L in GW-3); 1,3,5-Trimethylbenze (maximum 45 µg/L in GW-3); Ethyl Benzene (maximum 150 µg/L in GW-3); Isopropylbenzene (maximum 36 µg/L in GW-7); n-Butylbenzene (maximum 22 µg/L in GW-3); n-Propylbenzene (maximum 48 µg/L in GW-3); o-Xylene (maximum 12 µg/L in GW-3); p & m- Xylenes (maximum 230 µg/L in GW-3); and sec-Butylbenzene (maximum 6.3 µg/L in GW-3).

- The following SVOCs were detected on Lot 35 at levels above their respective NYSDEC TOGS Standards: Benzo(a)anthracene (maximum 0.116 µg/L in GW-3); Benzo(a)pyrene (maximum 0.232 µg/L in GW-3); Benzo(b)fluoranthene (maximum 0.200 µg/L in GW-3); Benzo(k)fluoranthene (maximum 0.200 µg/L in GW-3); Chrysene (maximum 0.147 µg/L in GW-3); and Indeno(1,2,3-cd)pyrene (maximum 0.105 µg/L in GW-3) and total Xylenes (maximum 240 µg/L in GW-3).

- The metals Manganese, Selenium, and Sodium were detected at concentrations above their respective NYSDEC TOGS Guidance Values but are considered naturally occurring or related to road salt application and are not contaminants of concern for this site.

1.5.2 Soil Vapor Chemistry

<u>Lot(s) 13 and 49 (Concourse Village West Apartments South):</u>

Several chlorinated VOCs were detected at low concentrations. Other VOCs detected included acetone at maximum concentration of 36 $\mu g/m^3$. Chlorinated compounds included 1,1,1-Trichloroethane (maximum 22 $\mu g/m^3$), Carbon tetrachloride (24 $\mu g/m^3$), Tetrachloroethene (56 $\mu g/m^3$), and trichloroethylene (15 $\mu g/m^3$). Concentrations of PCE and 1,1,1 Trichloroethane (TCA) are below the NYSDOH decision matrix and do not require monitoring. Carbon tetrachloride and TCE were detected above their monitoring range established by NYSDOH.

1.5.3 Asbestos-Containing Materials

As asbestos containing materials (ACM) have not been identified onsite, they are not currently monitored for at the site. However, in the course of earthwork, staff should be cognizant of potential ACM and report any suspected ACM to the CM Contractor and the CHSO, who will then determine the appropriate course of action.

1.5.4 Polychlorinated Biphenyls

As PCBs, have not been identified onsite above their respective SCGs, they are not considered a potential concern at the site.

1.6 Biological Hazards

During the course of the project, there is a potential for workers to come into contact with biological hazards such as animals, insects and plants. Workers will be instructed in hazard recognition, health hazards, and control measures during site-specific training.

1.6.1 Animals

During the conduct of site operations, wild animals such as stray dogs or cats, raccoons, and mice may be encountered. Workers will use discretion and avoid all contact with wild animals. If these animals present a problem, efforts will be made to remove these animals from the site by contacting a licensed animal control technician.

1.6.2 Insects

Insects, including bees, wasps, hornets, and spiders, may be present at the site making the chance of a bite possible. Some individuals may have a severe allergic reaction to an insect bite or sting that can result in a life-threatening condition. Any individuals who have been bitten or stung by an insect should notify the SSO. The following is a list of preventive measures:

- Apply insect repellent prior to performing any field work and as often as needed throughout the work shift.
- Wear proper protective clothing (work boots, socks and light colored pants).
- Field personnel who may have insect allergies should have bee sting allergy medication onsite and should provide this information to the SSO prior to commencing work.

1.6.3 Tick Borne Illnesses

Lyme disease is caused by infection from a deer tick that carries a spirochete. During the painless tick bite, the spirochete may be transmitted into the bloodstream that could lead to the worker contracting Lyme disease.

Lyme disease may cause a variety of medical conditions including arthritis, which can be treated successfully if the symptoms are recognized early and medical attention is received. Treatment with antibodies has been successful in preventing more serious symptoms from developing. Early signs may include a flu-like illness, an expanding skin rash, and joint pain. If left untreated, Lyme disease can cause serious nerve or heart problems, as well as a disabling type of arthritis.

Symptoms can include a stiff neck, chills, fever, sore throat, headache, fatigue and joint pain. This flu-like illness is out of season, commonly happening between May and October when ticks are most active. A large expanding skin rash may develop around the area of the bite. More than one rash may occur. The rash may feel hot to the touch and may be painful. Rashes vary in size, shape, and color, but often look like a red ring with a clear center. The outer edges expand in size. It's easy to miss the rash and the connection between the rash and a tick bite. The rash develops from three days to as long as a month after the tick bite. Almost one third of those with Lyme disease never get the rash.

Joint or muscle pain may be an early sign of Lyme disease. These aches and pains may be easy to confuse with the pain that comes with other types of arthritis. However, unlike many other types of arthritis, this pain seems to move or travel from joint to joint.

Lyme disease can affect the nervous system. Symptoms include stiff neck, severe headache, and fatigue usually linked to meningitis. Symptoms may also include pain and drooping of the muscles on the face, called Bell's Palsy. Lyme disease may also mimic symptoms of multiple sclerosis or other types of paralysis.

The disease can also cause serious, but reversible heart problems, such as irregular heartbeat. Finally, Lyme disease can result in a disabling, chronic type of arthritis that most often affects the knees. Treatment is more difficult and less successful in later stages. Often, the effects of Lyme disease may be confused with other medical problems.

It is recommended that personnel check themselves when in areas that could harbor deer ticks, wear light color clothing and visually check themselves and their buddy when coming from wooded or vegetated areas. If a tick is found biting an individual, the PM should be contacted immediately. The tick can be removed by pulling gently at the head with tweezers. The affected area should then be disinfected with an antiseptic wipe. The employee will be offered the option for medical treatment by a physician, which typically involves prophylactic antibiotics. If personnel feel sick or have signs similar to those above, they should notify the PM immediately.

The deer tick can also cause **Babesiosis**, an infection of the parasite Babesia Microti. Symptoms of Babesiosis may not be evident, but may also include fever, fatigue and hemolytic anemia lasting from several days to several months. Babesiosis is most commonly diagnosed in the elderly or in individuals whose immune systems are compromised.

Ehrlichiosis is a tick-borne disease which can be caused by either of two different organisms. Human monocytic ehrlichiosis (HME) is caused by *Ehrlichia chaffeensis*, which is transmitted by the lone star tick (*Amblyomma americanum*). Human granulocytic anaplasmosis (HGA), previously known as human granulocytic ehrlichiosis (HGE), is caused by *Anaplasma phagocytophilia,* which is transmitted by the deer tick (*Ixodes scapularis*).

In New York State, most cases of ehrlichiosis have been reported on Long Island and in the Hudson Valley. Ehrlichiosis is transmitted by the bite of infected ticks, including the deer tick and the lone star tick. The symptoms of HME and HGE are the same and usually include fever, muscle aches, weakness and headache. Patients may also experience confusion, nausea, vomiting and joint pain. Unlike Lyme disease or Rocky Mountain spotted fever, a rash is not common. Infection usually produces mild to moderately severe illness, with high fever and headache, but may occasionally be life-threatening or even fatal. Symptoms appear one to three weeks after the bite of an infected tick. However, not every exposure results in infection.

Rocky Mountain spotted fever (RMSF) is a tick-borne disease caused by a rickettsia (a microbe that differs somewhat from bacteria and virus). Fewer than 50 cases are reported annually in New York State. In the eastern United States, children are infected most frequently, while in the western United States, disease incidence is highest among adult males. Disease incidence is directly related to exposure to tick-infested habitats or to infested pets. Most of the cases in New York State have occurred on Long Island. RMSF is characterized by a sudden onset of moderate to high fever (which can last for two or three weeks), severe headache, fatigue, deep muscle pain, chills and rash. The rash begins on the legs or arms, may include the soles of the feet or palms of the hands, and may spread rapidly to the trunk or rest of the body. Symptoms usually appear within two weeks of the bite of an infected tick.

*(Information on Ehrlichiosis, Babesiosis, and Rocky Mountain Spotted Fever was derived from the New York State Department of Health).

1.6.4 Wasps and Bees

Wasps (hornets and yellow-jackets) and bees (honeybees and bumblebees) are common insects that may pose a potential hazard to the field team if work is performed during spring, summer or fall. Bees normally build their nests in the soil. However, they use other natural holes such as abandoned rodent nests or tree hollows. Wasps make a football-shaped, paper-like nest either below or above the ground. Yellow-jackets tend to build their nests in the ground but hornets tend to build their nests in trees and shrubbery. Bees are generally more mild-mannered than wasps and are less likely to sting. Bees can only sting once while wasps are capable of stinging multiple times because of a barbless stinger. Wasps sting when they feel threatened. By remaining calm and not annoying wasps by swatting, you lessen the chance of being stung.

Wasps and bees inject a venomous fluid under the skin when they sting. The venom causes a painful swelling that may last for several days. If the stinger is still present, carefully remove it with tweezers. Some people may develop an allergic reaction (i.e. anaphylactic shock) to a wasp or bee sting. If such a reaction develops, seek medical attention at once. Employees should inform the SSO if they are allergic to bees or wasps, and inform the SSO if an epi-pen is required treatment and the location of the pen.

1.6.5 Plants

The potential for contact with poisonous plants exists when performing field work in undeveloped and wooded areas. Poison ivy, sumac, and oak may be present onsite. Poison ivy can be found as vines on tree trunks or as upright bushes. Poison ivy consists of three leaflets with notched edges. Two leaflets form a pair on opposite sides of the stalk, and the third leaflet stands by itself at the tip. Poison ivy is red in the early spring and turns shiny green later in the spring. Poison sumac can be present in the form of a flat-topped shrub or tree. It has fern-like leaves, which are velvety dark green on top and pale underneath. The branches of immature trees have a velvety "down." Poison sumac has white, "hairy" berry clusters. Poison oak can be present as a sparingly branched shrub. Poison oak is similar to poison ivy in that it has the same leaflet configuration; however, the leaves have slightly deeper notches. Prophylactic application of Tecnu may prevent the occurrence of exposure symptoms. Post exposure over the counter products are available and should be identified at the local pharmacist. Susceptible individuals should be identified to the PM.

Contact with poison ivy, sumac, or oak may lead to a skin rash, characterized by reddened, itchy, blistering skin which needs first aid treatment. If a field worker believes they have contacted one of these plants, immediately wash skin thoroughly with soap and water, taking care not to touch your face or other body parts.

1.7 Sun Exposure

Employees are encouraged to liberally apply sunscreen, with a minimum sun protection factor (SPF) of 15, when working outdoors to avoid sunburn and potential skin cancer, which is associated with excessive sun exposure to unprotected skin. Additionally, employees should wear safety glasses that offer protection from UVA/UVB rays.

1.8 Personal Safety

Field activities have the potential to take site workers into areas which may pose a risk to personal safety. The following website (source) has been researched to identify potential crime activity in the area of the project:

http://www.nyc.gov/html/nypd/html/crime_prevention/crime_statistics.shtml

Type of Crime	Subject Property and Vicinity	New York City Total*
Murder	4	333
Rape	12	1,352
Robbery	151	16,539
Felony Assault	225	20,207
Burglary	134	16,765
Grand Larceny	393	43,862

*New York City Total includes values from the 121st Precinct

2014 crime statistics from this website report that the 121st Precinct, which is closest to the subject property, is shown above in comparison to the current New York City total.

To protect yourself, take the following precautions:

- <u>If deemed necessary, use the buddy system (teams of a minimum of two persons present);</u>
- <u>Let the Site Safety Officer (SSO) know when you begin work in these areas and when you leave;</u>
- <u>Call in regularly;</u>
- <u>Pay attention to what is going on around you; and</u>
- <u>If you arrive in an area and it does not look safe to get out of your vehicle, lock the doors and drive off quickly, but safely.</u>

Site workers must not knowingly enter into a situation where there is the potential for physical and violent behaviors to occur. If site workers encounter hostile individuals or a confrontation develops in the work area, suspend work activities, immediately leave the area of concern, and contact local 911 for assistance. Notify the SSO and CHSO of any incidents once you are out of potential danger.

In the event of an emergency, prompt communications with local emergency responders is essential. At least one charged and otherwise functioning cell phone to facilitate emergency communications will be on site.

2. Community Air Monitoring Plan

Concourse Village West Owner LLC will implement a Community Air Monitoring Plan (CAMP) in compliance with Appendix 1 of DER-10. Concourse Village West Owner LLC will contract with GEI Consultants, Inc., P. C. to implement the plan. Please see the body of the report of the Remedial Action Work Plan for full details outlining our CAMP efforts.

3. Project Personnel/Responsibilities and Lines of Authority

GEI Personnel		
Nicholas Recchia	Project Manager	Office: 631-759-2973 Cell: 516-395-8763
Thomas Johansen	Site Safety Officer (SSO), Field Representative (FR)	Office: 631-759-2976 Cell: 516-519-2872
Stephanie Cobleigh	Construction Manager (CM)	Office: 212-414-9414 Cell: 917-639-9400

Lines of Authority will be as follows:

Onsite – The CM Contractor will have responsibility for safety of its employees during the work performed at the site. The Field Representative (FR) will have a cell phone available to contact the appropriate local authorities, in the event of an emergency. The FR will be available for communication with the SSO and CM and with the client representative. The FR and/or SSO may change due to the nature of work being conducted onsite.

3.1 Construction Manager (CM)

Responsibilities of the CM include the following:

- Verifies implementation of the CHASP
- Conducts periodic inspections and documents these in the field book
- Participates in incident investigations
- Verifies the CHASP has the required approvals before any site work is conducted
- Verifies that the client and/or CM site manager is informed of project changes, which require modifications of the CHASP
- Has overall responsibility for project health and safety
- Acts as the primary point of contact with the client for site related activities and coordination with non-project related site operations
- Overseeing of performance of project tasks as outlined in the scope of work
- Plans field work using appropriate safe procedures and equipment
- Verifies and documents current OSHA construction training compliance for all construction trades

- Verifies that subcontractors acknowledge and sign the projects CHASP

3.2 Construction Health and Safety Officer (CHSO)

The CHSO is a qualified health and safety professional with experience in construction activities. Responsibilities of the CHSO include the following:

- Serves as the primary contact to review health and safety matters that may arise
- Approves revised or new safety protocols for field operations
- Coordinates revisions of this CHASP with field personnel
- Coordinates upgrading or downgrading of PPE with the site manager
- Leads the investigation of all accidents/incidents
- Provide the necessary training of subcontractor trade field crews in accordance with OSHA regulations and provides proof of training to the SSO prior to subcontractor trade personnel entering the site

3.3 Site Safety Officer (SSO)

Responsibilities of the SSO include the following:

- Verifies that the CHASP is implemented and that all health and safety activities identified in the HASP are conducted and/or implemented
- Verifies that field work is scheduled with adequate personnel and equipment resources to complete the job safely and enforces site health and safety rules
- Verifies that adequate communications between trade crews and emergency response personnel is maintained during emergency situations
- Verifies that field site personnel are adequately trained and qualified to work at the site and that proper PPE is utilized
- Report all accidents/incidents to the CHSO and CM
- Stop work if necessary
- Identifies operational changes which require modifications to the CHASP and ensures that the procedure modifications are implemented and documented through changes to the CHASP, with CHSO approval
- Determines upgrades or downgrades of PPE based on site conditions and/or real-time monitoring results with CHSO approval
- Reports to the CHSO and provides summaries of field operations and progress

3.4 Field Representative (FR)

The FR is responsible for carrying out field work on a monthly, quarterly, or as-needed basis. Responsibilities of the FR include:

- Conducts routine safety inspection of the work area
- Documenting occurrences of unsafe activity and what actions were taken to rectify the situation
- Reports any unsafe or potentially hazardous conditions to the SSO and CM
- Maintains familiarity of the information, instructions, and emergency response actions contained in the CHASP
- Complies with rules, regulations and procedures set forth in the CHASP
- Prevents admittance to work site by unauthorized personnel
- Inspects all tools and equipment, including PPE, prior to use and documents inspection on the daily safety meeting form or in the appropriate field book
- Verifies that monitoring instruments are calibrated
- Stops work if necessary

4. Subcontractors

The CM Contractor may subcontract with various companies to conduct various work onsite on an as-needed basis. Contact information for these subcontractors will be available when such work is being conducted.

The CM Contractor requires its subcontractors to work in a responsible and safe manner. Subcontractors for this project may be required to develop their own CHASP for protection of their employees and must adhere to applicable requirements set forth in this CHASP.

5. Emergency Contact List

EMERGENCY INFORMATION		
Important Phone Numbers		Directions to: **Lincoln Medical and Mental Health Center** 234 E. 149th Street Bronx, NY 10451
Police	911	▪ Head southwest on Concourse Village W toward E 153rd St. ▪ Continue onto E 153rd St. ▪ Turn left onto Grand Concourse ▪ Turn left onto E 149thSt. ▪ Turn right onto Park Ave. Refer to Hospital Route Map in **Appendix A**.
Fire Department	911	
Ambulance	911	
Mobile Health Clinic 2488 Grand Concourse #210 Bronx, NY 10458	(212) 695-5122	
Local Hospital: Lincoln Medical and Mental Health Center	(718) 579-5016	
Project Manager	Nicholas Recchia	Office: 631-759-2973 Cell: 516-395-8763
Developer/Contractor	Stephanie Cobleigh	Office: 212-414-9414

6. Training Program

6.1 Hazard Communication

In accordance with 29 CFR 1926, site workers shall, at the time of job assignment, have received hazard communication training. All hazardous materials used on the site will be properly labeled, stored, and handled. SDSs will be attached to this report and available to onsite staff.

6.2 Onsite Safety Briefings

Other onsite personnel will be given health and safety briefings by a FR to assist personnel in safely conducting work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the site's conditions, as well as periodic reinforcement of previously discussed topics. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety inspections. These safety briefing will be documented on a daily safety briefing form or other appropriate media.

7. Medical Support

In case of minor injuries, onsite care shall be administered with the Site first aid kit. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger.

Section 5 and **Appendix A** contain detailed emergency information, including directions to the nearest hospital, and a list of emergency services and their telephone numbers. Field personnel will carry a cellular telephone.

8. Personal Protective Equipment

PPE required for each level of protection is as follows.

Safety Equipment	Level A	Level B	Level C	Level D
Hard hats with splash shields or safety glasses			•	•
Steel-toe boots with overboots as appropriate for work being performed and materials handled			•	•
Protective Leather Work Gloves or Chemical-resistant gloves as needed			•	•
Reflective Vest			•	•
Half- or full-face respirators with HEPA cartridges as approved by the CHSO as needed			•	
Long Pants	•	•	•	•
Welding Helmet				•
Welding Gloves, apron, leggings (as needed)				•
Flame-resistant boots for welding				•

PPE can include hardhats, safety glasses or face shields, steel toe/steel shank boots, hearing protection, nitrile gloves, and leather gloves as necessary.

OSHA Requirements for PPE

All PPE used during the course of this field investigation must meet the following OSHA standards:

Type of Protection	Regulation	Source
Eye and Face	29 CFR 1910.133	ANSI Z87.1 1968
Respiratory	29 CFR 1910.134	ANSI Z88.1 1980
Head	29 CFR 1910.135	ANSI Z89.1 1969
Foot	29 CFR 1910.136	ANSI Z41.1 1999 or ASTM F-2412-2005, and ASTM F-2413-2005

CFR = Code of Federal Regulations
ANSI = American National Standards Institute
ASTM = American Society For Testing and Materials

Any onsite personnel who have the potential to don a respirator must have a valid fit test certification and documentation of medical clearance. The CHSO will maintain such information on file for onsite personnel. The CM will obtain such information from the subcontractor's site supervisor prior to the initiation of any such work. Both the respirator and cartridges specified for use in Level C protection must be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910.134). Air purifying respirators cannot be worn under the following conditions:

- Oxygen deficiency;
- IDLH concentrations; and
- If contaminant levels exceed designated use concentrations.

For most work conducted at the site, Level D PPE will include long pants, hard hats, safety glasses with side shields, and steel toe safety boots with steel shanks. The CHSO will determine if site works deems an upgrade in PPE. The use of respirators is not anticipated.

Use of Level A or Level B PPE is not anticipated. If conditions indicating the need for Level A or Level B PPE are encountered, personnel will leave the work zone and this CHASP will be revised with oversight of the CHSO, personnel will not re-enter the work zone until conditions allow.

9. Supplemental Contingency Plan Procedures

9.1 Fire

In the event of a fire, all personnel will evacuate the area. The FR will contact the local fire department and report the fire. Notification of evacuation will be made to the client, the CM and the CHSO. The FR or appropriate staff member will account for subcontractor personnel and report their status to the CM.

9.2 Severe Weather

The contingency plan for severe weather includes reviewing the expected weather to determine if severe weather is in the forecast. Severe weather includes high winds over 30 mph, heavy rains or snow squalls, thunderstorms, hurricanes, and lightning storms. If severe weather is approaching, the decision to evacuate staff and subcontractor personnel from the site is the responsibility of the FR. Notification of evacuation will be made to the Project Manager, the Construction Project Manager and the CHSO. The FR will account for onsite staff and report their status to the CM. If safe, work can resume 30 minutes after the last flash of lightening or clap of thunder.

9.3 Spills or Material Release

If a hazardous waste spill or material release occurs, the SSO or their representative, if safe, will immediately assess the magnitude and potential seriousness of the spill or release based on the following:

- SDS, if applicable, for the material spilled or released
- Source of the release or spillage of hazardous material
- An estimate of the quantity released and the rate at which it is being released
- The direction in which the spill or air release is moving
- Personnel who may be or may have been in contact with the material, or air release, and possible injury or sickness as a result
- Potential for fire and/or explosion resulting from the situation
- Estimates of area under influence of release

If the spill or release is determined to be within the onsite emergency response capabilities, the SSO will ensure implementation of the necessary remedial action. If the release is beyond the capabilities of the site personnel, all personnel will be evacuated from the immediate area and the local fire department will be contacted. The SSO will notify the CM and the CHSO.

9.4 Alcohol and Drug Abuse Prevention

Alcohol and drugs will not be allowed on the work site. Project personnel under the influence of alcohol or drugs will not be allowed to enter the site.

10. Decontamination Procedures

10.1 Personnel Decontamination Station

As needed, a personnel decontamination station where workers can drop equipment and remove PPE will be set up as needed by the Contractor. The PPE area will be equipped with basins for water and detergent, and trash bag(s) or cans for containing disposable PPE and discarded materials. Once personnel have decontaminated at this station and taken off their PPE, they will proceed to a portable sink where they will wash themselves wherever they have potentially been exposed to any contaminants (e.g., hands, face, etc.).

Contaminated PPE (gloves, suits, etc.) will be decontaminated and stored for reuse or placed in plastic bags (or other appropriate container) and disposed of in an approved facility.

Decontamination wastewater and used cleaning fluids will be collected and disposed of in accordance with all applicable state and federal regulations.

10.2 Decontamination Equipment Requirements

If heavily contaminated soils are encountered during intrusive work, the following equipment, as needed, will be in sufficient supply to implement decontamination procedures for equipment.

- Buckets
- Alconox™ detergent concentrate
- Hand pump sprayers
- Long handle soft bristle brushes
- Large sponges
- Cleaning wipes for respirators
- Bench or stool(s)
- Methanol
- Liquid detergent and paper towels
- Plastic trash bags

11. Construction Health and Safety Plan Sign-Off

All personnel conducting site activities must read this Construction Health and Safety Plan, be familiar with its requirements, and agree to its implementation.

All other personnel onsite for regulatory, observational and other activities not directly associated with site activities must read this Health and Safety Plan for hazard communication purposes.

Once the Construction Health and Safety Plan has been read, complete this sign-off sheet, and return it to the Project Manager**.**

Site Name:

702 Grand Concourse and 741 Concourse Village West, Bronx, NY

Activity:

- Building demolition
- Foundation excavation, loading and removal of site soils
- Site grading
- Building construction

I have received and read the Construction Health and Safety Plan, been briefed on it, and agree to its implementation.

Name	Signature	Date	Company

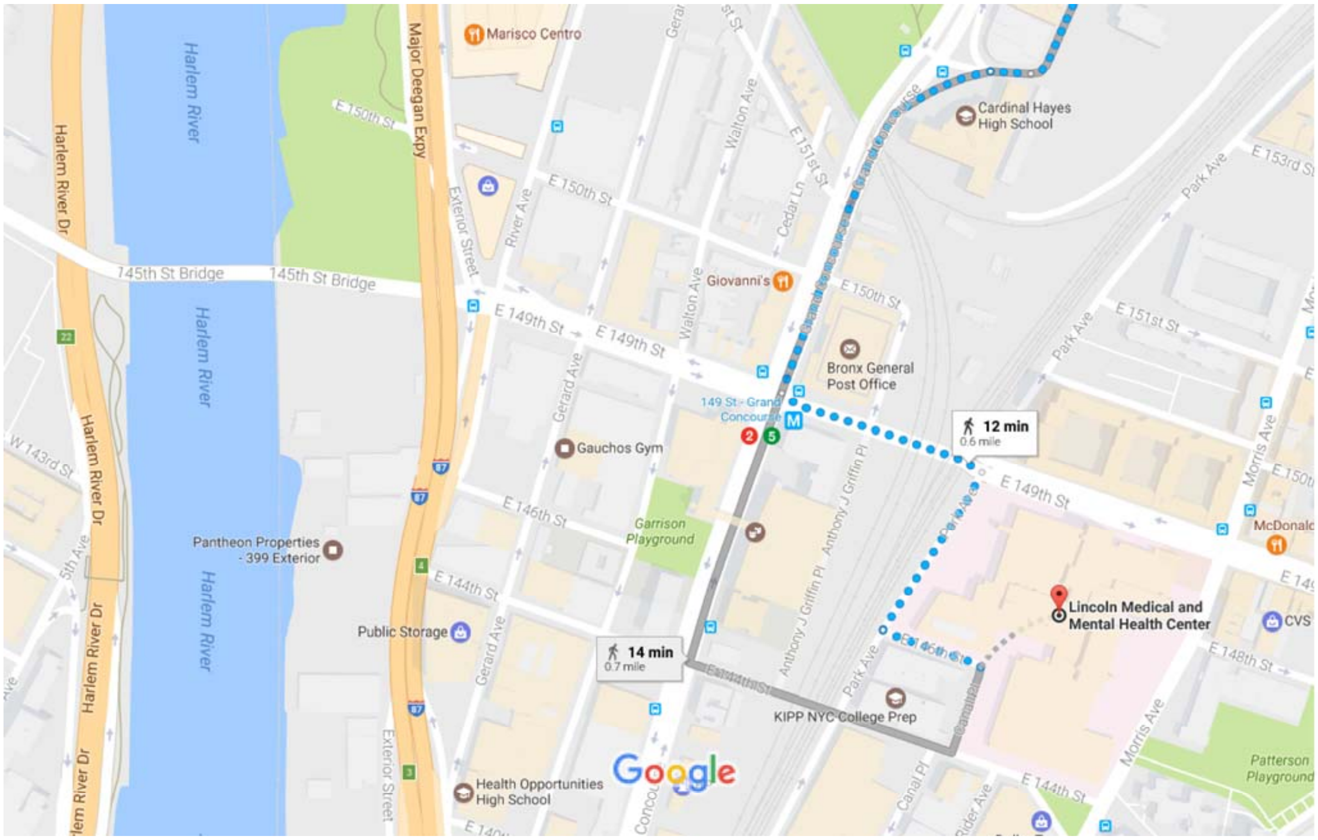
APPENDIX A

SITE-SPECIFIC INFORMATION

Google Maps

741 Concourse Village West, Bronx, NY to Lincoln Medical and Mental Health Center

Walk 0.6 mile, 12 min



Map data ©2017 Google 200 ft

741 Concourse Village W
Bronx, NY 10451

Use caution - may involve errors or sections not suited for walking

1. Head southwest on Concourse Village W toward E 153rd St
390 ft

2. Continue onto E 153rd St
112 ft

3. Turn left onto Grand Concourse
0.2 mi

4. Turn left onto E 149th St
0.1 mi

5. Turn right onto Park Ave
0.1 mi

6. Turn left onto E 146th St

292 ft

Lincoln Medical and Mental Health Center

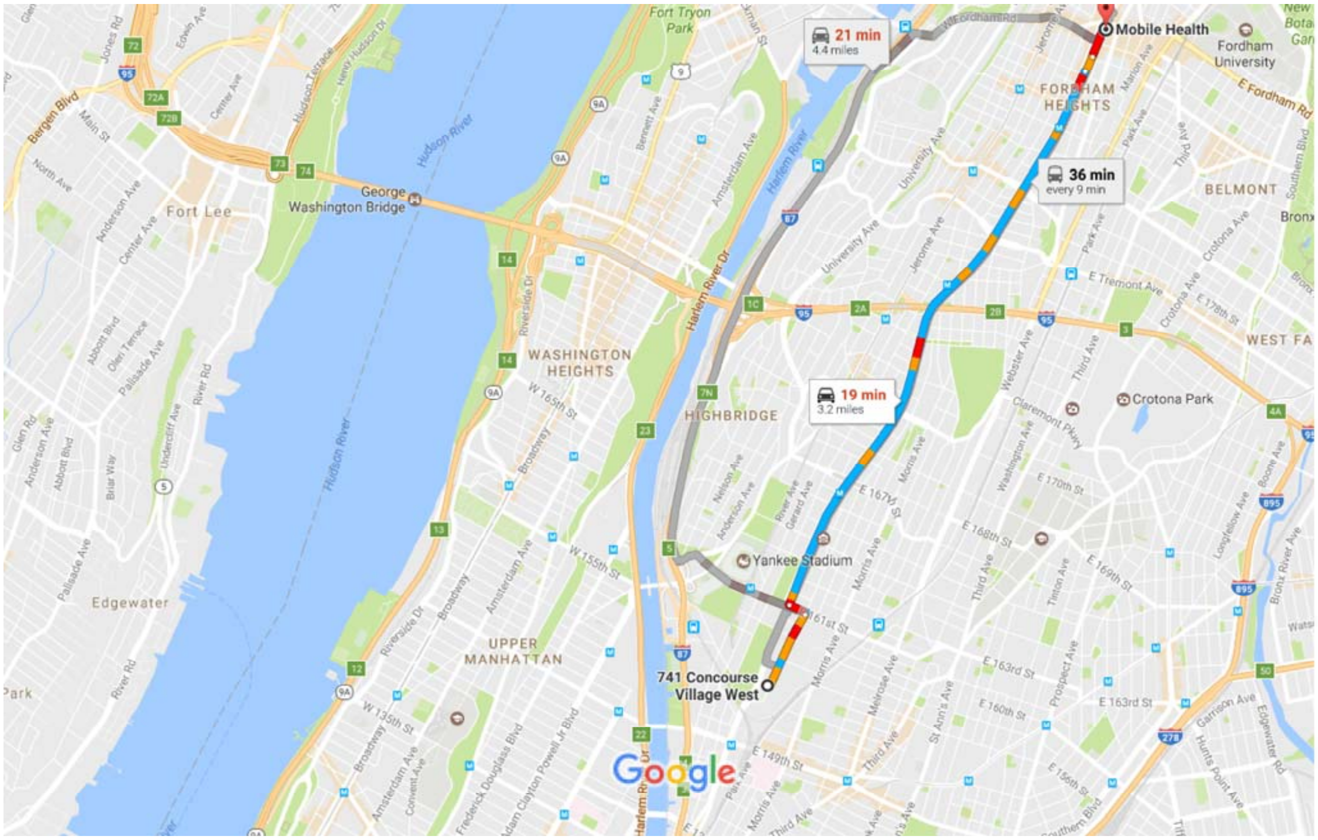
234 E 149th St, Bronx, NY 10451

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Google Maps

741 Concourse Village West, Bronx, NY to Mobile Health

Drive 3.2 miles, 19 min



Map data ©2017 Google 2000 ft

741 Concourse Village W

Bronx, NY 10451

1. Head northeast on Concourse Village W toward E 156th St

0.3 mi

2. Turn left onto E 161st St

466 ft

3. Turn right onto Grand Concourse

2.6 mi

4. Exit to stay on Grand Concourse

374 ft

5. Keep right to stay on Grand Concourse
   Destination will be on the right

0.1 mi

Mobile Health

2488 Grand Concourse #210, Bronx, NY 10458

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

APPENDIX B

COLD STRESS GUIDELINES

Cold Stress Guidelines

	Symptoms	What to do
Mild Hypothermia	▪ Body Temp 98-90°F ▪ Shivering ▪ Lack of coordination, stumbling, fumbling hands ▪ Slurred speech ▪ Memory loss ▪ Pale, cold skin	▪ Move to warm area ▪ Stay active ▪ Remove wet clothes and replace with dry clothes of blankets ▪ Cover the head ▪ Drink warm (not hot) sugary drink
Moderate Hypothermia	▪ Body temp 90-86°F ▪ Shivering stops ▪ Unable to walk or stand ▪ Confused irrational	▪ All of the above, plus: ▪ Call 911 ▪ Cover all extremities completely ▪ Place very warm objects, such as hot packs on the victim's head, neck, chest and groin
Severe Hypothermia	▪ Body temp 86-78°F ▪ Severe muscle stiffness ▪ Very sleepy or unconscious ▪ Ice cold skin ▪ Death	▪ Call 911 ▪ Treat victim very gently ▪ Do not attempt to re-warm
Frostbite	▪ Cold, tingling, stinging or aching feeling in the frostbitten area, followed by numbness ▪ Skin color turns red, then purple, then white or very pale skin ▪ Cold to the touch ▪ Blisters in severe cases	▪ Call 911 ▪ Do not rub the area ▪ Wrap in soft cloth ▪ If help is delayed, immerse in warm, not hot, water
Trench Foot	▪ Tingling, itching or burning sensation ▪ Blisters	▪ Soak feet in warm water, then wrap with dry cloth bandages ▪ Drink a warm sugary drink

APPENDIX C

HEAT STRESS GUIDELINES

HEAT STRESS GUIDELINES			
Form	**Signs & Symptoms**	**Care**	**Prevention[3]**
Heat Rash	Tiny red vesicles in affected skin area. If the area is extensive, sweating can be impaired.	Apply mild lotions and cleanse the affected area.	Cool resting and sleeping areas to permit skin to dry between heat exposures
Heat Cramps	Spasm, muscular pain (cramps) in stomach area and extremities (arms and legs).	Provide replacement fluids with minerals (salt) such as Gatorade.	Adequate salt intake with meals[1] ACCLIMATIZATION[2]
Heat Exhaustion	Profuse sweating, cool (clammy) moist skin, dizziness, confusion, pale skin color, faint, rapid shallow breathing, headache, weakness, muscle cramps.	Remove from heat, sit or lie down, rest, replace lost water with electrolyte replacement fluids (water, Gatorade) take frequent sips of liquids in amounts greater than required to satisfy thirst.	ACCLIMATIZATION[2] Adequate salt intake with meals 1 only during early part of heat season. Ample water intake, frequently during the day
Heat Stroke	HOT Dry Skin. Sweating has stopped. Mental confusion, dizziness, nausea, severe headache, collapse, delirium, coma.	HEAT STROKE IS A MEDICAL EMERGENCY - Remove from heat. - COOL THE BODY AS RAPIDLY AS POSSIBLE by immersing in cold (or cool) water, or splash with water and fan. Call for Emergency Assistance. Observe for signs of shock.	ACCLIMATIZATION[2] Initially moderate workload in heat (8 to 14 days). Monitor worker's activities.

Footnotes:

1) American diets are normally high in salt, sufficient to aid acclimatization. However, during the early part of the heat season, (May, June), one extra shake of salt during one to two meals per day may help, so long as this is permitted by your physician. Check with your personal physician.

2) ACCLIMATIZATION - The process of adapting to heat is indicated by worker's ability to perform hot jobs less fluid loss, lower concentrations of salt loss in sweat, and a reduced core (body) temperature and heart rate.

3) Method to Achieve Acclimatization - Moderate work or exercise in hot temperatures during early part of heat season. Adequate salt (mineral) and water intake. Gradually increasing work time in hot temperatures. Avoid alcohol. Normally takes 8 to 14 days to achieve acclimatization. Lost rapidly, if removed from strenuous work (or exercise) in hot temperature for more than approximately five days.

APPENDIX D

SAFETY DATA SHEET (SDS)

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations

SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**ALCONOX®**	
CHEMICAL FAMILY NAME:	Detergent.	
PRODUCT USE:	Critical-cleaning detergent for laboratory, healthcare and industrial applications	
U.N. NUMBER:	Not Applicable	
U.N. DANGEROUS GOODS CLASS:	Non-Regulated Material	
SUPPLIER/MANUFACTURER'S NAME:	Alconox, Inc.	
ADDRESS:	30 Glenn St., Suite 309, White Plains, NY 10603. USA	
EMERGENCY PHONE:	**TOLL-FREE in USA/Canada**	800-255-3924
	International calls	813-248-0585
BUSINESS PHONE:	914-948-4040	
DATE OF PREPARATION:	May 2011	
DATE OF LAST REVISION:	February 2008	

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS

EUROPEAN and (GHS) Hazard Symbols

Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1
EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC
EC# 207-638-8 Index# 011-005-00-2
EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

<u>GHS Hazard Classification(s):</u>
Eye Irritant Category 2A

<u>Hazard Statement(s):</u>
H319: Causes serious eye irritation

<u>Precautionary Statement(s):</u>
P260: Do not breath dust/fume/gas/mist/vapors/spray
P264: Wash hands thoroughly after handling
P271: Use only in well ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):
[Xi] Irritant

Risk Phrases:
R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:
S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS: ACUTE: Eye, respiratory System, Skin CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard *JIS Z 7250: 2000*.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing dificulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

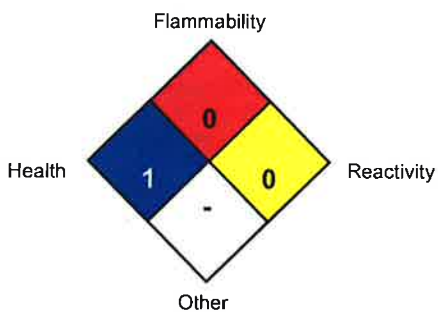
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT:	Not Flammable
AUTOIGNITION TEMPERATURE:	Not Applicable
FLAMMABLE LIMITS (in air by volume, %):	Lower (LEL): NA Upper (UEL): NA
FIRE EXTINGUISHING MATERIALS:	As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	This product is non-flammable and has no known explosion hazards.
Explosion Sensitivity to Mechanical Impact:	Not Sensitive.
Explosion Sensitivity to Static Discharge:	Not Sensitive
SPECIAL FIRE-FIGHTING PROCEDURES:	Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD (BLUE)			1
FLAMMABILITY HAZARD (RED)			0
PHYSICAL HAZARD (YELLOW)			0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8

For Routine Industrial Use and Handling Applications

Hazard Scale: 0 = Minimal **1** = Slight **2** = Moderate **3** = Serious **4** = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.

SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

MATERIAL SAFETY DATA SHEET

ALCONOX®

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m³	5 mg/m³	5 mg/m³
Sodium Carbonate	497-19-8	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m³ Total Dust	15 mg/m³ Total Dust	10 mg/m³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable
DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)
MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.
IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.
SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.
REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.
ENVIRONMENTAL STABILITY: No Data available at this time.
EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:
THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.
PROPER SHIPPING NAME: Non-Regulated Material
HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable
UN IDENTIFICATION NUMBER: Not Applicable
PACKING GROUP: Not Applicable.
DOT LABEL(S) REQUIRED: Not Applicable
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable
MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:
This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.
TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:
This product is not classified as Dangerous Goods, per regulations of Transport Canada.
INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):
This product is not classified as Dangerous Goods, by rules of IATA:
INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:
This product is not classified as Dangerous Goods by the International Maritime Organization.
EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health:	Yes	Chronic Health:	No	Fire:	No	Reactivity:	No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory if Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftliste List of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett   Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

APPENDIX E

INCIDENT REPORT FORM

Safety Briefing Log

GEI Consultants

Project Number:	**Project Name:**
Date:	**Time:**
Briefing Conducted by:	**Signature:**

This sign-in log documents the tailgate briefing conducted in accordance with the HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing.

TOPICS COVERED (check all those covered):

☐ General PPE Usage	☐ Confined Space	☐ Excavation Safety
☐ Hearing Conservation	☐ Slips, Trips, Falls	☐ Confined Space
☐ Respiratory Protection	☐ Heat Stress	☐ Traffic Safety
☐ Personal Hygiene	☐ Cold Stresses	☐ Changes to the HASP
☐ Exposure Guidelines	☐ Site Control	☐ Initial Review of Hazard Evaluation
☐ Decon Procedures	☐ Work Zones	☐ Other (Specify):
☐ Emergency Procedures (include route to hospital)	☐ Lockout/Tagout	☐ Other (Specify):

Personnel Sign-in List

Printed Name	Signature	Company Name

Project Safety Briefing Form

Project Number:	**Project Name:**	
Date:	**Time:**	**Project Manager:**
Briefing Conducted by:		**Signature:**

This sign-in log documents the project specific-briefing conducted in accordance with the HASP and GEI H&S policy. GEI personnel who perform work on site are required to attend the Project briefing and to acknowledge it's receipt. Applicable health and safety SOPs are also required to be reviewed in this briefing and attached as an appendix to the HASP. Prior to the start of the project **or upon the start of a new on-site project team member**, this form must be completed. Please email this completed form to Health&SafetyCommittee@geiconsultants.com.

TOPICS COVERED (check all those covered):

☐	General PPE Usage	☐	Excavation Safety	☐	SOP:
☐	Hearing Conservation	☐	Confined Space	☐	SOP:
☐	Respiratory Protection	☐	Traffic Safety	☐	SOP:
☐	Personal Hygiene	☐	Changes to the HASP	☐	SOP:
☐	Exposure Guidelines	☐	Site Control	☐	SOP:
☐	Decon Procedures	☐	Work Zones	☐	SOP:
☐	Emergency Procedures (include route to hospital)	☐	Lockout/Tagout	☐	SOP:
		☐	Review of Hazard Evaluation	☐	SOP:
☐	Confined Space			☐	SOP:
☐	Slips, Trips, Falls	☐	Other (Specify):	☐	SOP:
☐	Heat Stress	☐	Other (Specify):	☐	SOP:
☐	Cold Stress	☐	Other (Specify):	☐	SOP:

Personnel Sign-in List

Printed Name	**Signature**

GEI Consultants

Accident/Incident Report Form

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

SECTION A — ACCIDENT/INCIDENT DETAILS

EMPLOYEE INFORMATION:	OTHER INJURED (IF APPLICABLE):
Name: ______	**Name:** ______
Home Address: ______ Street Address / City / State / Zip Code	**Home Address:** ______ Street Address / City / State / Zip Code
Contact Information: ( ) ______ ( ) ______ Primary / Secondary	**Contact Information:** ( ) ______ ( ) ______ Primary / Secondary
Date of Birth: ______	**Date of Birth:** ______
Date of Hire: ______	**Date of Hire:** ______
Branch: ______	**Branch:** ______
Supervisor: ______	**Supervisor:** ______

Date and Time Accident/Incident	Date and Time Reported	LOCATION OF INCIDENT/ACCIDENT
______ /______ /______ Month Day Year	______ /______ /______ Month Day Year	**Project Name:** ______ **Client and Location:** ______ **or** ______
______ A.M. ______ P.M.	______ A.M. ______ P.M.	**Office Location:** ______

INCIDENT TYPE: (Check All That Applies)	WITNESS INFORMATION
☐ **Personal Injury/Illness** ☐ **Vehicle Accident** ☐ **Property Damage** ☐ **Environmental Spill** ☐ **Other**	**Name:** ______ **Contact Number:** ______ **Company:** ______

WHAT HAPPENED TO THE INJURED PARTY: ☐First Aid Administered ☐Refused Treatment/Transport ☐Transported to Hospital ☐Returned to Work ☐ Went Home ☐ Went to Physician ☐ Unknown

Clinic/Hospital or Treating Physician: ______ Phone: ______

Name / Street Address / City / State / Zip Code

SECTION B — PERSONAL INJURY

Cause of Injury: ______

Part of Body Injured: ______ Multiple Injuries: ☐Y ☐N

Was PPE worn when injured? : ☐Y ☐N What PPE was worn? ______

WAS INJURY A RESULT OF THE USE A MOTOR VEHICLE: ☐ **YES** ☐ **NO** **(If yes, complete Section C)**

Please complete this form and send it to your Branch Manager, HR and CHSO ***within 24 hours*** of the incident.

Accident/Incident Report Form

SECTION C — AUTO ACCIDENT ONLY

DRIVER/VEHICLE INFORMATION

Name of Insured: ______________________

Department: ______________________

Driver's License Number: ______________________

DOB: ____/____/____ State: ______________________

Description of Vehicle: License Plate Number: __________

Make: ________ Model: ________ Year:_____ Color:________

Owner: ______________________

Name of Other Driver: ______________________

Driver's License Number: ______________________

State: ______________________

Description of Vehicle: License Plate Number: __________

Make: ________ Model:______ Year:_____ Color:________

Insurance Carrier: ______________________

Policy Number: ____________Ph. Number:____________

SECTION D — PROPERTY DAMAGE OR CHEMICAL RELEASE ONLY

Type of Damage(s): ______________________

Cause of Damage(s): ______________________

Type of Chemical Released (if known): ______________________

Quantity of Chemical Released: ______________________

Spill Measures Employed: ______________________

SECTION E — NATURE OF ACCIDENT/INCIDENT AND EXTENT OF INJURIES/DAMAGES

(Please give a detailed description of what happened. Attach a sketch or picture if applicable)

I hereby certify that the above information is true and correct to my understanding of this accident/incident.

Employee/Preparer's Name ______________________ **Date and Time** ______________________

NEAR MISS REPORT

A near miss is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee work habits, improper use of equipment, or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential accidents/incidents immediately. Please complete this form as a means to report these near-miss situations. <u>Send a copy of the completed form to the Project Manager, Regional Health and Safety Officer and the Corporate Health and Safety Officer.</u>

Location: _____ Site Name: _____

Date: _____ Time: _____ ☐ a.m. ☐ p.m.

Weather conditions, site operations taking place during near miss. _____

Please check all appropriate conditions:

- ☐ Unsafe Act
- ☐ Unsafe equipment
- ☐ Unsafe Condition
- ☐ Unsafe use of equipment

Description of incident or potential hazard: _____

Employees or sub-contractors involved if applicable._____

Employee Signature ______________________________ Date _____

Print Name _____

NEAR MISS INVESTGATION

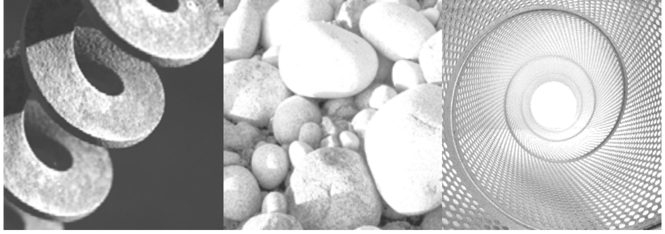
Description of the near-miss condition: _____
Causes (primary & contributing) _____
Corrective action taken (Remove the hazard, replace, repair, or retrain in the proper procedures for the task) _____
Actions not yet taken_____

Signed: ________________________________ Date Completed: _____

Print Name
Not completed for the following reason: ______Date:_____

Appendix E

Quality Assurance Project Plan



GEI Consultants

Consulting
Engineers and
Scientists

Quality Assurance Project Plan

Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and
C203092 (South)

Submitted to:
New York State Department of Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7020

Submitted by:
GEI Consultants, Inc., P. C.
110 Walt Whitman Road, Suite 204
Huntington Station, NY 11746
631-760-9300

September 2017
Project: 1700655

Thomas Johansen, Project Geologist

Nicholas J. Recchia, P.G., Project Manager/Hydrogeologist

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Abbreviations and Acronyms

ASP	Analytical Service Protocol
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Protocol
COC	Chain-of-Custody
DER	Division of Environmental Remediation
DQO	Data Quality Objective
DO	Dissolved Oxygen
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
EPA	United States Environmental Protection Agency
FSP	Field Sampling Plan
GEI	GEI Consultants, Inc.
LCS	Labortory Control Sample
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NTU	Nephelometric Turbidity Unit
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation Reductioin Potential
PACE	Pace Analytical Services
PAH	Polycyclic Aromatic Hydrocarbon
PID	Photoionization Detector
PM	Project Manager
PQL	Practical Quantification Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation Recovery Act
RIWP	Remedial Investigation Work Plan
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SD	Standard Deviation
SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCL+30	Target Compound List Plus 30
USDOT	United States Department of Transporation
VOC	Volatile Organic Compound

Quality Assurance Glossary

"Alteration" means altering a sample collected for analysis in any way other than by adding a preservative, such as nitric acid to lower pH. Examples of alteration include, but are not limited to: filtering, settling and decanting, centrifuging and decanting, and acid extracting.

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

"Correlation Sample" means a sample taken, when using a field-testing technology, to be analyzed by an Environmental Laboratory Accreditation Program (ELAP)-certified laboratory to determine the correlation between the laboratory and field analytical results.

"Confirmatory Sample" means a sample taken after remedial action is expected to be complete to verify that the cleanup requirements have been met. This term has the same meaning as "post remediation sample."

"Contract laboratory program" or "CLP" means a program of chemical analytical services developed by the EPA to support the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

"Data Usability Summary Report, (DUSR)" is a document that provides a thorough evaluation of the analytical data to determine whether the data, as presented, meets the site/project specific criteria for data quality and use.

"Effective solubility" means the theoretical aqueous solubility of an organic constituent in groundwater that is in chemical equilibrium with a separate phase mixed product (product containing several organic chemicals). The effective solubility of a particular organic chemical can be estimated by multiplying its mole fraction in the product mixture by its pure phase solubility.

"Environmental Laboratory Accreditation Program" or "ELAP" means a program conducted by the New York State Department of Health (NYSDOH), which certifies environmental laboratories through onsite inspections and evaluation of principles of credentials and proficiency testing.

"Filtration" means the filtering of a groundwater or surface water sample, collected for metals analysis, at the time of collection and prior to preservation. Filtering includes, but is not limited to, the use of any membrane, fabric, paper or other filter medium, irrespective of pore size, to remove particulates from suspension.

"**Final delineation sample**" means a sample taken as an endpoint sample, used to make a decision regarding the extent of contamination at a site, which is to be analyzed by an ELAP-certified laboratory.

"Intermediate Sample" means a sample taken during the investigation process that will be followed by another sampling event to confirm that remediation was successful or to confirm that the extent of contamination has been defined to below a level of concern.

"Method detection limit" or "MDL" means the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a given matrix containing the analyte.

"Minimum reporting limit" means the lowest concentration at which an analyte can be detected and which can be reported with a reasonable degree of accuracy. It is the lowest concentration that can be measured, a lab-specific number, developed from minimum detection limits, and is also referred to as the practical quantitation limit (PQL).

"Nephelometric Turbidity Unit" or "NTU" is the unit by which turbidity in a sample is measured.

"Non-targeted compound" means a compound detected in a sample using a specific analytical method that is not a targeted compound, a surrogate compound, a system monitoring compound, or an internal standard compound.

"Practical quantitation level" or "PQL" means the lowest quantitation level of a given analyte that can be reliably achieved among laboratories within the specified limits of precision and accuracy of a given analytical method during routine laboratory operating conditions.

"Preservation" means preventing the degradation of a sample due to precipitation, biological action, or other physical/chemical processes between the time of sample collection and analysis. The most common examples involve refrigeration at 4 degrees Celsius and lowering sample pH by the addition of acid to keep dissolved metals in solution or to reduce the biodegradation of dissolved organic analytes.

"PAH" means polycyclic aromatic hydrocarbon as defined by USEPA Method 8270.

"Quality assurance" or "QA" means the total integrated program for assuring the reliability of monitoring and measurement data, which includes a system for integrating the quality planning, quality assessment, and quality improvement efforts to meet data end-use requirements.

"Quality assurance project plan" or "QAPP" means a document, which presents in specific terms the policies, organization, objectives, functional activities, and specific quality assurance/quality control activities designed to achieve the data quality goals or objectives of a specific project or operation.

"Quality control" or "QC" means the routine application of procedures for attaining prescribed standards of performance in the monitoring and measurement process.

"Semi-volatile organic compound" or "SVOC" means compounds amenable to analysis by extraction of the sample with an organic solvent. For the purposes of this section, semi-volatiles are those target compound list compounds identified in the statement of work in the current version of the EPA Contract Laboratory Program.

"Target analyte list" or "TAL" means the list of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis. For the purpose of this Project Plan, a Target Analyte List scan means the analysis of a sample for Target Analyte List compounds/ elements.

"Targeted compound" means a hazardous substance, hazardous waste, or pollutant for which a specific analytical method is designed to detect that potential contaminant both qualitatively and quantitatively.

"Target compound list plus 30" or "TCL+30" means the list of organic compounds designated for analysis (TCL) as contained in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis, and up to 30 non-targeted organic compounds (plus 30) as detected by gas chromatography/mass spectroscopy (GC/MS) analysis. For the purposes of this Project Plan, a Target Compound

List+30 scan means the analysis of a sample for Target Compound List compounds and up to 10 non-targeted volatile organic compounds and up to 20 non-targeted semi-volatile organic compounds using GC/MS analytical methods. Non-targeted compound criteria should be pursuant to the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"Tentatively identified compound or TIC" means a chemical compound that is not on the target compound list but is detected in a sample analyzed by a GC/MS analytical method. TICs are only possible with methods using mass spectrometry as the detection technique. The compound is tentatively identified using a mass spectral instrumental electronic library search and the concentration of the compound estimated.

"Unknown compound" means a non-targeted compound which cannot be tentatively identified. Based on the analytical method used, the estimated concentration of the unknown compound may or may not be determined.

"Volatile organic compounds" or "VOC" means organic compounds amenable to analysis by the purge and trap technique. For the purposes of this Project Plan, analysis of volatile organics means the analysis of a sample for either those priority pollutants listed as amenable for analysis using EPA method 624 or those target compounds identified as volatiles in the version of the EPA "Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration" in effect as of the date on which the laboratory is performing the analysis.

"**Waste oil"** means used and/or reprocessed engine lubricating oil and/or any other used oil, including but not limited to: fuel oil, engine oil, gear oil, cutting oil, transmission fluid, oil storage tank residue, animal oil, and vegetable oil, which has not subsequently been refined.

"Well development" means the application of energy to a newly installed well to establish a good hydraulic connection between the well and the surrounding formation. During development, fine-grained formation material that may have infiltrated the sand pack and/or well during installation is removed, allowing water from the formation to enter the well without becoming turbid and unrepresentative of groundwater in the formation.

1. Purpose

GEI Consultants, Inc., P.C. (GEI) has prepared this Quality Assurance Project Plan (QAPP) to address analytical sampling at Concourse Village West Apartments, Bronx, New York NYSDEC BCP Site No. C203291 (North) and C203092 (South) (the site). The QAPP is a companion document and attachment to the *Remedial Investigation Work Plan (RIWP).* The QAPP presents the project scope and goals, organization, objectives, sample handling procedures and Quality Assurance Quality Control (QA/QC) procedures associated with the site.

Furthermore, this QAPP identifies project responsibilities, prescribes guidance and specifications to make certain that:

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

The requirements of this QAPP apply to all contractor activities as appropriate for their respective tasks.

This QAPP was prepared based upon guidance provided by the United States Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) including:

- *Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation.* New York State Department of Environmental Conservation. *May 3, 2010.*
- *Analytical Service Protocol*, New York State Department of Environmental Conservation. *July 2005.*
- *US EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5, March 2001).*
- *Guidance for Quality Assurance Project Plans (EPA QA/G-5, December 2002).*

2. Project Goals and Objectives

An RIWP has been developed to develop a remedial analysis for onsite petroleum volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals impacts. The RIWP program will include:

- Soil borings
- Soil vapor probes
- Groundwater monitoring well installations
- Soil field screening
- Soil analytical sampling
- Soil vapor sampling
- Groundwater analytical sampling

3. Project Organization and Responsibility

GEI is responsible for the implementation of the scope of work associated with the RIWP, including the supervision of contractors, field activities, and the evaluation and interpretation of data. GEI will perform the sampling activities and coordinate submittal of samples to testing laboratories. The project organization and key personnel for GEI are listed below:

In-House Consultant: Errol S. Kitt
Program Manager: Nicholas J. Recchia
Field Team Leader: Thomas Johansen
Quality Assurance Officer: Jaimie Wargo
GEI Corporate Health & Safety Officer: Steve Hawkins, CSP
Data Manager: Brian Skelly

The primary responsibilities of each of these personnel are described in the following table.

Key Project Personnel and Responsibilities		
Position	**GEI Personnel**	**Areas of Responsibilities**
In-House Consultant	Errol S. Kitt	▪ Provide strategic guidance of project activities ▪ Client contact regarding strategic issues ▪ Review of project deliverables
Program Manager	Nicholas J. Recchia	▪ Overall program oversight ▪ Project management ▪ Project schedule ▪ Client contact regarding project related issues ▪ Personnel and resource management ▪ Review of project submittals ▪ Budgeting
Project Manager	Nicholas J. Recchia	▪ Client contact regarding project related issues ▪ Coordination of contractors ▪ Technical development and implementation of RIWP and related documents ▪ Personnel and resource management ▪ Preparation and review of project submittals ▪ Budgeting
Field Team Leader	Thomas Johansen	▪ Client contact regarding project related issues on day to day basis as part of field operations ▪ Coordination of contractors ▪ Implementation of RIWP and Field Sampling ▪ Plan personnel and resource management ▪ Preparation of project submittals

Quality Assurance Officer	Jaimie Wargo	▪ QA/QC for sampling and laboratory performance
Data Manager	Brian Skelly	▪ Manage raw data from the laboratory ▪ Maintain copies of COCs in the project file

Pace Analytical Services (Pace), located in Melville, New York, has been selected to perform the following standard analytical chemistry parameters for soil, soil vapor, and groundwater samples including:

- Volatile Organic Compounds (VOCs) per EPA Method 8260
- Semi-Volatile Organic Compounds (SVOCs) per EPA Method 8270
- Target Analyte List (TAL) Metals per EPA Method 6010B/7470A/7471B
- VOCs in air using EPA Method TO15

Pace's relevant certifications are summarized in the following table.

Pace Analytical Services Certifications		
Location	Responsible Agency	Certification
New York	New York State Department of Health	Environmental Laboratory Approval Program (ELAP) for potable water/non-potable water, solid and hazardous waste Contract Laboratory Protocol (CLP)
	New York State Department of Environmental Conservation	July 2005 Analytical Service Protocol (ASP)
United States	United States Environmental Protection Agency	CLP-Lab: 10478 [VOCs/SVOCs/Inorganics/Pesticides/ PCBs/Herbicides]

Table 1 provides a summary of soil analyses, **Table 2** provides a summary of soil vapor analyses, **Table 3** provides a summary of groundwater analyses, and **Table 4** provides a summary of quality assurance samples, holding times, and analysis for each media.

4. Quality Assurance Objectives

This section establishes the QA objectives for measurements that are critical to the project. The QA objectives are developed for relevant data quality indicators. These indicators include the method detection limit (MDL), reporting limit (RL), precision, accuracy, completeness, representativeness, and comparability. The data quality objectives (DQOs) are based on project requirements and ensure: (1) that the data generated during the project are of known quality and (2) that the quality is acceptable to achieve the project's technical objectives.

Quantitation Limits are laboratory-specific and reflect those values achievable by the laboratory performing the analyses. However, to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy, precision, and completeness. The analytical methods to be used at this site will provide a level of data quality and can be used to evaluate potential impacts to soil, soil vapor, and groundwater compared to New York State Standards, Criteria and Guidance values, and for purposes of risk assessment.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs. Specific procedures for sampling, chain of custody, laboratory instruments calibration, laboratory analysis, reporting of data, internal quality control, and corrective action are described in other sections of the QAPP.

The data quality indicators are presented in subsections 4.1 through 4.6. Procedures to assess the data quality indicators are given below in Section 13.

Table 5, **Table 6,** and **Table 7** provide the RLs, MDLs and the DQO's for soil, soil vapor, and groundwater samples, respectively. The DQO's for soil samples for this project include minimum RLs specified within the 2005 NYSDEC Analytical Service Protocol (ASP), as well as unrestricted use criteria listed in 6 New York Codes, Rules and Regulations (NYCRR) Part 375. The DQO's for soil vapor samples for this project include minimum RLs specified within the 2005 NYSDEC ASP PER PACE. The DQO's for groundwater samples for this project include minimum RLs specified within the 2005 NYSDEC ASP, as well as GA groundwater criteria listed in the Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.

4.1 Required Quantification Limit

The required quantification limit is the quantitative analytical level for individual analytes needed to make decisions relative to the objectives of the project. Quantitative limits may be expressed as the MDL or some quantitative level defined in terms relative to the program. It should be noted that there is some ambiguity in the definitions and use of terms that define quantification limits. The MDL presented herein is a well-defined and accepted entity, although attainable only under ideal laboratory conditions.

Method Detection Limit: The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDL is determined from analysis of a sample in a given matrix type containing the analyte.

Practical Quantitation Limit: The practical quantitation limit (PQL) (also referred to as the reporting limit [RL]) is the concentration in the sample that corresponds to the lowest concentration standard of the calibration curve.

Tables 8, Table 9, and **Table 10** provide the reporting limits and the DQO's for soil, soil vapor, and groundwater samples, respectively.

4.2 Accuracy

Accuracy is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being used (e.g., sample liners, drilling shoe, or stainless–steel sampling implements).

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of "standards," materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses, or %R of spiked compounds in matrix spikes (MS), matrix spike duplicates (MSD) and/or laboratory control samples (LCS). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds.

4.3 Precision

Precision is the agreement among a set of replicate measurements without consideration of the "true" or accurate value: i.e., variability between measurements of the same material for the same analyte. In environmental sampling, precision is the result of field sampling and analytical factors. Precision in the laboratory is easier to measure and control than precision in the field. Replicate laboratory analyses of the same sample provide information on analytical precision; replicate field samples provide data on overall measurement precision. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation. The difference between the overall measurement precision and the analytical precision is attributed to sampling precision.

Precision in the field is assessed through the collection and measurement of field duplicates. Field duplicates will be collected at a frequency of one per twenty investigative samples per matrix per analytical parameter, except for the waste characterization parameters. Precision will be measured through the calculation of relative percent differences (RPD) as described in subsection 13.2. The resulting information will be used to assess sampling and analytical variability. Duplicate samples are described below in subsection 5.1.3. **Table 4** summarizes the number of duplicates per media sampled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples and field duplicates. For the inorganic analyses, laboratory precision will be assessed through the analysis of matrix duplicate pairs and field duplicate pairs. MS/MSD samples or matrix duplicate pairs will be performed at a frequency of one per twenty primary samples per matrix. Duplicate samples are described in subsection 5.1.3. **Table 4** summarizes the number of duplicates per media sampled.

4.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned. The objective for completeness is a sufficient amount of valid data to achieve a predetermined statistical level of confidence. Critical samples must be identified and plans must be formulated to secure requisite valid data for these samples.

Field completeness is a measure of the amount of 1) valid measurements obtained from all the measurements taken in the project and 2) valid samples collected. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

To ensure that these percentages are met, materials for crucial parameters will be retained if re-sampling is required and strict adherence to holding times will be required.

4.5 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that any future work plans are followed and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times.

4.6 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the RIWP is followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized EPA or equivalent analytical methods and the reporting of data in standardized units. To facilitate data comparison, the data-reporting format as presented below will be used:

- Conventions (units reported as): for solids (weight/unit weight [i.e., mg/kg]); for liquids (weight/unit volume [i.e., μg/L]); for air (weight/unit volume [i.e., μg/m3]).
- Use common chemical name with corresponding chemical abstracts service (CAS) code.
- Report all data for soils on a dry-weight basis.

5. Sampling Plan

Environmental sampling will include subsurface soil, soil vapor, groundwater, and waste characterization sampling. Direct push drilling (Geoprobe®) will be the preferred method for obtaining subsurface soil samples and soil vapor probes. Soil vapor samples will be collected by the direct-push drilling method. Groundwater samples will be collected utilizing low-flow sampling methods, peristaltic pumps, bailers, whale pumps, or bladder pumps. Performing grab or composite sampling by appropriate hand-held sampling equipment will be the preferred method for waste characterization sampling. Sampling methods and procedures are presented in Appendix C of the RIWP.

5.1 Sample Type, Location, and Frequency

5.1.1 Subsurface Soil Samples

Subsurface soil samples will be collected using the Geoprobe® drilling method. The depth, location and number of soil borings will be specified in a job specific Work Plan. Soil samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and Field Sampling Plan (FSP). A summary of typical subsurface soil sample naming analysis is located in Table **1**.

5.1.2 Soil Vapor Samples

Soil vapor samples will be collected and submitted for laboratory analysis in general accordance with the RIWP. Soil vapor samples will be collected and submitted for laboratory analysis in general accordance with the RIWP and FSP. A summary of soil vapor samples and analysis as depicted in Table **2**.

5.1.3 Groundwater Samples

Groundwater samples will be collected and submitted for laboratory analysis in general accordance with the RIWP. Water quality parameters including temperature, pH, turbidity, salinity, dissolved oxygen (DO), oxidation reduction potential (ORP), and specific conductance, will be collected prior to laboratory analysis. A summary of groundwater samples and analysis is depicted in Table **3**.

5.1.4 Field QC Sample Collection

Field QC samples are used to monitor the reproducibility and representativeness of field sampling activities. The field QC samples are handled, transported and analyzed in the same manner as the associated field samples. Field QC samples will include equipment blanks, trip blanks, field duplicates and MS/MSDs. The quantity, field QC sample type and analysis is detailed in Table **4**.

Equipment Blank Samples are used to monitor the adequacy of decontamination procedures and possible sources of contamination such as potential laboratory methodologies. Equipment blanks will consist of laboratory-supplied, distilled or de-ionized water and will be used to check for potential contamination of the equipment which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through a decontaminated piece of sampling equipment or disposable sampling equipment into laboratory supplied bottles. Non-dedicated field equipment will be decontaminated as specified below in subsection 5.3. Equipment blanks will be submitted to the laboratory at a frequency of one per twenty samples per matrix per type of equipment being used per parameter. Equipment blanks will not be completed for waste characterization sampling activities.

Trip Blank Samples will consist of analyte free water and will be prepared by the laboratory. Trip blanks are used to assess the potential for VOC contamination of samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the project location unopened, stored with the site characterization samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler which contains samples submitted for VOC analysis.

Field Duplicate Samples, also referred to as blind duplicate samples, are two samples that are submitted from the same interval using the same sample procedures. Field duplicates will be used to assess the sampling and analytical reproducibility. Both samples are collected utilizing the same methods and are submitted for the same laboratory analysis however different sample identification numbers are used. Field duplicates will be submitted at a frequency of one per twenty samples for all matrices and all parameters. Field duplicates will not be completed for waste characterization sampling activities.

MS/MSD Samples are two additional aliquots of the same sample submitted for the same parameters as the original sample. However, the additional aliquots are spiked with the compounds of concern. Matrix spikes provide information about the effect of the sample matrix on the measurement methodology. MS/MSDs will be submitted at a frequency of one per twenty investigative samples per matrix for organic and inorganic parameters. MS/MSDs will not be completed for waste characterization sampling activities.

Refer to **Table 4** for a summary of QC sample preservation and container requirements.

5.2 Sample Preservation and Containerization

The analytical laboratory will supply the sample containers for the chemical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest EPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to EPA specifications. The containers will be pre-preserved, where appropriate. Sample preservation and containerization details are outlined in Table **4**.

5.3 Equipment Decontamination

All non-dedicated sampling equipment shall be cleaned between each use in the following manner:

- Wash/scrub with a biodegradable degreaser ("Simple Green") if there is oily residue on equipment surface.
- Tap water rinse.
- Wash and scrub with Alconox (or non-phosphate soap) and water mixture.
- Tap water rinse.
- Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

The drilling equipment will be decontaminated by steam cleaning or equivalent.

Decontamination fluids will be containerized into United States Department of Transportation (USDOT)/UN-approved 55-gallon drums or containment vessels and will be characterized and disposed of by an approved disposal facility.

6. Documentation and COC

6.1 Sample Collection Documentation

6.1.1 Field Notes

Field notes documenting field activities will be maintained in a field notebook in general accordance with the FSP. Field logbooks will provide the means of recording the chronology of data collection activities performed during the investigation. The logbook will be a bound notebook with water-resistant pages. Logbook entries will be dated, legible, and contain accurate and inclusive documentation of the activity. No erasures or obliterations of field notes will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, which is signed and dated by the sampler. The correction shall be written adjacent to the error.

Field logbooks will be reviewed at regular intervals by the field team leader, site manager, and project manager for completeness and representativeness. When necessary, logbooks will be supported by daily activity reports.

6.1.2 Chain-of-Custody Records

Sample custody is discussed in detail below in subsection 6.2. COC records are initiated by the samplers in the field. The field portion of the custody documentation should include:

- The project name
- Signature(s) of sampler (s) responsible for sample custody
- Sample ID number
- Date and time of collection
- Whether the sample is grab or composite
- Names of individuals involved in sampling
- Air bill or other shipping number (if applicable)

On a regular basis (daily or on such a basis that all holding times will be met), samples will be transferred to the custody of the respective laboratories, via third-party commercial carriers or via laboratory courier service. Sample packaging and shipping procedures, and field COC procedures are described below in subsection 6.2.1 of this Plan. Sample receipt and log-in procedures at the laboratory are described below in subsection 6.2.2 of this Plan.

6.1.3 Sample Labeling

Each sample will be labeled with a pre-printed adhesive label using indelible ink. The label should include the date and time of collection, sampler's initials, tests to be performed, preservative (if applicable), and a unique identification. The following identification scheme will be used:

PRIMARY SAMPLES TYPES	QA/QC SAMPLE TYPES
SOIL SAMPLES Boring -ID (SAMPLE DEPTH-FEET) SB-01 (10-15) **SOIL VAPOR SAMPLES** Soil Vapor Point-ID SV-01 **GROUNDWATER SAMPLES** Monitoring Well-ID MW-01S	**FIELD BLANKS** SAMPLE-ID [DATE] SS-FB-033110 **MATRIX SPIKE/DUP** SAMPLE [ID] [DEPTH] [EITHER MS OR MSD] SS-01 (10-15) MS/MSD **TRIP BLANKS** SAMPLE-ID [DATE] TB-033110 **BLIND DUPLICATES** SAMPLE-ID [XX] [DATE] SS-XX-033110

This sample label contains the authoritative information for the sample. Inconsistencies with other documents will be settled in favor of the vial or container label unless otherwise corrected in writing from the field personnel collecting samples or the Data Manager and/or the Project QA Officer.

6.1.4 Sample Handling

Samples will be handled in general accordance with the FSP.

6.2 Sample Custody

The COC provides a record of the custody of any environmental field sample from the time of collection to the delivery to the laboratory. Custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample is under a person's custody if:

- The item is in the actual possession of a person
- The item is in the view of the person after being in actual possession of the person

- The item was in the actual physical possession of the person and is locked up to prevent tampering
- The item is in a designated and identified secure area

6.2.1 Field Custody Procedures

Samples will be collected following the sampling procedures indicated in the FSP. A summary of samples and collection methods are provided above in Section 5 of this QAPP. Documentation of sample collection is described above in subsection 6.1. Sample COC and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory with the COC intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified using sample labels with sample numbers, sampling locations, date/time of collection, and type of analysis. The sample numbering system is presented above in subsection 6.1.3.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions.
- Samples will be accompanied by a completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, and to the laboratory facility.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and provided to the data manager and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the cooler and covered with clear plastic tape after being signed by field personnel.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature

of the laboratory sample custodian on COC document as receiving the samples and signature of sampler as relinquishing samples.

6.2.2 Laboratory Custody Procedures

After accepting custody of the shipping containers, the laboratory will document the receipt of the shipping containers by signing the COC record. The laboratory will:

- Examine the shipping containers to verify that the custody tape is intact;
- Examine all sample containers for damage;
- Determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC records;
- Compare samples received against those listed on the COC;
- Verify that sample holding times have not been exceeded;
- Examine all shipping records for accuracy and completeness;
- Determine sample pH (if applicable) and record on COC forms;
- Sign and date the COC immediately (if shipment is accepted) and attach the air bill;
- Note any problems associated with the coolers and/or samples on the cooler receipt form and notify the laboratory project manager, who will be responsible for contacting the GEI data manager;
- Attach laboratory sample container labels with unique laboratory identification and test; and
- Place the samples in the proper laboratory storage.

Following receipt, samples will be logged in according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field ID provided by field personnel.
- The completed COC, air bills, and any additional documentation will be placed in the project file.

7. Calibration Procedure

7.1 Field Instruments

Field instruments will be calibrated according to the manufacturer's specifications. Air monitoring instruments will be calibrated to a known reference gas standard and ambient air outside the work zone. Calibration will be completed daily. If concentrations of VOCs are encountered above the reference gas standard, the soil screening photoionization detector (PID) may be calibrated or re-checked against the reference gas standard. Water quality meters will be calibrated with known reference solutions. All calibration procedures performed will be documented in the field logbook and will include the date/time of calibration, name of person performing the calibration, reference standard used, and the readings. The following equipment may be used during sampling activities.

Subsurface Soil Sampling Activities:

- RAE Systems MiniRAE 2000 (PID) with 10.6 eV lamp or equivalent.
- MIE pDR 1200 with cyclone and pump [particulate monitor] or equivalent.

Soil Vapor Sampling Activities:

- RAE Systems MiniRAE 2000 (PID) with 10.6 eV lamp or equivalent.
- MSA LC Pump or SKC 224-PCXR4 (air pump for air purging monitoring) or equivalent.

Groundwater Sampling Activities:

- Horiba U22 or equivalent.

7.2 Laboratory Instruments

Calibration procedures for a specific laboratory instrument will consist of initial calibrations, initial calibration verifications, and/or continuing calibration verification. Detailed descriptions of the calibration procedures for a specific laboratory instrument are included in the laboratory's quality assurance plan, which describe the calibration procedures, their frequency, acceptance criteria, and the conditions that will require recalibration.

The laboratory quality plan for York Analytical Laboratory is located in **Appendix A**.

8. Sample Preparation and Analytical Procedures

Analytical samples will be collected in general accordance with the FSP and as specified in the RIWP. **Table 1, Table 2,** and **Table 3** provide sample collection matrices for soil, soil vapor, and groundwater.

9. Data Reduction, Validation, and Reporting

Appropriate QC measures will be used to ensure the generation of reliable data from sampling and analysis activities. Proper collection and organization of accurate information followed by clear and concise reporting of the data is a primary goal in this project. Complete data packages suitable for data validation to support the generation of a Data Usability Summary Report (DUSR) according to NYSDEC requirements will be provided by the project data validator. Data Management will be performed under the direction of Jaimie Wargo, Senior Technician – Data Management.

9.1 Field Data Evaluation

Measurements and sample collection information will be transcribed directly into the field logbook or onto standardized forms. If errors are made, results will be legibly crossed out, initialed and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Reviews of the field records by the field team leader, site manager, and project manager will ensure that:

- Logbooks and standardized forms have been filled out completely and that the information recorded accurately reflects the activities that were performed.
- Records are legible and in accordance with good record keeping procedures, i.e., entries are signed and dated, data are not obliterated, changes are initialed, dated, and explained.
- Sample collection, handling, preservation, and storage procedures were conducted in accordance with the protocols described in the FSP and Work Plan, and that any deviations were documented and approved by the appropriate personnel.

9.2 Analytical Data Validation

Laboratory deliverables will consist of an original hard copy data package that is in general accordance with NYSDEC ASP Category B data deliverable requirements when validation is requested.

10. Internal Quality Control

Laboratory and field quality internal control checks will be used to ensure the data quality objectives. At a minimum, this will include:

- Matrix spike and/or matrix spike duplicate samples
- Matrix duplicate analyses
- Laboratory control spike samples
- Instrument calibrations
- Instrument tunes for VOC 8260B analyses
- Method and/or instrument blanks
- Surrogate spikes for organic analyses
- Internal standard spikes for VOC 8260B analyses
- Detection limit determination and confirmation by analysis of low-level calibration standard

Field quality control samples, as identified in **Table 4**, will include:

- Equipment blanks as outlined
- Field duplicate samples as outlined
- Trip blanks as outlined
- MS/MSDs as outlined

11. Performance and System Audits

Audits are an independent means of: 1) evaluating the operation or capability of a measurement system, and 2) documenting the use of QC procedures designed to generate data of known and acceptable quality.

Field audits may be completed to assess sample collection protocols, determine the integrity of COC procedures, and evaluate sample documentation and data handling procedures. Field audits may be scheduled by the QA officer, Project Manager (PM), site manager or in-house consultant, at their discretion. Written records of audits and any recommendations for corrective action will be submitted to the PM.

The QA officer is the interface between management and project activities in matters of project quality. The QA officer will review the implementation of the QAPP. Reviews will be conducted at the completion of field activities and will include the results of any audits and an evaluation of the data quality.

12. Preventative Maintenance

Preventative maintenance will be performed on field equipment in accordance with the manufacturer's recommendations. Preventative maintenance to rented field equipment will be provided by equipment vendor, U.S Environmental Rental Corporation, Pine Environmental Services, or other selected vendors.

Laboratory equipment calibration and maintenance procedures are specified in Pace's laboratory quality assurance manual provided in **Appendix A**.

13. Specific Procedures to Assess Data Quality Indicators

QC analyses conducted as a part of the testing program will provide a quantitative quality assessment of the data generated and their adherence to the data quality indicators. The data quality indicators ensure that the quality assurance objectives for the project are met.

13.1 Detection Limits

13.1.1 Method Detection Limit

The MDL is defined as follows for all measurements:

MDL = (t[n-1,1-a=0.99]) x (s)

where: s = standard deviation of the replicate analysis,
t(n-1, 1-a=0.99) = student's t-value for a one-sided, 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom

The MDLs calculated by the laboratory are determined under ideal conditions. MDLs for environmental samples are dependent on the sample aliquot, the matrix, the concentration of analyte, and interference present in the matrix, the percent of moisture, dilution factor, etc. The MDL for each sample analysis will be adjusted accordingly.

13.1.2 *Reporting Limit*

The RL is the concentration of an analyte in the sample that corresponds to the lowest concentration standard of the calibration curve. As with the MDLs, the RLs are dependent on the sample aliquot, the final sample volume, the percent of moisture, dilution factor, etc.

The RL is determined as follows:

$$RL = \frac{Lowest\ conc.\ std\ (ng)}{Volume\ injected\ (uL)}\ x\ \frac{Sample\ aliquot\ (mL\ or\ g)}{Final\ volume\ (mL)}\ x\ DF\ x\ \frac{100}{(100 - \%M)}$$

where: DF = dilution factor, including all dilutions or lost samples not accounted for in a sample aliquot/final volume ratio

%M = percent moisture for solid samples.

13.2 Precision

Variability will be expressed in terms of the RPD when only two data points exist. The RPD is calculated as:

$$RPD = \frac{(Larger\ Value - Smaller\ Value)}{[(Larger\ Value + Smaller\ Value)/2]}\ x\ 100\%$$

For data sets greater than two points, the percent relative standard deviation (percent RSD) is used as the precision measurement. It is defined by the equation:

$$Percent\ RSD = \frac{Standard\ Deviation}{Mean}\ x\ 100\%$$

Standard deviation (SD) is calculated as follows:

$$SD = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n - 1}}$$

where: SD = standard deviation

yi = measured value of the ith replicate

y = mean of replicate measurements

n = number of replicates

For measurements such as pH, where the absolute variation is more appropriate, precision is usually reported as the absolute range (D) of duplicate measurements:

$$D = \left| \text{first measurement - second measurement} \right|$$

or as the absolute standard deviation previously given. RPD, %RSD, and D are independent of the error of the analyses and reflect only the degree to which the measurements agree with each other, not the degree to which they agree with the true value for the parameter measured.

13.3 Accuracy

Accuracy is related to the bias in a measurement system. Accuracy describes the degree of agreement of a measurement with a true value. Accuracy will be expressed as percent recovery for each matrix spike analyte by using the following equation:

$$\%\ Recovery = \frac{Css - Cus}{Csa}\ X\ 100\%$$

where:	Css	=	measured concentration in spiked sample
	Cus	=	measured concentration in unspiked sample
	Csa	=	known concentration added to the sample

Accuracy for a measurement such as pH is expressed as bias in the analysis of a standard reference sample according to the equation:

$$\text{Bias} = pH_m - pH_t$$

where:	pH_m	=	measured pH
	pH_t	=	the true pH of the standard reference sample

13.4 Completeness

Data completeness is a measure of the amount of usable data resulting from a measurement effort. For this program, completeness will be defined as the percentage of valid data obtained compared to the total number of measurements necessary to achieve our required statistical level of confidence for each test. The confidence level is based on the total number of samples.

Data completeness is calculated as:

$$Completeness = \frac{Number\ of\ valid\ data\ points}{Number\ of\ data\ points\ necessary\ for\ confidence\ level}\ x\ 100\%$$

The completeness goal is to generate a sufficient amount of valid data. It is anticipated that 95 percent of the data will be complete. Data validation criteria discussed in Section 9 of this QAPP will be used to determine data completeness. Any data deficiencies and their effect on project goals will be evaluated in the DUSR.

13.5 Representativeness

Representativeness is a qualitative statement that expresses the extent to which the sample accurately and precisely represents the characteristics of interest of the study. Representativeness is primarily concerned with the proper design of the sampling program and is best ensured by proper selection of sampling locations and the taking of a sufficient number of samples. It is addressed by describing the sampling techniques, the matrices sampled, and the rationale for the selection of sampling locations, which are discussed in the FSP and RIWP.

13.6 Comparability

Comparability is a qualitative parameter expressing the confidence that one set of data can be compared to another. Comparability is possible only when standardized sampling and analytical procedures are used.

14. Corrective Action

If unacceptable conditions are identified as a result of audits or are observed during field sampling and analysis, the PM, Field Team Leader, and QA officer will document the condition and initiate corrective procedures. The specific condition or problem will be identified, its cause will be determined, and appropriate action will be implemented.

The entire sampling program will be under the direction of the PM and QA officer. The emphasis in this program is on preventing problems by identifying potential errors, discrepancies, and gaps in the data collection, laboratory analysis, and interpretation process. Any problems identified will be promptly resolved. Likewise, follow-up corrective action is always an option in the event that preventative corrective actions are not effective.

The acceptance limits for the sampling and analyses to be conducted in this program will be those stated in the method or defined by other means in the Work Plan and FSP. Corrective actions are likely to be immediate in nature and most often will be implemented by the contracted laboratory analyst or the PM. The corrective action will usually involve recalculation, reanalysis, or repeating a sample run.

14.1 Immediate Corrective Action

Corrective action in the field may be needed when the sample requirements are changed (i.e., more/less samples, sampling locations other than those specified in the Work Plan), or when sampling procedures and/or field analytical procedures require modification, etc. due to unexpected conditions. The field team may identify the need for corrective action. The Field Team Leader, Site Manager, and PM will approve the corrective action and notify the QA officer. The PM and QA officer will approve the corrective measure. The Field Team Leader and Site Manager will ensure that the corrective measure is implemented by the field team.

Corrective actions will be implemented and documented in the field record book. Documentation will include:

- A description of the circumstances that initiated the corrective action
- The action taken in response
- The final resolution
- Any necessary approvals

Corrective action in the laboratory will be completed in accordance with the quality assurance procedures located in **Appendix A**. Any corrective actions completed by the laboratory will be documented in both the laboratory's corrective action files, and the narrative data report sent from the laboratory to the PM. If the corrective action does not rectify the situation, the laboratory will contact the PM, who will determine the action to be taken and inform the appropriate personnel.

If potential problems are not solved as an immediate corrective action, the contractor will apply formalized long-term corrective action if necessary.

Tables

Table 1. Soil and Sediment Field Sampling Matrix
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Typical Sample I.D.	TYPICAL DEEP SOIL BORING SAMPLE SELECTION RATIONALE: 1. Soil/sediment sample within heaviest observed impacts (if present). 2. Soil/sediment sample beneath zone of deepest impacts. 3. Refer to job specific Work Plan for specific sampling details. TYPICAL SHALLOW SOIL BORING SAMPLE SELECTION RATIONALE: 1. Subsurface soil/sediment sample collected from the two feet immediately below the current site.								Analysis					
	Sample Number								TCL VOCs (EPA Method 8260B)	TAL Metals (EPA Method 6010B/7470A)	TCL SVOCs (EPA Method 8270)	Pesticides (EPA Method 8081)	Herbicides (EPA Method 8151)	PCBs (EPA Method 8082)
	Number Samples Proposed	Number Samples Collected	Date Collected	Within Historic Fill Layer	Heaviest Impacted Zone below 10 feet (if Present)	Water Table Interface	Subsurface soil/sediment below deepest observed visual impacts	Completion depth of boring						
Subsurface Soil														
B-XX	3								X	X	X	X	X	X

Notes:
NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
TCL - Target Compound List
TAL - Target Analyte List
EPA - Environmental Protection Agency
PCBs - Polychlorniated biphenyls
Samples will be analyzed in accordance with the Field Sampling Plan

Table 2. Soil Vapor Field Sampling Matrix
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Typical Sample I.D.	SAMPLE SELECTION RATIONALE: 1. The soil vapor probes will be installed to a depth of six feet below grade, or within the backfill utility trenches.						Analysis	Soil Vapor Quality Measurements
	Sample Number							
	Number Samples Proposed	Number Samples Collected	Date Collected	Sampling Duration	Flow Rate	Soil Vapor Probe Installation Depth(1)	USEPA Method TO-15	Tracer Gas (Helium)
Soil Vapor Sample								
SV-XX	6			2 hours	0.2 L/min	6'	X	X

Notes:
NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
USEPA - United States Environmental Protection Agency
L/m - Liters per minute
(1) – Probes will be installed 15 feet below ground surface

Table 3. Groundwater Field Sampling Matrix
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Sample I.D.	Sample Location	SAMPLE SELECTION RATIONALE: 1. Groundwater Sample locations and depth intervals will be specified within a job specific Work Plan				Water Quality Measurements							Analysis				
		Sample Number			Sample Zone	pH	Specific Conductance	Temperature	Oxidation Reduction Potential	Turbidity	Salinity	Dissolved Oxygen	TCL VOCs (EPA Method 8260B)	TCL SVOCs (EPA Method 8270)	TAL Metals (EPA Method 6010B/7470A)	Pesticides (EPA Method 8081)	PCBs (EPA Method 8082)
		Number Samples Proposed	Number Samples Collected	Date Collected	Water Table												
Monitoring Well Sample Locations																	
MW-XX	TBD	5				X	X	X	X	X	X	X	X	X	X	X	X

Notes:
NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
VOCs - Volatile Organic Compounds
SVOCs - Semi-volatile Organic Compounds
TCL - Target Compound List
TAL - Target Analyte List
EPA - Environmental Protection Agency
PCBs - Polychlorniated biphenyls
Samples will be collected in accordance with the Field Sampling Plan

Table 4. Analytical Methods/Quality Assurance Summary
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Media	Number of Primary Samples	QA/QC Samples				Total Number of Samples	Analytical Parameters	Method	Preservative	Holding Time	Container
		TB	FB[1]	DUP	MS/MSD						
Shallow Subsurface & Deep Soil	TBD	1/Cooler	1/20	1/20	1/20	TBD	TCL VOCs	8260B	Cool to 4°C	5 days unpreserved, 12 days preserved	3-40 mL vials (2 with stir bars) + 2 - 1 oz jars
	TBD	1/Cooler	1/20	1/20	1/20	TBD	TAL Metals	6010B/7471B	Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	Wide mouth 8-oz. clear glass jar
	TBD	1/Cooler	1/20	1/20	1/20	TBD	Pesticides	8081	Cool to 4°C	10 days	2-oz jar
	TBD	1/Cooler	1/20	1/20	1/20	TBD	PCBs	8082	Cool to 4°C	10 days	2-oz jar
	TBD	1/Cooler	1/20	1/20	1/20	TBD	TCL SVOCs	8270C	Cool to 4°C	10 days	2-oz jar
Groundwater	TBD	1/Cooler	1/20	1/20	1/20	TBD	TCL VOCs	8260B	pH<2 with HCl, Cool to 4°C	10 days	(2) 40 mL VOA vials w/HCL
	TBD	1/Cooler	1/20	1/20	1/20	TBD	TCL SVOCs	8270C	Cool to 4°C	5 days	(2) Liter amber glass
	TBD	1/Cooler	1/20	1/20	1/20	TBD	Pesticides	8081	Cool to 4°C	5 days	(2) Liter amber glass
	TBD	1/Cooler	1/20	1/20	1/20	TBD	PCBs	8082	Cool to 4°C	5 days	(2) Liter amber glass
	TBD	1/Cooler	1/20	1/20	1/20	TBD	TAL Metals	6010B7470A	pH<2 with HNO3 Cool to 4°C	28 days to analysis for mercury; 6 months to analysis for other metals	(1) 500 mL Polyethylene container w/HNO3
Soil Vapor	TBD	NA	NA	1/20	NA	TBD	Toxic Organic Compounds	USEPA Method TO-15	None	30 Days	(1) Stainless steel canister

Notes:
NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
QA/QC - Quality Assurance/Quality Control
TB - Trip Blank
FB - Field Blank
DUP - Duplicate
MS/MSD - Matrix Spike/Matrix Spike Duplicate
VOCs - Volatile organic compounds
SVOCs - Semivolatile organic compounds
°C- Degrees Celsius
L - Liter
oz - Ounce
mL - Milliliter
TBD - To be Determined
TAL - Target Analyte List
TCL - Target Compound List
PCBs - Polychlorniated biphenyls
NA - Not Available/Not Analyzed
USEPA - United States Environmental Protection Agency
m/L - Milliliters
VOA - Volatile Organic Analysis

Table 5. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte	DQO's		Pace Analytical	
		ASP 2005	Residential Use [1]		
		CRQL	SCO	RL	MDL
TCL Volatile Organic Compounds (µg/Kg) via Method 8260 B					
71-55-6	1,1,1-Trichloroethane	10	100,000	5	0.389
79-34-5	1,1,2,2-Tetrachloroethane	10	35,000	5	0.591
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	NE	100,000	5	3.9
79-00-5	1,1,2-Trichloroethane	10	NE	5	0.699
75-34-3	1,1-Dichloroethane	10	19,000	5	0.426
75-35-4	1,1-Dichloroethene	10	100,000	5	0.355
87-61-6	1,2,3-Trichlorobenzene	10	NE	5	1.55
120-82-1	1,2,4-Trichlorobenzene	10	NE	5	1.29
96-12-8	1,2-Dibromo-3-chloropropane	100	NE	5	2.06
106-93-4	1,2-Dibromoethane (EDB)	10	NE	5	0.729
95-50-1	1,2-Dichlorobenzene	10	100,000	5	1.2
107-06-2	1,2-Dichloroethane	10	2,300	5	0.845
78-87-5	1,2-Dichloropropane	10	NE	5	1.86
541-73-1	1,3-Dichlorobenzene	10	17,000	5	1.32
106-46-7	1,4-Dichlorobenzene	10	9,800	5	1.22
123-91-1	1,4-Dioxane	NE	9,800	125	22.2
78-93-3	2-Butanone (MEK)	10	100,000	10	1.05
591-78-6	Methyl Butyl Ketone (2-Hexanone)	10	NE	10	0.212
108-10-1	4-Methyl-2-pentanone (MIBK)	10	NE	10	0.617
67-64-1	Acetone	10	100,000	10	1.42
71-43-2	Benzene	10	2,900	5	0.591
74-97-5	Bromochloromethane	10	NE	5	0.743
75-27-4	Bromodichloromethane	10	NE	5	0.412
75-25-2	Bromoform	10	NE	5	0.807
74-83-9	Bromomethane	10	NE	5	0.571
75-15-0	Carbon disulfide	10	100,000	5	0.584
56-23-5	Carbon tetrachloride	10	1,400	5	0.407
108-90-7	Chlorobenzene	10	100,000	5	0.797
75-00-3	Chloroethane	10	NE	5	0.56
67-66-3	Chloroform	10	10,000	5	0.662
74-87-3	Chloromethane	10	NE	5	0.74
156-59-2	cis-1,2-Dichloroethene	10	59,000	5	0.4
10061-01-5	cis-1,3-Dichloropropene	10	NE	5	0.363
110-82-7	Cyclohexane	NE	NE	5	4.45
124-48-1	Dibromochloromethane	10	NE	5	0.831
75-71-8	Dichlorodifluoromethane (FREON 12)	10	NE	5	1.17
100-41-4	Ethylbenzene	10	30,000	5	1.01
98-82-8	Isopropylbenzene	10	NE	5	0.734
79-20-9	Methyl Acetate	NE	NE	5	1.13
1634-04-4	Methyl tert-butyl ether (MTBE)	NE	62,000	5	0.577
108-87-2	Methylcyclohexane	NE	NE	5	1.27
75-09-2	Methylene chloride	10	51,000	5	0.649
100-42-5	Styrene	10	NE	5	0.6
127-18-4	Tetrachloroethene	10	5,500	5	1.92
108-88-3	Toluene	10	100,000	5	0.379
156-60-5	trans-1,2-Dichloroethene	10	100,000	5	0.507
10061-02-6	trans-1,3-Dichloropropene	10	NE	5	0.501
79-01-6	Trichloroethene	10	10,000	5	0.589
75-69-4	Trichlorofluoromethane (FREON 11)	10	NE	5	0.334
75-01-4	Vinyl chloride	10	210	5	0.706
1330-20-7	Total Xylene	10	100,000	5	0.732
TCL Semivolatile Organic Compounds (µg/Kg) via Method 8270					
92-52-4	1,1´-Biphenyl	NE	NE	170	48.6
95-94-3	1,2,4,5-Tetrachlorobenzene	330	NE	170	41.8
52438-91-2	2,2-oxybis[1-Chloropropane]	330	NE	170	41
95-95-4	2,4,5-Trichlorophenol	330	NE	330	60
88-06-2	2,4,6-Trichlorophenol	330	NE	170	52.1
120-83-2	2,4-Dichlorophenol	330	2,000	170	36.7
105-67-9	2,4-Dimethylphenol	330	NE	170	43.2
51-28-5	2,4-Dinitrophenol	800	NE	330	57.6
121-14-2	2,4-Dinitrotoluene	330	NE	170	41.2
606-20-2	2,6-Dinitrotoluene	330	1,030	170	43.2
91-58-7	2-Chloronaphthalene	330	NE	170	42.7
95-57-8	2-Chlorophenol	330	400,000	170	33.7

Table 5. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte	DQO's		Pace Analytical	
		ASP 2005	Residential Use [1]		
		CRQL	SCO	RL	MDL
91-57-6	2-Methylnaphthalene	330	NE	170	42.1
95-48-7	2-Methylphenol (o-Cresol)	330	100,000	170	37.3
88-74-4	2-Nitroaniline	800	NE	330	38.9
88-75-5	2-Nitrophenol	330	NE	170	55.3
91-94-1	3,3-Dichlorobenzidine	660	NE	170	35.5
99-09-2	3-Nitroaniline	800	NE	330	35.1
534-52-1	4,6-Dinitro-2-methylphenol	800	NE	330	53
101-55-3	4-Bromophenyl phenyl ether	330	NE	170	49.5
59-50-7	4-Chloro-3-methylphenol	330	NE	170	46.2
106-47-8	4-Chloroaniline	330	200,000	170	36.8
7005-72-3	4-Chlorophenyl phenyl ether	330	NE	170	45.5
106-44-5	4-Methylphenol (p-Cresol)	330	100,000	170	78.8
100-01-6	4-Nitroaniline	800	NE	330	42.8
100-02-7	4-Nitrophenol	800	NE	330	42.6
83-32-9	Acenaphthene	330	100,000	170	40.2
208-96-8	Acenaphthylene	330	100,000	170	38.8
98-86-2	Acetophenone	330	NE	170	57.7
120-12-7	Anthracene	330	100,000	170	41.8
108-95-2	Atrazine	NE	NE	170	47.8
100-52-7	Benzaldehyde	NE	NE	170	107
56-55-3	Benz[a]anthracene	330	1,000	170	40.8
50-32-8	Benzo[a]pyrene	330	1,000	170	40.5
205-99-2	Benzo[b]fluoranthene	330	1,000	170	34.2
191-24-2	Benzo[g,h,i]perylene	330	100,000	170	34.6
207-08-9	Benzo[k]fluoranthene	330	1,000	170	59.5
111-91-1	Bis(2-chloroethoxy)methane	330	NE	170	44.8
111-44-4	Bis(2-chloroethyl)ether	330	NE	170	38.7
117-81-7	Bis(2-ethylhexyl)phthalate	330	50,000	170	46.9
85-68-7	Butyl benzyl phthalate	330	100,000	170	48.9
105-6--2	Caprolactam	NE	NE	170	41.7
86-74-8	Carbazole	330	NE	170	42.6
218-01-9	Chrysene	330	1,000	170	49.3
84-74-2	Di-n-butyl phthalate	330	100,000	170	38.5
117-84-0	Di-n-octyl phthalate	330	100,000	170	45.6
53-70-3	Dibenz[a,h]anthracene	330	330	170	37.9
132-64-9	Dibenzofuran	330	14,000	170	41.7
84-66-2	Diethyl phthalate	330	100,000	170	38.2
131-11-3	Dimethyl phthalate	330	NE	170	41.5
206-44-0	Fluoranthene	330	100,000	170	29.7
86-73-7	Fluorene	330	100,000	170	41.6
118-74-1	Hexachlorobenzene	330	410	170	41.2
87-68-3	Hexachlorobutadiene	330	NE	170	42.2
77-47-4	Hexachlorocyclopentadiene	330	NE	170	43.3
67-72-1	Hexachloroethane	330	NE	170	41.9
193-39-5	Indeno[1,2,3-cd]pyrene	330	500	170	36.6
78-59-1	Isophorone	330	100,000	170	45.8
621-64-7	N-Nitrosodi-n-propylamine	330	NE	170	29.6
86-30-6	N-Nitrosodiphenylamine	330	NE	170	86.1
91-20-3	Naphthalene	330	100,000	170	41.6
98-95-3	Nitrobenzene	330	3,700	170	32.7
87-86-5	Pentachlorophenol	800	2,400	330	64.6
85-01-8	Phenanthrene	330	100,000	170	42.4
108-95-2	Phenol	330	100,000	170	23.3
129-00-0	Pyrene	330	100,000	170	51.5
Inorganic Analytes (mg/Kg) via Methods 6010 & 7471					
7429-90-5	Aluminum	NE	NE	200	24
7440-36-0	Antimony	60	NE	60	4
7440-38-2	Arsenic	10	16	10	4
7440-39-3	Barium	200	350	200	16
7440-41-7	Beryllium	5	14	5	0.2
7440-43-9	Cadmium	5	2.5	**5**	0.0
7440-70-2	Calcium	NE	NE	5000	27
7440-47-3	Chromium (sum of Cr III and Cr IV)	10	NE	10	8
7440-48-4	Cobalt	50	30	**50**	1
7440-50-8	Copper	25	270	25	3

Table 5. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte	DQO's		Pace Analytical	
		ASP 2005	Residential Use [1]		
		CRQL	SCO	RL	MDL
7439-89-6	Iron	NE	2,000	100	29
7439-92-1	Lead	5	400	3	24
7439-95-4	Magnesium	NE	NE	5000	34
7439-96-5	Manganese	NE	2,000	15	1
7439-97-6	Mercury	0.2	0.8	0.1	0.2
7440-02-0	Nickel	40	140	40	1
7440-09-7	Potassium	NE	NE	5000	176
7782-49-2	Selenium	5	36	5	4
7440-22-4	Silver	10	36	10	0
7440-23-5	Sodium	NE	NE	5000	338
7440-28-0	Thallium	10	NE	10	17
7440-62-2	Vanadium	50	100	50	1
7440-66-6	Zinc	20	2,200	20	2
Pesticides (µg/Kg) via Method 8081					
72-54-8	4,4'-DDD	16	1,800	3.3	0.153
72-55-9	4,4'-DDE	16	1,700	3.3	0.234
50-29-3	4,4'-DDT	16	2,600	3.3	0.237
309-00-2	Aldrin	8	19	1.7	0.408
319-84-6	alpha-BHC	8	97	1.7	0.176
5103-71-9	alpha-Chlordane	NE	910	1.7	0.197
319-85-7	beta-BHC	8	72	1.7	0.918
319-86-8	delta-BHC	8	100,000	1.7	0.176
60-57-1	Dieldrin	16	39	3.3	0.168
959-98-8	Endosulfan I	16	4,800	1.7	0.168
33213-65-9	Endosulfan II	16	4,800	3.3	0.189
1031-07-8	Endosulfan sulfate	16	4,800	3.3	0.226
72-20-8	Endrin	16	2,200	3.3	0.176
7421-93-4	Endrin aldehyde	32	NE	3.3	0.134
53494-70-5	Endrin ketone	NE	NE	3.3	0.386
58-89-9	gamma-BHC (Lindane)	8	280	1.7	0.187
5103-74-2	gamma-Chlordane	NE	540	1.7	0.347
76-44-8	Heptachlor	8	420	1.7	0.201
1024-57-3	Heptachlor epoxide	8	77	1.7	0.108
72-43-5	Methoxychlor	8	100,000	17	0.388
8001-35-2	Toxaphene	160	NE	170	21.2
PCBs (µg/Kg) via Method 8082					
12674-11-2	Aroclor 1016	80	NE	33	4.65
11104-28-2	Aroclor 1221	80	NE	67	
11141-16-5	Aroclor 1232	80	NE	33	
53469-21-9	Aroclor 1242	80	NE	33	
12672-29-6	Aroclor 1248	80	NE	33	
11097-69-1	Aroclor 1254	160	NE	33	
11096-82-5	Aroclor 1260	160	NE	33	15.61

Notes:

NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
CAS - Chemical Abstracts Number
mg/kg - milligrams per kilogram
µg/Kg - micrograms per kilogram
RL - Reporting Limits
MDL - Method Detection Limit
DQO - Data Quality Objectives
NE - Not Established
TCL - Target Compound List
SCO - Site Cleanup Objective
[1] - DQOs are based on 6 NYCRR Part 375 -6.8(b) Residential Use Soil Clean-up Objectives

Table 6. Chemical Parameters, Reporting Limits and Data Quality Objectives for Soil Vapor Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte	RL	MDL
USEPA TO-15 Compounds (ppbv)			
71-55-6	1,1,1-Trichloroethane	0.2	0.018
79-34-5	1,1,2,2-Tetrachloroethane	0.2	0.012
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	0.2	0.012
79-00-5	1,1,2-Trichloroethane	0.2	0.022
75-34-3	1,1-Dichloroethane	0.2	0.015
75-35-4	1,1-Dichloroethene	0.2	0.024
95-63-6	1,2,4-Trichlorobenzene	0.2	0.022
95-63-6	1,2,4-Trimethylbenzene	0.2	0.012
106-93-4	1,2-Dibromoethane	0.2	0.030
95-50-1	1,2-Dichlorobenzene	0.2	0.017
107-06-2	1,2-Dichloroethane	0.2	0.025
156-59-2	1,2-Dichloroethene (cis)	0.2	0.017
540-59-0	1,2-Dichloroethene (total)	0.2	0.031
78-87-5	1,2-Dichloropropane	0.2	0.034
76-14-2	1,2-Dichlorotetrafluoroethane	0.2	0.017
108-67-8	1,3,5-Trimethylbenzene	0.2	0.015
541-73-1	1,3-Dichlorobenzene	0.2	0.010
10061-01-5	1,3-Dichloropropene (cis)	0.2	0.030
10061-02-6	1,3-Dichloropropene (trans)	0.2	0.028
87-68-3	1,3-Hexachlorobutadiene	0.2	0.017
106-46-7	1,4-Dichlorobenzene	0.2	0.012
67-64-1	Acetone	0.2	0.076
71-43-2	Benzene	0.2	0.017
75-27-4	Bromodichloromethane	0.2	0.022
75-25-2	Bromoform	0.2	0.012
74-83-9	Bromomethane	0.2	0.022
75-15-0	Carbon disulfide	0.2	0.017
56-23-5	Carbon tetrachloride	0.2	0.017
108-90-7	Chlorobenzene	0.2	0.024
75-00-3	Chloroethane	0.2	0.034
67-66-3	Chloroform	0.2	0.022
74-87-3	Chloromethane	0.2	0.015
124-48-1	Dibromochloromethane	0.2	0.010
75-71-8	Dichlorodifluoromethane	0.2	0.025
100-41-4	Ethylbenzene	0.2	0.022
591-78-6	Methyl butyl ketone	0.2	0.031
78-93-3	Methyl ethyl ketone	0.2	0.018
108-10-1	Methyl isobutyl ketone	0.2	0.024
1634-04-4	Methyl tert-butyl ether	0.2	0.028
75-09-2	Methylene chloride	0.2	0.036
100-42-5	Styrene	0.2	0.015
127-18-4	Tetrachloroethene	0.2	0.022
108-88-3	Toluene	0.2	0.022
79-01-6	Trichloroethene	0.2	0.030
75-69-4	Trichlorofluoromethane	0.2	0.012
105-05-4	Vinyl acetate	0.2	0.040
75-01-4	Vinyl chloride	0.2	0.026
108-38-3/ 106-42-3	Xylenes (m&p)	0.2	0.012
95-42-3	Xylenes (o)	0.2	0.012
91-20-3	Naphthalene	0.5	0.022

Notes:

NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
CAS - Chemical Abstracts Number
USEPA - United States Environmental Protection Agency
ppbv - parts per billion per volume
RL - Reporting Limits
MDL - Method Detection Limit

Table 7. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte Name	DQO's		Pace Analytical	
		ASP 2005	NY AWQS GA [1]		
		CRQL	H(WS)	RL	MDL
Volatile Organic Compounds Method 8260 B (µg/L)					
71-55-6	1,1,1-Trichloroethane	1	5	5	0.06
79-34-5	1,1,2,2-Tetrachloroethane	1	5	5	0.12
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	NE	5	5	0.78
79-00-5	1,1,2-Trichloroethane	1	1	**5**	0.104
75-34-3	1,1-Dichloroethane	1	5	5	0.07
75-35-4	1,1-Dichloroethene	1	0.07	**5**	0.155
87-61-6	1,2,3-Trichlorobenzene	1	5	5	0.252
120-82-1	1,2,4-Trichlorobenzene	1	5	5	0.296
96-12-8	1,2-Dibromo-3-chloropropane	1	0.04	**5**	0.178
106-93-4	1,2-Dibromoethane (EDB)	1	0.0006	**5**	0.085
95-50-1	1,2-Dichlorobenzene	1	3	**5**	0.114
107-06-2	1,2-Dichloroethane	1	NE	5	0.087
78-87-5	1,2-Dichloropropane	1	1	**5**	0.095
541-73-1	1,3-Dichlorobenzene	1	3	**5**	0.129
106-46-7	1,4-Dichlorobenzene	1	3	**5**	0.113
123-91-1	1,4-Dioxane	NE	NE	125	28.259
78-93-3	2-Butanone (MEK)	5	50*	10	0.77
591-78-6	Methyl Butyl Ketone (2-Hexanone)	5	50*	10	0.439
108-10-1	4-Methyl-2-pentanone (MIBK)	5	NE	10	0.164
67-64-1	Acetone	5	50*	10	0.356
71-43-2	Benzene	1	1	**5**	0.074
74-97-5	Bromochloromethane	1	5	5	0.074
75-27-4	Bromodichloromethane	1	50*	5	0.063
75-25-2	Bromoform	1	50*	5	0.486
74-83-9	Bromomethane	1	5	5	0.216
75-15-0	Carbon disulfide	1	60*	5	0.543
56-23-5	Carbon tetrachloride	1	5	5	0.467
108-90-7	Chlorobenzene	1	5	5	0.034
75-00-3	Chloroethane	1	5	5	0.196
67-66-3	Chloroform	1	7	5	0.111
74-87-3	Chloromethane	1	5	5	0.181
156-59-2	cis-1,2-Dichloroethene	1	5	5	0.149
10061-01-5	cis-1,3-Dichloropropene	1	0.4	**5**	0.105
110-82-7	Cyclohexane	NE	NE	5	0.087
124-48-1	Dibromochloromethane	1	50*	5	0.174
75-71-8	Dichlorodifluoromethane (FREON 12)	1	5	5	0.102
100-41-4	Ethylbenzene	1	5	5	0.132
98-82-8	Isopropylbenzene	1	5	5	0.108
79-20-9	Methyl Acetate	NE	NE	5	0.753
1634-04-4	Methyl tert-butyl ether (MTBE)	NE	10*	5	0.031
108-87-2	Methylcyclohexane	NE	NE	5	1.27
75-09-2	Methylene chloride	2	5	5	0.169
100-42-5	Styrene	1	5	5	0.118
127-18-4	Tetrachloroethene	1	5	5	0.384
108-88-3	Toluene	1	5	5	0.077
156-60-5	trans-1,2-Dichloroethene	1	5	5	0.075
10061-02-6	trans-1,3-Dichloropropene	1	0.4	**5**	0.144
79-01-6	Trichloroethene	1	5	5	0.08
75-69-4	Trichlorofluoromethane (FREON 11)	1	5	5	0.141
75-01-4	Vinyl chloride	1	2	**5**	0.119
1330-20-7	Total Xylene	1	5	5	0.065

Table 7. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte Name	DQO's		Pace Analytical	
		ASP 2005	NY AWQS GA [1]		
		CRQL	H(WS)	RL	MDL
Semivolatile Organic Compounds (µg/L) via Method 8270					
92-52-4	1,1´-Biphenyl	NE	5	5	0.318
95-94-3	1,2,4,5-Tetrachlorobenzene	10	5	5	0.637
52438-91-2	2,2´-oxybis(1-chloropropane)	10	NE	5	0.595
95-95-4	2,4,5-Trichlorophenol	10	NE	10	1.044
88-06-2	2,4,6-Trichlorophenol	10	NE	5	0.692
120-83-2	2,4-Dichlorophenol	10	5	5	0.784
105-67-9	2,4-Dimethylphenol	10	50*	5	0.476
51-28-5	2,4-Dinitrophenol	25	10*	10	0.866
121-14-2	2,4-Dinitrotoluene	10	5	5	0.473
606-20-2	2,6-Dinitrotoluene	10	5	5	0.701
91-58-7	2-Chloronaphthalene	10	10**	5	0.677
95-57-8	2-Chlorophenol	10	NE	5	0.82
91-57-6	2-Methylnaphthalene	10	NE	5	0.616
95-48-7	2-Methylphenol (o-Cresol)	10	1**	**5**	0.262
88-74-4	2-Nitroaniline	25	5	10	0.699
88-75-5	2-Nitrophenol	10	NE	5	1.867
91-94-1	3,3-Dichlorobenzidine	20	5	5	0.815
99-09-2	3-Nitroaniline	25	5	10	0.486
534-52-1	4,6-Dinitro-2-methylphenol	25	NE	10	2.313
101-55-3	4-Bromophenyl phenyl ether	10	NE	5	0.692
59-50-7	4-Chloro-3-methylphenol	10	NE	5	0.601
106-47-8	4-Chloroaniline	10	5	5	0.49
7005-72-3	4-Chlorophenyl phenyl ether	10	NE	5	0.594
106-44-5	4-Methylphenol (p-Cresol)	10	1**	**5**	0.253
100-01-6	4-Nitroaniline	25	5	10	0.517
100-02-7	4-Nitrophenol	25	NE	10	0.925
83-32-9	Acenaphthene	10	20**	5	0.523
208-96-8	Acenaphthylene	10	NE	5	0.604
98-86-2	Acetophenone	10	NE	5	0.711
120-12-7	Anthracene	10	50*	5	0.591
108-95-2	Atrazine	NE	7.5	5	0.341
100-52-7	Benzaldehyde	NE	NE	5	0.507
56-55-3	Benz[a]anthracene	10	0.002*	**5**	0.63
50-32-8	Benzo[a]pyrene	10	ND	5	0.511
205-99-2	Benzo[b]fluoranthene	10	0.002*	**5**	0.587
191-24-2	Benzo[g,h,i]perylene	10	NE	5	0.45
207-08-9	Benzo[k]fluoranthene	10	0.002*	**5**	0.419
111-91-1	Bis(2-chloroethoxy)methane	10	5	5	0.465
111-44-4	Bis(2-chloroethyl)ether	10	1	5	0.56
117-81-7	Bis(2-ethylhexyl)phthalate	10	5	5	1.024
85-68-7	Butyl benzyl phthalate	10	50*	5	0.447
105-6--2	Caprolactam	NE	NE	5	0.128
86-74-8	Carbazole	10	NE	5	0.321
218-01-9	Chrysene	10	0.002*	**5**	0.657
84-74-2	Di-n-butyl phthalate	10	50	5	0.515
117-84-0	Di-n-octyl phthalate	10	50*	5	0.416
53-70-3	Dibenz[a,h]anthracene	10	NE	5	0.477
132-64-9	Dibenzofuran	10	NE	5	0.584
84-66-2	Diethyl phthalate	10	50*	5	0.555
131-11-3	Dimethyl phthalate	10	50*	5	0.564
206-44-0	Fluoranthene	10	50*	5	0.463
86-73-7	Fluorene	10	50*	5	0.532
118-74-1	Hexachlorobenzene	10	0.04	5	0.602
87-68-3	Hexachlorobutadiene	10	0.5	5	0.559
77-47-4	Hexachlorocyclopentadiene	10	5	5	0.392
67-72-1	Hexachloroethane	10	5	5	0.498
193-39-5	Indeno[1,2,3-cd]pyrene	10	0.002*	**5**	0.363
78-59-1	Isophorone	10	50*	5	0.55
621-64-7	N-Nitrosodi-n-propylamine	10	NE	5	0.626
86-30-6	N-Nitrosodiphenylamine	10	50*	5	0.438
91-20-3	Naphthalene	10	10**	5	0.526
98-95-3	Nitrobenzene	10	0.4	**5**	0.481
87-86-5	Pentachlorophenol	25	1**	**10**	1.304
85-01-8	Phenanthrene	10	50*	5	0.673
108-95-2	Phenol	10	1**	**5**	0.336
129-00-0	Pyrene	10	50*	5	0.624

Table 7. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

CAS Number	Analyte Name	DQO's		Pace Analytical	
		ASP 2005	NY AWQS GA [1]		
		CRQL	H(WS)	RL	MDL
Inorganic Analytes (mg/L) via Methods 6010 & 7470					
7429-90-5	Aluminum	NE	NE	200	10
7440-36-0	Antimony	60	3	**60**	3
7440-38-2	Arsenic	10	25	10	3
7440-39-3	Barium	200	1000	200	200
7440-41-7	Beryllium	5	3*	**5**	0.3
7440-43-9	Cadmium	5	5	5	0
7440-70-2	Calcium	NE	NE	5000	15
7440-47-3	Chromium (sum of Cr III and Cr IV)	10	50	10	1
7440-48-4	Cobalt	50	NE	50	1
7440-50-8	Copper	25	200	25	1
7439-89-6	Iron	NE	300	100	8
7439-92-1	Lead	5	25	3	1
7439-95-4	Magnesium	NE	35000*	5000	35
7439-96-5	Manganese	NE	300	15	0
7439-97-6	Mercury	0.2	0.7	0.1	0.3
7440-02-0	Nickel	40	100	40	1
7440-09-7	Potassium	NE	NE	5000	238
7782-49-2	Selenium	5	10	5	4
7440-22-4	Silver	10	50	**10**	1
7440-23-5	Sodium	NE	20000	5000	48
7440-28-0	Thallium	10	0.5*	**10**	4
7440-62-2	Vanadium	50	NE	50	1.4
7440-66-6	Zinc	20	2000*	20	1
Pesticides (µg/L) via Method 8081					
72-54-8	4,4´-DDD	0.1	0.3	0.1	0.012
72-55-9	4,4´-DDE	0.1	0.2	0.1	0.01
50-29-3	4,4´-DDT	0.1	0.2	0.1	0.011
309-00-2	Aldrin	0.05	ND	0.05	0.007
319-84-6	alpha-BHC	0.05	NE	0.05	0.009
5103-71-9	alpha-Chlordane	NE	NE	0.05	0.01
319-85-7	beta-BHC	0.05	NE	0.05	0.018
319-86-8	delta-BHC	0.05	NE	0.05	0.009
60-57-1	Dieldrin	0.1	NE	0.1	0.011
959-98-8	Endosulfan I	0.1	NE	0.05	0.01
33213-65-9	Endosulfan II	0.1	NE	0.1	0.01
1031-07-8	Endosulfan sulfate	0.1	NE	0.1	0.011
72-20-8	Endrin	0.1	ND	0.1	0.011
7421-93-4	Endrin Aldehyde	0.2	5	0.1	0.015
53494-70-5	Endrin Ketone	NE	5	0.1	0.012
58-89-9	gamma-BHC (Lindane)	0.05	NE	0.05	0.009
5103-74-2	gamma-Chlordane	NE	NE	0.05	0.012
76-44-8	Heptachlor	0.05	0.04	**0.05**	0.009
1024-57-3	Heptachlor epoxide	0.05	0.03	**0.05**	0.01
72-43-5	Methoxychlor	0.5	35	0.5	0.013
8001-35-2	Toxaphene	1	0.06	**5**	0.199
PCBs (ug/L) via Method 8082					
12674-11-2	Aroclor 1016	0.5	NE	1	0.046
11104-28-2	Aroclor 1221	0.5	NE	2	
11141-16-5	Aroclor 1232	0.5	NE	1	
53469-21-9	Aroclor 1242	0.5	NE	1	
12672-29-6	Aroclor 1248	0.5	NE	1	
11097-69-1	Aroclor 1254	1.0	NE	1	
11096-82-5	Aroclor 1260	1.0	NE	1	0.033

Notes are on the following page.

Table 7. Chemical Parameters, Reporting Limits and Data Quality Objectives for Groundwater Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Notes:

NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
CAS - Chemical Abstracts Number
NE - Not Established
ND - Not Detected
* = Guidance Value
NY AWQS - New York Ambient Water Quality Standards and Guidances
mg/L - milligrams per Liter
µg/L - micrograms per Liter
RL - Reporting Limit
MDL - Method Detection Limit
ASP - Analytical Services Protocol
CRQL - Contracrt Required Quantitation Limit
DQO - Data Quality Objectives
[1] - DQOs are based on Technical Operations Guidance Series (TOGS) Ambient Water Quality Standards and Guidance Values and Groundwater
** New York Ambient Water Quality Standards and Guidances (NY AWQS) are for the GA water class deginated as
type Health (Water Source) [H(WS)]. If the H(WS) designation was not available, the Aesthetic [E] type is used shown.
Bolding - RL does not meet the DQO

Table 8. Quality Control Limits Percision and Accuracy for Soil and Sediment Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Soil/Sediment QC Limits										
Analytical	**Analytical Method**	**MS/MSD Compound**	**MS/MSD % Recovery**			**LCS % Recovery**		**Surrogate**	**Surrogate % Recovery**	
			Low	High	RPD	Low	High		Low	High
VOCs	8260B	1,1-Dichloroethene	59	172	22	59	172	1,2-Dichloroethane-d4	33	145
		Benzene	66	142	21	66	142	4-Bromofluorobenzene	60	148
		Chlorobenzene	60	133	21	60	133	Toluene-d8	60	132
		Toluene	59	139	21	59	139			
		Trichloroethene	62	137	24	62	137			
SVOCs	8270	2,4-Dinitrotoluene	28	116	47	24	96	1,2-Dichlorobenzene-d4	20	130
		2-Chlorophenol	25	102	50	27	123	2,4,6-Tribromophenol	19	122
		4-Chloro-3-methylphenol	26	103	33	23	97	2-Chlorophenol-d4	20	130
		4-Nitrophenol	11	114	50	10	80	2-Fluorobiphenyl	30	115
		Acenaphthene	31	137	19	46	118	2-Fluorophenol	25	121
		N-Nitroso-di-n-propylamine	41	126	38	41	116	4-Terphenyl-d14	18	137
		Pentachlorophenol	17	109	47	9	103	Nitrobenzene-d5	23	120
		Phenol	26	90	35	12	110	Phenol-d5	24	113
		Pyrene	35	142	36	26	127			
Metals	6010B	Metals excluding Hg	75[(a)]	125	20[(b)]	Varies	Varies	NA		
	7471B	Mercury	75[(a)]	125	20[(b)]	NA	NA	NA		
Pesticides	8081	4,4´-DDT	23	134	27	23	134	Decachlorobiphenyl	30	150
		Aldrin	34	132	43	34	132	Tetrachloro-m-xylene	30	150
		Dieldrin	31	134	38	31	134			
		Endrin	42	139	45	42	139			
		gamma-BHC (Lindane)	35	135	31	35	135			
		Heptachlor	40	131	20	40	131			
PCBs	8082	Aroclor 1016	50	136	40	50	136	Decachlorobiphenyl	30	150
		Aroclor 1260	45	154	40	45	154	Tetrachloro-m-xylene	30	150

Notes:

NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
MS/DS - Material Safety Data Sheets
QC - Quality Control
LCS - Laboratory Control Sample
PCBs - Polychlorniated biphenyls
(a) Matrix spike only
(b) Laboratory duplicate RPD
NA - Not Applicable
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
RPD - Relative Percent Difference

Table 9. Quality Control Limits Percision and Accuracy for Soil Vapor Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Aqueous QC Limits										
Analytical	**Analytical Method**	**MS/MSD Compound**	**MS/MSD % Recovery**			**LCS % Recovery**		**Surrogate**	**Surrogate % Recovery**	
			Low	High	RPD	Low	High		Low	High
AIR	TO-15	N/A	N/A	N/A	N/A	ALL COMPOUNDS 70-130%		4-Bromofluorobenzene	70	130

Notes:
NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
QC - Quality Control
MS/MSD - Matrix Spike/Matrix Spike Duplicate
LCS - Laboratory Control Sample
N/A - Not Applicable

Table 10. Quality Control Limits Percision and Accuracy for Groundwater Samples
Concourse Village West Apartments
Bronx, New York
NYSDEC BCP Site No. C203291 (North) and C203092 (South)
Sampling Dates: February 7, 8, and 13, 2017

Aqueous QC Limits										
Analytical	**Analytical Method**	**MS/MSD Compound**	**MS/MSD % Recovery**			**LCS % Recovery**		**Surrogate**	**Surrogate % Recovery**	
			Low	High	RPD	Low	High		Low	High
VOCs	8260B	1,1-Dichloroethene	61	145	14	61	145	1,2-Dichloroethane-d4	76	114
		Benzene	76	127	11	76	127	4-Bromofluorobenzene	86	115
		Chlorobenzene	75	130	13	75	130	Toluene-d8	88	110
		Toluene	76	125	13	76	125			
		Trichloroethene	71	120	14	71	120			
SVOCs	8270	2,4-Dinitrotoluene	24	96	38	24	96	1,2-Dichlorobenzene-d4	16	110
		2-Chlorophenol	27	123	40	27	123	2,4,6-Tribromophenol	10	123
		4-Chloro-3-methylphenol	23	97	42	23	97	2-Chlorophenol-d4	33	110
		4-Nitrophenol	10	80	50	10	80	2-Fluorobiphenyl	43	116
		Acenaphthene	46	118	31	46	118	2-Fluorophenol	21	110
		N-Nitroso-di-n-propylamine	41	116	38	41	116	4-Terphenyl-d14	33	141
		Pentachlorophenol	9	103	50	9	103	Nitrobenzene-d5	35	114
		Phenol	12	110	42	12	110	Phenol-d5	10	110
		Pyrene	26	127	31	26	127			
Metals	6010B	Metals excluding Hg	75[a]	125	20[b]	80	120	NA	--	--
	7470A	Mercury	75[a]	125	20[b]	NA	NA	NA	--	--
Pesticides	8081	4,4´-DDT	38	127	27	23	134	Decachlorobiphenyl	30	150
		Aldrin	40	120	22	34	132	Tetrachloro-m-xylene	30	150
		Dieldrin	52	126	18	31	134			
		Endrin	56	121	21	42	139			
		gamma-BHC (Lindane)	56	123	15	35	135			
		Heptachlor	40	131	20	40	131			
PCBs	8082	Aroclor 1016	53	116	40	42	134	Decachlorobiphenyl	30	150
		Aroclor 1260	46	126	40	34	146	Tetrachloro-m-xylene	30	150

Notes:
NYSDEC - New York State Department of Envirnmental Conservation
BCP - Brownfield Cleanup Program
QC - Quality Control
MS/MSD - Matrix Spike/Matrix Spike Duplicate
LCS - Laboratory Control Sample
[a] Matrix spike only
[b] Laboratory duplicate RPD
NA - Not Applicable
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenols

Appendix A

Pace Analytical Services Laboratory Quality Assurance Manual (electronic only)

120 Research Drive
Stratford, CT 06615
203-325-1371

Quality Manual

Lab Director	Benjamin Gulizia
Sr. Scientist/Tech Dir/CT	Robert Q. Bradley
QA/QC Officer CT/NY	Magdalena Szymczuk
Date of Issue:	March 29, 2017
Revision:	2.9

Table of Contents-York Quality Manual

Quality Manual

This Quality Manual meets the requirements of ISO 17025, ISO 9001 and NELAC. This Quality Manual is confidential and assigned as outlined below.

Issued to: ______________________________

Revision History

Revision 2.0	04/30/2010	First issue rewritten quality manual
Revision 2.1	11/13/2011	Updated Org Chart and Master List of Documents
Revision 2.2	06/29/2012	Updated Org Chart and Master List of Documents
Revision 2.3	12/26/2012	Added Data Integrity Plan, Reformatted document
Revision 2.4	04/12/2013	Added Aquatic Toxicity information
Revision 2.5	07/18/2014	Updated Org Chart and Master List of Documents
Revision 2.6	10/06/2014	Updated Org Chart and Master List of Documents
Revision 2.7	07/12/2016	Updated Org Chart and Master List of Documents
Revision 2.8	02/23/2017	Updated Org Chart and Master List of Documents Replaced printed copy with electronic.
Revision 2.9	03/29/2017	Modified Section 4.7.1 to include time frame for notifying clients of questionable data reported. Modified Section 4.13.1 to include time frame for maintaining records. Modified Section 4.16.1- procedure for data review.

A protected copy of the Quality Manual is available for each Employee on the York's network (G Drive, folder QUALITY MANUAL)

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1. Introduction

Purpose

This Quality Manual contains all the requirements that our laboratory uses to demonstrate our quality management system, technical competence, and valid results.

Analytical data are used for many purposes, including: compliance with regulatory requirements; determination for the presence, concentration, and movement of hazardous materials in the environment; potential effects upon or protection required for persons; and the actions necessary for disposal of treatment of hazardous materials.

Analytical data may be used to support a broader-based project involved with: site characterization and/or remediation; on-site treatment; treatment and/or disposal or health and safety protection of York personnel and the public. Data may also be produced for outside commercial testing and submitted directly to clients for their decision making. In all cases, data must be of known quality.

It is the purpose of the York Quality Assurance Program, as expressed in this Quality Systems Manual, to provide all data which are of known quality. To achieve this, a system is described which controls:

- Preservation of samples
- Receipt and handling of samples
- Processing and analyses of samples
- Analytical instrumentation
- Data verification
- Data reporting

Section 4 specifies how we demonstrate sound management and maintain client satisfaction.

Section 5 specifies how we demonstrate technical competence in our laboratory.

In addition, this Quality Manual outlines how York complies with:

- ISO 17025
- ISO 9001
- NELAC

All personnel are to take an active role in establishing, implementing, and maintaining our quality management program. We do not separate quality from our daily business. Quality cannot be something that we do just to pass audits. Quality is integrated into every facet of the decision-making process in the management of our laboratory and the science that we practice.

Distribution List

The Quality Assurance Officer (QAO) maintains the distribution list for this Quality Manual.

2. Scope

This Quality Manual facilitates:

- Recognition of technical competence for standardized methods, non-routine methods, and laboratory-developed methods we perform
- Inspection and product certification capabilities and/or services we provide
- Total quality for our administrative and technical systems
- Audits by clients, regulatory authorities and accreditation bodies
- Meeting the requirements of NELAC, ISO 17025, and ISO 9001
- Client satisfaction

3. Normative References

Reference List

ISO/IEC 17000, Conformity assessment – Vocabulary and general principles

VIM, International vocabulary of basic and general terms in metrology, issued by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.

ISO 9001:2008 – Quality Management Systems – Requirements.

ISO 17025:2005 – General Requirements for the Competence of Testing and Calibration Laboratories.
NELAC 2003 and NELAC 2009-Quality Systems

4. Management Requirements

4.1 Organization

This section discusses general positions and quality-related responsibilities which provide for the implementation of the Quality Assurance Program and completion of quality control activities. Also discussed is the role of the York Quality Assurance Officer.

4.1.1 Legal Identification / Registration

York Analytical Laboratories, Inc.
120 Research Drive
Stratford, Connecticut 06615
203-325-1371
Fax 203-357-0166
E-mail: ClientServices@yorklab.com

State of Connecticut Department of Health (CTDOH) Certification no. PH-0723
New York State Department of Health (NYSDOH) ELAP/NELAP Certification no. 10854
State of New Jersey Dept. of Environmental Protection (NJDEP) Certification no. CT-005
State of Pennsylvania Registration No. 68-04440
EPA ID NO. CT-005

4.1.2 Laboratory Requirements

The departments of York Analytical Laboratories, Inc. have been organized to satisfy the needs of the Client and regulatory authorities and to meet the NELAC and international standards ISO 17025 and ISO 9001. York Analytical Laboratories, Inc. is comprised of the following Departments or Groups:

Laboratory Director's Office

Quality Assurance Group
Client Services/Sales Groups
Sample Control Group
Classical Chemistry Group
Organic Preparations Group
Atomic Spectroscopy/Metals Group
Gas Chromatography Group
Gas Chromatography/Mass Spectrometry Groups (Volatiles, Air and Semi-Volatiles)
Report production/Data Management Group

4.1.3 Scope of Management System

The management system covers activities in the laboratory's permanent facility at 120 Research Drive, Stratford, CT 06615. The fields of activities include:

Analysis of environmental samples (water, wastewater, soil, sludge, and air) for Federal and State regulated contaminants.

The laboratory's scope of tests is listed in the our specific Certifications and encompasses volatile organics, semi-volatile organics, pesticides, herbicides, PCBs, metals, and various general chemistry parameters.

4.1.4 Potential Conflicts of Interest

York has no potential conflicts of interest since it is independently owned and operated and provides only environmental laboratory analysis services. The ownership of York does not have any other interest that would be considered a potential conflict of interest.

4.1.5 Organization

A) Management and Technical Personnel

Policy:
The laboratory managerial and technical personnel, irrespective of other responsibilities, have the necessary authority and resources needed to meet the mandates assigned to their areas.

Details:
Responsibilities are detailed in 4.1.5 (F).

Departures from the organizational and management policies in this manual can only be approved by the Laboratory Director.

Departures from quality management system procedures can only be approved by the Quality Assurance Officer or the Laboratory Director.

Departures from test methods or technical standard operating procedures (SOPs) can only be approved by the Laboratory Director. See also section 5.2.

B) Undue Pressure

Policy:
Management and personnel are to be free from any undue internal and external commercial, financial and other pressures that may adversely affect the quality of their work. The integrity of test results is the responsibility of all personnel. Management ensures that employees are never instructed or forced to alter or falsify data.

Details:
The following list provides some guidelines on how employees avoid conflict of interest situations. Employees shall not:

- falsify records, prepare fraudulent reports, or make false claims
- seek or use privileged or confidential company information, or data from any Client, for any purpose beyond the scope of employment
- conduct non-laboratory business on laboratory time, or use company facilities or instrumentation to conduct outside interests in business, unless prior approval has been obtained
- solicit business on their own behalf (rather than the laboratory) from a Client
- be employed by, or affiliated with, organizations whose products or services compete with laboratory products or services
- have employment that negatively affects or interferes with their performance of laboratory duties
- compete with the laboratory in the purchase, sale, or leasing of property or goods
- allow association, family, or friends to influence business decisions to their benefit - decisions must be made on a strictly business basis, always in the best interest of the laboratory
- make any decision that provides gains or benefits to the employee and/or others
- have personal financial dealings with an individual or company that does business with the laboratory which might influence decisions made on the laboratory's behalf

Firm adherence to this code of values forms the foundation of our credibility. Personnel involved in dishonest activities are subject to a range of disciplinary action including dismissal.

C) Client Confidentiality

Policy:
It is the policy of our laboratory to protect the confidential information and proprietary rights of our Client including the electronic storage and transmission of results.

Details and Procedures:
All employees sign an Employee Confidentiality Agreement. The signed agreement is retained in each employee's Human Resources file.

Test results are only released to the Client. Release to someone other than the Client requires the express permission of the Client, except when the situation contravenes State or Federal Legislation and the results must be provided to the appropriate agency. The release of test results to anyone other than the Client requires the permission of the Client and management. Laboratory reports are reviewed for accuracy and completeness prior to release.

D) Operational Integrity

Policy:
The laboratory will avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity.

Details and Procedures:
To ensure confidence in laboratory operations a formal quality assurance program is implemented. Technical competence is ensured through check sample programs. Impartiality is assessed through audits and approvals. Judgment is ensured through the hiring of qualified personnel and by continuously refining, upgrading, and improving his or her skills. Operational integrity is reviewed by management on a regular basis at management review meetings to ensure continued suitability and effectiveness of laboratory policies and procedures. Any problems are acted on immediately through corrective action procedures.

E) Organizational Structure

Policy:
The organization and management structure of the laboratory and the relationships between management, technical operations, support services, and the quality management system is defined through the aid of an organizational chart.

Details:
Senior management keeps the most current organizational chart on file. An organizational chart is available with this manual as a reference record-ATTACHMENT A and is considered the official record on the date it is marked in the lower right corner.

F) Responsibility and Authority

Laboratory Director

- develops primary goals, operating plans, policies, and short and long range objectives for the laboratory; implements these following Board of Directors' approval
- directs and coordinates activities to achieve profit and return on capital
- establishes organizational structure and delegates authority to subordinates
- leads the laboratory towards objectives, meets with and advises other executives, and reviews results of business operations
- determines action plans to meet the needs of stakeholders
- represents organization to major Clients, government agencies, shareholders, and the public
- is knowledgeable of the scope of all processes under supervision
- provides the necessary resources (personnel, instrumentation, supplies) for the quality assurance program, in order to ensure confidence in the laboratory's results
- ensures instrumentation is maintained and calibrated, reporting all deficiencies (e.g., instrumentation malfunctions) in the appropriate manner
- ensures personnel are trained for the duties they perform - includes substitutes when regular personnel are absent
- maintains current job descriptions
- maintains records and manages all aspects of testing activities

Quality Assurance Officer (QAO)

- ensures that the Quality Management System is established, implemented and maintained in accordance with the ISO 9001, ISO 17025 and NELAC standards
- manages the internal audit program
- coordinates laboratory accreditation activities
- handles the maintenance and distribution of the Quality Manual and associated documents
- maintains a master list of current versions of quality documentation
- trains personnel on Quality Management System activities
- monitors the Quality Management System
- reports on the performance of the Quality Management System to senior management for review and as a basis for improvement of the Quality Management System
- supervises the laboratory's double-blind proficiency testing program

Group Leaders

- responds to York Client Services Group inquiries and provides professional advice
- hires personnel with Laboratory Director
- orientates new personnel

- determines technical training needs of personnel
- conducts employee performance reviews
- schedules vacation and coverage
- ensures that all health and safety regulations are followed
- ensures that all Human Rights Legislation are complied with
- prioritizes workload
- facilitates operational concerns in their area
- ensures accurate and consistent testing procedures through the validation of all current procedures and by developing, validating and implementing new procedures
- coordinates purchasing requests
- ensures that the operational needs are within budget and advising management of any discrepancies

Analysts and Technicians

- maintains records of all quality activities as documented in SOPs and test methods
- handles samples and performing analyses according to SOPs and test methods
- provide input and assists in preparation of SOPs and test methods
- maintain and calibrate instrumentation and instrumentation
- reports deficiencies or malfunctions to the Group Leader
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and recording potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities
- improves laboratory and/or quality activities on a continuous basis

Project Managers/Client Services

- provides vision and direction for analysis activities
- Responds to Clients' and provides professional advice
- develops and reviews proposals/Quotations
- Reviews Quality Assurance Project Plans for Clients
- monitors the progress of Work-in-Process
- reviews reports for selected Clients
- oversees, standard pricing, customized quotations, and invoicing for tests performed
- controls the flow of communication between the Client and the laboratory

Administrative/Data Management Personnel

- performs work functions and keeps records as per approved SOPs and/or laboratory policies
- generate final reports, invoices and data packages for transmittal to Clients
- assist in preparation of SOPs
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and records potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities

- improves laboratory and/or quality activities on a continuous basis

G) Laboratory Supervision

Policy:
Adequate supervision is provided in each area of the laboratory for all testing and calibration personnel, including trainees, by persons familiar with the methods and procedures.

Details:
Adequate supervision is ensured through designated supervisors as well as through documentation such as this Quality Manual, test methods and SOPs. A thorough orientation and training program is adhered to for all new employees. Ongoing training for regular personnel is required.

H) Technical Management

Policy:
A Group Leader is assigned to each major technical department of the laboratory. They have overall responsibility for the technical operations and the provision of resources needed to ensure the required quality and production of laboratory operations.

Details:
While the Group Leader may at times delegate duties to other personnel, the Group Leader is accountable for any nonconforming activities.

I) Quality Assurance Officer

Policy:
The Quality Assurance Officer is appointed by the highest level of management. The Quality Assurance Officer, who, irrespective of other duties and responsibilities, has defined responsibility and authority for ensuring that the management system related to quality is implemented and followed. The Quality Assurance Officer has direct access to the highest level of management where decisions are taken on laboratory policy or resources.

Details:
This statement notifies all laboratory personnel that Magdalena Szymczuk is the Quality Assurance Officer as authorized by the Laboratory Director. Any change in this position requires the reissue of this section to all holders of controlled copies of the Quality Manual. The following signature also serves as approval for this Quality Manual and affirms senior management's commitment to the policies and procedures set forth in this manual.

J) Managerial Substitutions

Policy:
Deputies for key personnel are appointed to fulfill the key personnel's duties in their absence.

Details:
In the absence of the Quality Assurance Officer, the Technical Director or Laboratory Director will assume his/her responsibilities.

In the absence of the Group Leader, the Laboratory Director, Technical Director or other Group Leader will assume his/her responsibilities.

Management is responsible for ensuring that current and/or increased workload requirements are met. This includes making adjustments as a result of employee absence. Only fully trained employees are utilized to fulfill the duties of personnel who are absent. If sufficient human resources are not available, management will identify the best possible solution to meet operational requirements.

K) Awareness

Policy:
Management ensures that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.

Details:
Supervisors review the details of each employee's job description with the appropriate employee and how the overall Quality Policy Statement (Section 4.2.2) relates to their activities to achieve the objectives of the management system.

4.1.6 Communication Processes

Policy and Details:
Top management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

4.2 Management System

4.2.1 Policies and Procedures

Policy:
The Quality Management System is established, implemented, and maintained by management. It is applicable to all the fields of testing and activities in which the laboratory is involved and undertakes. All policies, systems, programs, procedures and instructions are documented to the extent necessary to enable the laboratory to assure the quality of results generated. These documents are communicated to, understood by, available to, and implemented by the appropriate personnel.

Details:
The purpose of our Quality Management System is to ensure that all services and products satisfy the Client's requirements and have been designed, manufactured, and delivered under controlled conditions.

The effectiveness of the Quality Management System is assessed in several ways:

- by a program of planned internal audits, covering all aspects of the operation of the quality management system
- by regular management reviews of the suitability and effectiveness of the quality management system
- by analysis of potential and actual problems as shown by Client complaints and supplier and subcontractor assessments
- by other methods approved from time to time by the Laboratory Director

This Quality Manual and associated documents (including procedures) and records serves as the quality plan for the laboratory. Other documents and records include:

- standard operating procedures
- quality control plans in test methods
- organizational charts
- proposals and Quality Assurance Project Plans (QAPP)
- project management schemes

4.2.2 Quality Policy Statement

Policy:
The policies and objectives for laboratory operations are documented in this Quality Manual. The overall objectives are set out in the Quality Policy Statement and reviewed during management review. The Quality Policy Statement is issued under the authority of the Laboratory Director on the effective date.

Quality Policy Statement:
To ensure accurate and timely environmental laboratory analysis services and to continuously meet or exceed the stated or implied expectations of our Clients through day-to-day interactions.

Effective Date: April 30, 2010

a) *Management commitment to good professional practice and quality of services provided to the Client*: analyses and calibrations are always carried out in accordance with stated standardized methods and Clients' requirements. Requests to perform tests that may jeopardize an objective result or have a low validity are rejected.

b) *Standards of service include*:
- Client Satisfaction
- Quality
- Timeliness

Excellence in the workplace is promoted by providing all employees with the knowledge, training, and tools necessary to allow for the completion of accurate and timely work.

c) *Purpose of management system related to quality*: to manage our business by meeting the needs of our Clients.

d) *Personnel*: familiarize themselves with quality documentation and implement the policies and procedures in their work.

e) *Management is committed to complying with NELAC, ISO 17025 and ISO 9001 international standards and to continually improve the effectiveness of the management system*: the objective of this Quality Manual is to document the compliant policies and associated procedures that are integrated into our daily activities. Continual improvements are established, implemented, and integrated into the management system. Additional objectives include:

- to establish the level of the laboratory's performance
- to make test method changes to improve performance
- to participate in proficiency testing or quality evaluation programs with peer laboratories
- to ensure that all personnel are trained to a level of familiarity with the quality management system appropriate to the individual's degree of responsibility
- to improve and validate laboratory methodologies by participation in method validation collaborative tests
- to establish and report on quality savings

4.2.3 Commitment to the Management System

Policy:
Top management is committed to the development and implementation of the management system and continually improving its effectiveness.

Details:
The results of the management system are regularly reviewed during management review (see Section 4.15) and continual improvements are made as outlined in Section 4.10 – Improvements.

4.2.4 Communication of Requirements

Policy:
Top management communicates to the organization the importance of meeting Client requirements as well as statutory and regulatory requirements.

Details:
In general, the underlying message in all oral and written management communications involves meeting the aforementioned requirements. Meeting Client requirements ensures that ongoing business relationships secure the contracts that keep everyone employed. Meeting statutory and regulatory requirements ensures that laboratory operations will not be disrupted and the organization can continue to meet Client needs.

4.2.5 Quality Manual

Policy:
This Quality Manual outlines the structure of the documentation used in the quality management system. This Quality Manual makes reference to supporting procedures including technical procedures and is maintained up to date.

Details:
This quality management system is structured in three tiers of documentation. The tiers are as follows:
1. Quality Manual
2. Standard Operating Procedures and Test Methods
3. Records

For most Clients, this Quality Manual and the associated documents form a general Quality Plan. If necessary, specific Quality Assurance Project Plans (QAPP) will be prepared on a 'per-Client' basis. These QAPPs will modify the general requirements stated in the Manual and associated documents.

All of the above documents are controlled documents in yellow only.
The following records and directive documents are referenced in the Quality Manual, but maintained separately:
- organizational chart (section 4.1.5.E)
- copies of the Quality Policy Statement posted in the laboratory (section 4.2.2)
- identification of resources and management review (section 4.15.1)
- job descriptions (section 5.2.4)
- statistical techniques (section 5.9)
- test reports (section 4.13.2 and 5.10)
- identification of the laboratory's approved signatures (section 5.10.2)
- laboratory's scope of tests (section 4.1.3)
- instrumentation inventory and records (sections 5.5.4 and 5.5.5)
- calibration status indicators (section 5.5.8)
- reference standards inventory (section 5.6.3)
- verification records (section 5.9)
- quality control plan / criteria for workmanship (section 5.4.1)
- corrective action records (section 4.11)
- preventive action records (section 4.12)
- client complaint records (section 4.8.1)
- audit schedule and records (section 4.14.3)
- procurement and subcontracting records (sections 4.6 and 4.5.4)

- training records (section 5.2.5)
- master list of documentation (section 4.3.2)
- confidentiality agreements (section 4.1.5 C)
- contract review (section 4.4.2)
- validation of test methods (section 5.4.5)
- facility floor plan (section 5.3.1)

4.2.6 Technical Management and the Quality Assurance Officer

The roles and responsibilities for technical management (Group Leaders) and the Quality Assurance Officer are outlined in section 4.1.5 (F) of this manual.

Technical management (Group Leaders) ensures that section 5 of this manual is implemented and maintained. The Quality Assurance Officer ensures that section 4 of this manual is implemented and maintained.

4.2.7 Maintenance

Policy and Details:
Top management ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented.

4.3 Document Control

Policy: The SOP# ADMINDOC043010 is used to control all quality management system documents. These may include documents of external origin, such as regulations,

standards, other normative documents, test and/or calibration methods, as well as drawings, specifications, instructions, and manuals.

Details:
Document means any information or instructions including policy statements, procedures, specifications, calibration tables, charts, text books, posters, notices, memoranda, software, drawings, and plans. These may be in various media, whether hard copy or electronic and they may be digital, analog, photographic or written.

The documents to be controlled include:
- Quality Manual
- Standard Operating Procedures
- Forms
- Standards

The control of data related to testing and calibration is covered in section 5.4.7. The control of records is covered in section 4.13.

4.3.1 Document Approval and Issue

4.3.1.1 Review / Approval / Master List

Policy and Details:
All documents issued to personnel in the laboratory as part of the quality management system are reviewed and approved for use by authorized personnel prior to issue (i.e., reviewed by personnel knowledgeable in the documented activity and then approved by management). A master list identifying the current revision status and distribution of documents in the quality management system is readily available in order to preclude the use of invalid and/or obsolete documents (see SOP# ADMINDOC043010). A revision history of documents is also maintained. Documents are formally reviewed on a biennial basis to ensure their continuing suitability. APPENDIX B contains a current Master List of Documents.

4.3.1.2 Availability and Obsolete Documents

Policy and Details:
The master list includes all current controlled documents. The master list document is organized with the following information:

- Description
- SOP Number
- Date of Issue (effective date of each procedure)
- Revision Number
- Date of Revision (effective date of each current revision)

Controlled documents are approved before issue.

The SOP# ADMINDOC043010 for document control ensures that:
- authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed
- documents are periodically reviewed and where necessary revised to ensure continuing suitability and compliance with applicable requirements
- invalid or obsolete documents are promptly removed from all points of issue or use to assure against unintended use
- obsolete documents retained for either legal or knowledge preservation purposes are suitably marked (i.e., stamped "OBSOLETE" and dated)

4.3.1.3 Identification
Policy and Details:
All quality management system documentation is identified by:

- date of issue and/or revision number
- page numbering
- total number of pages (e.g., page 5 of 5)
- issuing authority (i.e., approval signature)

4.3.2 Document Changes

4.3.2.1 Review / Approval
Policy:
Changes to documents are reviewed and approved by the same function (i.e., personnel or position) that performed the original review unless specifically designated otherwise.

Details:
Developments in policies and procedures require documents to be changed from time to time. Changes to documents receive the same level of review and approval as the originals.

The Quality Manual is reviewed annually by the Quality Assurance Officer. Records are kept of this review.

Test methods and SOPs are reviewed on a biennial basis. Procedures for this are outlined in SOP# ADMINDOC043010.

Obsolete documents are withdrawn, but are retained for archive purposes and clearly labeled as obsolete.

4.3.2.2 Identification of Changes

Policy:
The nature of document changes is identified in the document.

Details:
As outlined in SOP# ADMINDOC043010.

In general, the nature of changes is described in the document. Revision history is recorded at the end of the document.

4.3.2.3 Amendments by Hand

Policy and Details:

Hand-written amendments are clearly marked, initialed, and dated by the Laboratory Director and/or the QA/QC Officer on all controlled yellow copies.

4.3.2.4 Computerized Documents

Policy and Details:
The SOP# ADMINDOC043010 details how changes in documents maintained in computerized systems are made and controlled.

4.4 Review of Requests and Contracts

4.4.1 Policies and Procedures

Policy:
The SOP AMINCONTRACT043010 is used to review requests or contracts. This procedure ensures that:

a) the Client requirements including the methods to be used are adequately defined, documented and understood (see section 5.4.2)
b) the laboratory has the licensing, capability and resources to meet the requirements
c) the appropriate testing method is selected and capable of meeting the Client's requirements or data quality objectives (see section 5.4.2)

Any differences between the request and the contract are resolved before any work commences. Each contract must be acceptable by both the laboratory and the Client.

Details:
The request and contract review is conducted in a practical and efficient manner, and the effect of financial, legal, and time schedule aspects are taken into account.

The review of capability establishes that the laboratory possesses the necessary physical, personnel, and information resources, and that the laboratory's personnel have the skills and expertise necessary for the performance of the tests in question. The review may also encompass results of earlier participation in inter-laboratory comparisons or proficiency testing and/or the running of trial test using samples or items of known value in order to determine uncertainties of measurement, limits of detection, and confidence limits.

The contract review ensures that each Client's requirements are adequately defined and documented before the service or product is ordered or dispatched. This should ensure that any order, once accepted, can be completed without delay, and that the Client's requirements including delivery date, technical specification, and cost can be met.

If the contract review highlights any ambiguities or uncertainties then the Client will be contacted and the problem resolved before the order is accepted.

The SOP AMINCONTRACT043010 also describes the activities that take place should there be a subsequent amendment to a Client's order.
Typical types of contracts include:

- approved service quotations
- confidentiality agreements
- non-disclosure agreements
- sample submission requests
- memorandum of agreement
- memorandum of understanding
- research proposals and contracts
- verbal orders (oral agreements)
- activity plans

4.4.2 Records of Review

Policy:
Records of request and contract review, including significant changes, are maintained. Records of pertinent discussions with a Client relating to the Client's requirements or the work during the period of execution of the contract are also maintained.

Details:
For review of routine and other simple tasks, the date and the identification (e.g., initials) of the person in the laboratory responsible for carrying out the contracted work are considered adequate. For repetitive routine tasks, the review need be made only at the initial enquiry stage or on grant of the contract for on-going routine work performed under a general agreement with the Client, provided that the Client's requirements remain unchanged. For new, complex or advanced testing tasks, a more comprehensive record is maintained.

4.4.3 Review of Subcontracted Work

Policy:
Request and contract review also includes work that is subcontracted by the laboratory.

Details:
Subcontractor laboratories are reviewed as described in section 4.5.

4.4.4 Notification of Client

Policy and Details:
Clients are informed of deviations from the contract. This is typically communicated to the Client prior to the performing the deviation.

4.4.5 Contract Amendment

Policy and Details:
If a contract needs to be amended after the work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

4.5 Subcontracting of Analyses and Calibrations

4.5.1 Subcontractor Competence

Policy:

Work that must be subcontracted due to:

- unforeseen circumstances
- workload
- large contracts
- contracts requiring some extra technical expertise
- Tests not performed in-house

is subcontracted to a technically competent laboratory.

Details:

The subcontracted laboratory demonstrates technical competence by possession or receipt of one or more of the following:

- recognized technical accreditation- NYSDOH NELAC or other NELAC accreditation body
- registration under the ISO 9001 standard
- satisfactory performance of appropriate quality control check samples, certified reference material, in-house reference material or replicate analysis
- Review of the subcontractor's quality management system by our QA Officer

It is the responsibility of the Quality Assurance Officer to assess and approve the competence level of subcontractor laboratories.

4.5.2 Client Approval

Policy:
Clients are advised of work (or any portion thereof) that is being subcontracted to another laboratory and their approval is obtained (preferably in writing). Upon log-in at the lab, a Subcontract Notification Form is generated by Sample Control and e-mailed immediately to the Client.

Details:
Clients are advised of subcontracted work through fee schedules or any type of contract listed in section 4.4.1.

4.5.3 Assurance of Subcontractor Competence

Policy:
The laboratory is responsible to the Client for the subcontractor's work. Technical competence of subcontractor laboratories is demonstrated through various records.

> **Note** – there may be circumstances where the Client specifies which subcontractor is to be used. In such cases we may not be able to demonstrate the competence of the subcontractor and therefore are not responsible for the results.

Details:
Records of subcontractor competence may include, but are not limited to, the following:
- accreditation certificates or documentation
- registration certificates
- check sample results
- audit results
- approval by the Quality Assurance Officer

4.5.4 Subcontractor Register

Policy:
A register of all subcontractors performing tests is maintained.

Details:
The approved register of subcontractors and all relevant records are maintained by the Quality Assurance Officer.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.6 Purchasing Services and Supplies

4.6.1 Policies and Procedures

Policy:
The SOP ADMINPURCHASESING043010 is used to select and purchase services and supplies. The SOP ADMINPURCHASESING043010 is used for procurement, reception, and storage of supplies.

Details:
Consumable materials are stored according to the appropriate test method, SOP, or work instruction.

4.6.2 Specifications

Policy:
Only services and supplies of the required quality are used. These quality requirements are detailed in laboratory SOPs under the "*Materials Required*" section and will identify the appropriate minimum specifications when necessary.

Details:
Packing slips are checked against package content labels and matched with the Purchase Order if accepted. Once accepted, the packing slip is dated and initialed as evidence of compliance. Certificates of analysis (COA) are maintained on file after the COA is checked to ensure the received item meets minimum specifications.

Chemicals are purchased with manufacturer's certificates where possible. Uncertified chemicals are purchased from ISO 9000 registered companies where possible. Whatever the source, the laboratory verifies the quality of the standards by comparing the new batch of standards to the old. Due regard is paid to the manufacturer's recommendations on storage and shelf life.

Reagents are generally purchased from manufacturers who have a quality management system based on ISO 9000. The grade of any reagent used (including water) is stated in the method together with guidance on any particular precautions to be observed in its preparation or use.

Where no independent assurance of the quality of procured goods or services is available or the supplier's evidence is insufficient the laboratory ensures that purchased goods and services comply with specified requirements. Where possible and practical the laboratory ensures that goods are inspected, calibrated, or are otherwise in compliance with any standard specification relevant to the calibrations or tests concerned.

4.6.3 Purchasing Documents

Policy:
Purchasing requests are recorded on the Purchase Order form and contain data describing the product ordered. The Purchase Order is reviewed and approved for technical content prior to release.

Details:
The description may include type, class, grade, precise identification, specifications, drawings, inspection instructions, other technical data including approval of test results, quality required and quality management system standard under which they were produced.

The completion of the Purchase Order is the responsibility of the originator.

4.6.4 Approved Suppliers

Policy:
Suppliers of critical services are evaluated and approved before use. An approved supplier list is maintained.

Details:
Audits or tender evaluation is conducted to qualify suppliers of critical services prior to use. The criteria for evaluation may include, but is not limited to the following:

- references
- accreditation
- formal recognition

The records are maintained by purchasing personnel. SOPs detail the acceptable vendors for all materials.

4.7 Service to the Client

4.7.1 Service

Policy:
Client requests are clarified for the Clients or their representatives. Furthermore the Client or their representative will be afforded the right to monitor the performance of the laboratory in relation to the work performed, provided that the laboratory ensures confidentiality to other Clients.

Details and Procedures:

Service to the Client includes:

- Affording the Client or the Client's representative reasonable access to relevant areas of the laboratory for the witnessing of work performed for the Client; it is understood that such access should not conflict with rules of confidentiality of work for other Clients or with safety.

- Preparing, packaging, and dispatching of test data needed by the Client for verification purposes.

- Maintaining of open contacts. The Client values advice and guidance in technical matters, and opinions and interpretations based on results. Contact with the Client, especially in large assignments, should be maintained throughout the work by Client Services personnel. The laboratory should inform the Client of any delays or major deviations or issues encountered during the performance of the tests.

- Notifying customers of any event that casts doubt onto the validity of results supplied to them within 10 days after discovering the issue.

4.7.2 Feedback

Policy and Details:
The laboratory seeks feedback from the Client. Positive and negative feedback can be obtained passively through ongoing communications with the Client (e.g., review of test reports with Clients) or actively through Client satisfaction surveys. The feedback is used to improve the quality management system, testing activities, and Client service.

4.8 Complaints

4.8.1 Policies and Procedures

Policy:
The SOP ADMINCOMPLAINTS 04302010 is used for resolving complaints received from Clients or other parties. Records are maintained of all complaints and follow-up.

Details:
Records of complaints include the following information:

- details of the complaint
- investigation
- corrective action
- follow-up verification

See also section 4.11.

All personnel are responsible for recording and responding to complaints.

4.9 Control of Nonconforming Analyses

4.9.1 Procedures to Control Nonconforming Work

Policy:
The SOP ADMINNONCONFORM 04302010 is used to control any aspect of testing, or the results of this work, when they do not conform with the test methods, SOPs or the agreed to requirements of the Client.

Details:
The procedure ensures that:
- Responsibilities and authorities for the management of nonconforming work are designated and actions (including halting of work and withholding of test reports as necessary) are defined and taken into consideration when nonconforming work is identified
- an evaluation of the significance of the nonconforming work is made
- correction is taken immediately, together with any decision about the acceptability of the nonconforming work
- where necessary, the Client is notified and the work is recalled
- the responsibility for authorizing the resumption of work is defined

Identification of nonconforming work or problems with the quality management system or with testing activities can occur at various locations within the quality management system and technical operations such as:
- Client complaints
- quality control
- instrument calibration
- checking of consumable materials
- staff observations or supervision
- test report review
- management reviews
- internal or external audits

4.9.2 Root Cause Analysis

Policy:
Where evaluation indicates that nonconforming work could recur or that there is doubt about the compliance of the laboratory's operations with its own policies and procedures,

the corrective action procedures given in 4.11 are followed to identify the root cause(s) of the problem and to eliminate cause(s).

Details:
The SOP ADMINCORRACTION043010 outlines the recording of the root cause analysis for investigating nonconforming work.

Situations warranting corrective action investigation include:
- failure to comply with test method including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- presentation of uncertain knowledge as to compliance with test methods including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- failure or suspected failure in method performance as demonstrated by results provided by quality control samples
- lack of relevant evidence provided by quality audit, proficiency testing, or Client feedback
- lack of relevant evidence provided by data validation
- neglect to check the inherent property of the sample that compromises the testing

4.10 Improvements

4.10.1 Policies and Procedures

Policy:
The laboratory continually improves the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective actions, and management review.

Details:
The laboratory has implemented a continual improvement philosophy within the management system. Every employee in the laboratory is encouraged to suggest new ideas for improving services, processes, systems, productivity, and the working environment.

Opportunities for improvement of operations and processes are identified by managers on a continual basis from ongoing feedback on operations and through management reviews. Opportunities for improvement of services are identified by anyone within the organization including Sales, Marketing and Client Services.

Inputs for improvement opportunities are obtained from the following sources:
- Client satisfaction surveys and any other Client feedback
- market research and analysis
- employees, suppliers, and other interested parties
- internal and external audits of the management system
- records of service nonconformities
- data from process and service characteristics and their trends

Opportunities for improvement may also be identified on a special project basis. The following are listed only as examples:
- improving usefulness of bench space
- reducing excessive inspection/analysis
- reducing excessive handling and storage
- reducing test/calibration failures

Opportunities for improvement from daily feedback on operational performance (i.e., internal audits, Client feedback, test/calibration failures) are evaluated by the Laboratory Director or Quality Assurance Officer. Typically, they are implemented through the corrective and preventive action system.

Opportunities for improvement from analysis of longer-term data and trends are evaluated and implemented through the management review process. They are prioritized with respect to their relevance for achieving quality objectives. When opportunities for improvement are no longer supported by the current policy and objectives, management will establish new quality objectives, and possibly change the policy. The process for this evaluation is described in Section 4.15. Longer-term improvement projects are initiated through the management review process, as well as the corrective and preventive action system.

Service improvement opportunities are evaluated by management. They are implemented through the supervisor of the laboratory who ensures that the improvements are validated as outlined in Section 5.4 of this manual and appropriate level of quality control is performed on an ongoing basis.

4.11 Corrective Action

4.11.1 General

Policy:
The SOP ADMINCORRACTION043010 is utilized for implementing corrective action when nonconforming work or departures from policies and procedures in the quality management system or technical operations have been identified. The procedure requires that appropriate authority be designated for the implementation of corrective actions. The procedure includes cause analysis, selection and implementation of corrective action, and monitoring of actions.

Details:
Problems with the quality management system or technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feed-back from Clients, or staff observations.

Corrective action investigations are documented and required changes to operational procedures are implemented. The corrective action request (CAR), investigation and resolution are recorded on a CAR form.

4.11.2 Cause Analysis

Policy:
Corrective action always begins with an investigation to determine root cause(s) of the problem (see SOP ADMINCORRACTION043010).

Details:
Potential causes of the problem could include Client requirements, the samples, sample specifications, methods and procedures, personnel skills and training, consumable materials, or instrumentation and its calibration.

4.11.3 Selection and Implementation of Corrective Actions

Policy and Details:

After determining the cause(s) of the problem, potential corrective actions are identified. The most likely action(s) (this includes practical and/or reasonable) are selected and implemented to eliminate the problem and to prevent recurrence. It should be noted that any corrective actions taken to eliminate the cause(s) of nonconformities or other departures are to a degree appropriate to address the magnitude of the problem and commensurate with the risks encountered (Note – in plain language, this means determine whether the benefit outweighs the cost). Controls are applied to prevent recurrence. The laboratory documents and implements the required changes resulting from corrective action investigations.

4.11.4 Monitoring of Corrective Action

Policy:
After implementing the corrective action(s), the laboratory monitors the results to ensure that the actions taken have been effective in overcoming the problems originally identified.

Details:
Monitoring is assigned to an appropriate individual such as the originator of the CAR or the originator's manager. Changes resulting from corrective action are documented.

4.11.5 Additional Audits

Policy:
Where the identification of nonconformities or departures casts doubts on compliance of policies, procedures, regulations, international quality standards, the appropriate areas of activity are promptly audited in accordance with section 4.14.

Details:
Special audits follow the implementation of corrective actions to confirm their effectiveness. A special audit is only necessary when a serious issue or risk to the business is identified. Special audits are carried out by trained and qualified personnel who are [whenever resources permit] independent of the activity to be audited. See section 4.14 for more details.

4.12 Preventive Action

4.12.1 Preventive Action Identification

Policy:
Opportunities for needed improvement and potential sources of nonconformities, either technical or with the quality management system shall be identified. If action is required, action plans are developed, implemented and monitored, to reduce the likelihood of occurrence of such nonconformities and to take advantage of the improvement opportunities.

Details:

Records of preventive action include the following information:

- details of potential nonconformities
- investigation
- preventive action
- follow-up verification

These records are maintained in the Preventive Action Request (PAR) form/binder.

4.12.2 Preventive Action Plans

Policy:
The preventive action procedure includes the initiation of such actions and application of controls to ensure that they are effective.

Details:
Preventive action may result from the review of operational procedures and analysis of data. Analysis of data includes trend analysis, analysis of proficiency testing results, and risk analysis.

The SOP ADMINPREVACTION043010 is utilized to implement opportunities for needed improvement and prevent potential sources of nonconformities.

4.13 Control of Records

The York Quality Assurance Program has been developed to provide analytical results of known quality. To demonstrate that quality has been achieved, York maintains a record management system that includes documents pertinent to the analytical performance of the laboratory. Laboratory records are maintained in two broad categories.

- Documents which are specific to a project or a group of samples within an ongoing project, such as chain-of-custody, and raw analytical data.
- Documents which demonstrate overall laboratory operation, such as instrument log books and control charts. These records will directly affect the data for a specific project, but in general their applicability is not limited to one project.

This procedure addresses identification, collection, indexing, access, file, store, maintain, protect, backup, and disposal of quality and technical records. To outline procedures for the protection and backup of data/records held on computers.

4.13.1 General

This procedure applies to all quality and technical records. Quality records include audit reports, management review, corrective action requests, and preventive action requests. Technical records include observations, calculations, derived data, calibration records, personnel records, and test reports.

4.13.1.1 Procedures

Policy:
The SOP ADMINRECORDS043010 is used to identify, collect, index, access, file, store, maintain, protect, backup, and dispose quality and technical records. Quality records include reports from internal audits and management reviews as well as corrective and preventive action records.

Details:
Records are available to demonstrate conformance to requirements and effective operation of the Quality Management System. Quality records from suppliers are also controlled.

All records, (electronic and hard copy) including test reports, are safely stored and held secure in locked areas, and in confidence to the Client. Records are maintained in the designated archival area for **five (5)** years, except for Drinking Water (**minimum 10 years**) and for Copper and Lead in drinking water **– 12 years.**

4.13.1.2 PROJECT RECORDS

Separate files are maintained for each project. Filing of records for a specific project shall be by the unique project identification number assigned by the laboratory for that project. Within a project file, categories of information are filed separately. Upon completion of all projects (SDGs), the file contents are scanned to an unalterable image file (.pdf) and archived removable hard disk media. Such media are held for a period of 5 years. Paper copy is maintained for three months after data submission. Following is a brief discussion of each item that is maintained for each project file.

A - Correspondence

All correspondence pertinent to the analytical program shall be maintained. This includes letters to and from clients and internal memorandums. Correspondence should be filed chronologically.

B - Chain-of-Custody

Chain-of-custody records shall be maintained by the laboratory. The chain-of-custody forms should be filed for samples as received and should be placed in the project file immediately after they are signed by Sample Control personnel.

C - Request for Analysis

Analysis requests provided by the field personnel are maintained in this file. Also, any changes or additions to the analytical program should be documented in this file.

D - Calibration Records

In general, calibration records are maintained with laboratory operation records. However, if an analytical program requires a calibration which is performed solely for a project, the records shall be maintained in this file. If calibration is performed as an integral part of the analytical process, the calibration records should be maintained with the analytical data.

E - Analytical Data

Analytical data files should be complete for a group of samples. The file should contain raw analytical data, processing of the data and/or data reduction, and any data validation. It should be possible to use data files to completely demonstrate that the data have been adequately obtained, processed, and reviewed.

G - Quality Control Samples

If quality control samples, such as field blanks, are processed for a specific project, the data shall be maintained with the project file. The results of quality control samples processed on a general basis are included in the laboratory operations files. Statistical evaluation of quality control sample data for a project shall also be maintained in this file.

If quality control samples are processed as an integral part of a group of samples such that the data cannot be readily separated, the quality control sample data can be stored with the analytical data.

H - Data Reports

Complete copies of all reports issued by the laboratory are accessible on the Network and are not stored with the project files.

I - Project-Specific Requirements

If a project requires analytical procedures other than what is adopted in the York Quality Assurance Program, the requirements shall be included in this file. Specific requirements may be due to government regulations, specific contracts, or project need. Changes from stated practice can be, for example, frequency of QC sample analysis, test method, statistical data evaluation, and reporting format.

If it is necessary to adopt a new analytical procedure, a procedure different than conventionally used, or alter an existing procedure, the method used for the project must be documented. If the analytical procedure is developed by York as part of the analytical program, the procedure shall be documented and included. If an existing procedure is altered, the Analyst or Group Leader shall prepare a memorandum to the project file stating what the changes were and the justification for change.

J - Nonconformance

Nonconformances and subsequent corrective actions which are specific to a project are included in this file. The record should be in the form of a memorandum (or copy of other records discussed in this manual) with the nonconformance stated, how it was corrected, and the approval for the correction. A separate file for each incidence is not required, the file should be maintained chronologically.

K - QA Plan

If a specific Quality Assurance Project Plan, and revisions, are prepared for a project, they shall be stored in this file.

L - Miscellaneous

The miscellaneous file includes all records not applicable to the previous categories.

4.13.1.3 GENERAL LABORATORY OPERATIONS RECORDS

General laboratory records document overall laboratory performance and operations. These records are filed separately from project records and will be maintained so they can be referenced to project records if necessary. Examples of general records pertinent to project records are instrument log books and computer software verifications.

There are two types of general laboratory records:

< Documents which demonstrate laboratory performance

< Reference documents for laboratory operations

Records which demonstrate laboratory performance shall be filed in categories in a manner similar to project files. Reference documents are not indexed and their usage is not controlled.

Many of the laboratory operations records are in daily use, such as the Master Log Book, instrument calibration logs, and control charts. It is not intended that the records be stored daily while they are in use. However, when individual log books, etc. are filled, they shall be placed in the files.

Following is a brief discussion of the General Lab Operations records:

A - Sample Log Books

The Sample Log Books chronologically record all samples entering the laboratory, independent of project designation.

B - Instrument Calibration Logs

All calibration performed independent of a specific project shall be recorded by instrument. A separate file should be maintained for each instrument subject to calibration. These files are scanned and archived on the network by instrument and date.

C - Instrument Maintenance Logs

Separate maintenance files should be kept for each instrument incorporated in the preventive maintenance program. The file shall include records of maintenance performed in-house or by outside groups.

D - Performance Evaluation Records

Laboratory participation in Performance Evaluation Programs shall be documented in this category. If performance standards are analyzed as part of the overall quality control sample program, the results should be included in Category G.

E - Certification Program (NY, CT, NJ , PA) Records

If the laboratory participates in certification programs, such as the NELAP, ELAP, etc. program, the results shall be maintained in this category. Records should include all correspondence, analytical data, agency results, etc.

F - Control Charts

Control charts are generated and maintained on the Element LIMS.

G- Purchased Material Certificates

All information which verifies that purchased materials meet the requirements of the laboratory should be maintained. Certification may be supplied by a vendor or from in-house verification analysis. Separate files should be kept for chemicals, gases, water, glassware, etc.

4.13.1.4 RECORD CONTROL

The individual responsible for the records management system is part of the Data Management Group. This person shall:

- Initiate new project files including project index
- Add new records to existing files, initiate new files within a category, and update the index
- Assist laboratory personnel in withdrawing and returning records.

To maintain control of hard copy records within the laboratory, a Records Accession LOG is maintained. The LOG indicates:

- Project from which file is borrowed
- Date and person borrowing record
- Date returned to the record system

The dating format for records is MM/DD/YYYY.

4.13.2.1 Record Integrity

Policy:
All records are to be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.

Details:
The retention time for records is set at **five** years.

Records may be in the form of any type of media, such as hard copy or electronic media.

4.13.2.2 Record Security

Policy:
All records are held secure and in confidence.

Details:
Access to records is secured through limited access areas and computer access via user defined privileges.

4.13.2.3 Record Backup

Policy:
The SOP ADMINRECORDS043010 is followed to protect and backup data/records held on computers at all times and to prevent unauthorized access to or amendment of data/records on computers.
Details:
Data is password protected.

Backups ensure integrity and availability of data / information in the event of a system / power failure.

4.13.3 Technical Records

4.13.3.1 Record Information

Policy:
Original observations, calculations, derived data and sufficient information to establish an audit trail, calibration records, personnel records and a copy of each test report issued are retained for five years.

The records for each test shall contain sufficient information to facilitate, if possible, identification of factors affecting the test uncertainty and to enable the test or calibration to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for sampling, performing of each test and/or calibration and checking of results.

Details:
Technical records are accumulations of data (see 5.4.7) and information that result from carrying out tests and/or calibrations and which indicate whether specified quality or process parameters are achieved. They may include forms, contracts, work sheets, work books, note books, instrument printouts, magnetic media, check sheets, work notes, control graphs, test reports, calibration certificates, Client’s notes, papers and feedback, and test reports to Clients.

The records for each test contain sufficient information to permit its repetition. Records include:
- date of sampling
- sample receipt
- sample handling, storage, and disposal

- identification of personnel
- analyst proficiency
- instrumentation identification and performance
- calibration records
- media performance, where appropriate
- test batch # or lot #, where appropriate
- results
- reports (mailed, e-mailed, faxed)
- review

***Note* –** the above records may be stored in separate locations. They are cross-referenced for easy retrieval.

4.13.3.2 Recording

Policy:
Observations, data, and calculations are clearly and permanently recorded and identifiable to the specific job at the time they are made.

Details:
Handwritten records must be legible and made with indelible ink immediately after an observation, after data is collected and/or after calculations are made.

4.13.3.3 Corrections to Records

Policy:
Changes to test data are made so as not to obscure or delete the previous data entry.

Details:
Mistakes are crossed out and the correct value entered alongside. Mistakes are not erased, made illegible, or deleted. All alterations to records are signed or initialed by the person making the correction. In the case of computer-collected data, similar measures are taken to avoid loss or change of original data.

4.14 Internal Audits

4.14.1 Internal Audit Program

Policy:
The internal audit program involves periodic audits conducted according to a predetermined schedule for each year. This program is defined on an annual basis and conducted as outlined in this section with further details found in SOP ADMININTAUDIT043010. All elements of this Quality Manual will be audited each year and all relevant laboratory records are available to personnel conducting the audit. These audits are performed to verify operations continue to comply with the requirements of this Quality Manual and are effective.

Details:
The Quality Manual, test procedures, and laboratory results are verified for compliance. It is the responsibility of the Quality Assurance Officer to plan and organize audits as required by the schedule and requested by management. Audits are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel are not to audit their own activities except when it can be demonstrated that an effective audit will be carried out (see also 4.11.5). Audits are performed through the aid of a checklist prepared in advance to minimize the possibility of overlooking any details during the audit.

Generally, the types of audits include:
- quality management system
- processes and procedures
- services and reports

4.14.2 Corrective Action

Policy:
When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of test or calibration results, timely corrective action is taken and Clients are notified if investigations show that laboratory results may have been affected.

Details:
Nonconformities that can be resolved easily are to be corrected immediately, ideally during the audit. Records are made on the audit checklist. Nonconformities that require a

more involved resolution are recorded on a CAR and resolved as described in section 4.11.

Corrective actions and Client modifications must be kept on record for each audit deviation that casts doubt as described in this section.

4.14.3 Records and Management

Policy:
Records are made of the activity being audited, the audit findings, and corrective actions that arise. Management ensures that corrective actions are discharged within an appropriate and agreed timeline.

Details:
A report is prepared by the auditors and distributed to those audited and/or the area manager/supervisor within an appropriate and agreed timeline. The audit report may include the following sections, as appropriate:

- audit objective and scope
- area or section audited
- personnel involved – auditors and auditees
- date of audit
- reference documents
- observations including nonconformities and commendations
- opening and closing meetings
- recommendations
- audit report distribution

The appropriate manager is responsible for ensuring that corrective actions are sufficiently recorded. Follow-up is performed by the auditor and recorded when corrective action is complete and deemed effective. The audit records are kept in the laboratory.

4.14.4 Follow-up Audits

Policy:
Follow-up audits are performed to verify and record the implementation and effectiveness of the corrective action taken.

Details:
The follow-up audit is performed at a mutually acceptable time between the area implementing corrective action and the auditor. This time is determined when the CAR is issued.

4.15 Management Reviews

4.15.1 Review of Quality Management System and Testing

Policy:
Top management periodically (at least annually) and in accordance with a predetermined schedule and SOP ADMINMGMTREV043010, conduct a review of the laboratory's quality management system and testing activities to ensure their continuing suitability and effectiveness and to introduce any necessary changes or improvements.

Details:
The review takes account of:
- suitability of policies and procedures
- reports from managerial and supervisory personnel
- the outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of inter-laboratory comparisons or proficiency tests
- changes in the volume and type of work undertaken
- feedback from Clients, including complaints and Client satisfaction surveys
- recommendations for improvement
- other relevant factors, such as quality control activities, resources and personnel training

A minimum period for conducting a management review is once a year. Results of the review feed into the laboratory planning system and include goals, objectives and action plans for the coming year.

A management review can be supplemented by consideration of related subjects at regular management meetings.

4.15.2 Findings, Actions, and Records

Policy and Details:
Findings from management reviews and the actions that arise are recorded in the minutes of the meeting. Management will ensure that the actions are discharged within an appropriate and agreed upon timeline.

4.16 Data Integrity Plan

4.16.1 Purpose

The purpose of the Data Integrity Plan is four-fold:

(a) to describe the laboratory's data integrity system,
(b) to emphasize the paramount importance of ethics in the performance of all analytical work,
(c) to obtain the commitment of laboratory staff to the principle that all analyses shall be performed in a controlled and documented manner, and
(d) to ensure that laboratory staff consistently meet the specific ethical requirements defined in this data integrity plan.

4.16.2 Scope

This procedure applies to all analyses and activities performed within the laboratory's scope of accreditation.

4.16.3 Responsibilities

Senior managers support and provide initial data integrity training and on-going annual training to laboratory managers and staff. Senior managers ensure that only staff who sign the ethics agreement are allowed to work in the laboratory.

The QAO shall maintain records of ethics/data integrity training and data integrity monitoring.

4.16.4 Procedure

Ethics Training

Ethics training is a required part of new employee orientation and is provided on an annual basis for all laboratory managers and staff by senior laboratory management. Initial training during orientation includes the overall organizational mission and its relationship to the absolute need for honesty and full disclosure in all analytical reporting and record-keeping. Resources where applicable ethics policy and law can be found are made available and copies are distributed. Examples are described that illustrate unethical behavior and ethical behavior related to laboratory data manipulation. Laboratory standard operating procedures are reviewed with respect to proper procedure, data qualifiers, and adequacy of record keeping. Management will disclose that reports and the data generated to support them are subject to routine in-depth review.

The organizations response to infractions of the data integrity plan will be discussed and the trainee shall understand that infractions will be investigated in a detailed way. The consequences to an employee found to be in violation of the data integrity plan may result in immediate termination, debarment, and/or civil/criminal prosecution. Confidentiality is assured during this process.

Employee attendance or participation is documented.

Ethics Agreement

Following initial ethics training and on-going annual training for laboratory managers and staff, trainees shall sign a written ethics agreement. Senior managers who provide the training shall also sign the agreement. The agreement states that the signers will not engage in any unethical practices with respect to data integrity nor will they tolerate improper behavior in others if it is observed or suspected. By signing, senior managers acknowledge their duties in upholding the spirit and intent of the data integrity system and in effectively implementing the specific requirements of the plan.

Monitoring

Data integrity monitoring is accomplished by periodic data package and manual integration reviews by the QAO and/or Laboratory Director, annual internal audits, and monthly QC sample tracking. Therefore the QAO, shall have an in-depth understanding of typical inappropriate analytical behavior and be trained in the data integrity system. Refer to the laboratory's SOP "**QC Review/Evaluation of Data"** for data review.

Blind known reference samples may be submitted for analysis as real samples by the QAO, (blind to the analyst) as part of any project or event. Data and results of the reference sample are reviewed by the QAO to verify that all data integrity requirements are met.

Documentation

All data integrity incidents must be documented, including investigative findings and disciplinary actions. Corrective actions are recorded. Confidentiality is critical and maintained by use of locked filing cabinets and password protected electronic files. If client disclosure is determined to be necessary by senior laboratory management, then such disclosures and outcomes are recorded.

All data integrity documents, plans, SOPs, personal records and records of investigations shall be maintained for a period of five years. Documents are subject to the document control system and records are subject to the records management system as described in the laboratory's quality manual and related SOPs.

4.16.5 References

Internal
York Data Integrity and Ethics Training SOP (ADMIN Ethics 040102)
York Internal Quality Audit SOP (ADMIN Audit 043010)
York Manual Integration Review SOP (ADMIN ManIntReview 043010)

External
NELAC Quality Systems, Chapter 5, Sections *5.4.2.3*, *5.4.2.6, and 5.4.15*, June 5, 2003 and Module 2, *Sections 4.2.8.4, 4.2.8.1, 5.2.7, and 4.16*, August 24, 2009.

5.1 Technical Requirements

5.2 General

5.2.1 .1 Correctness and Reliability

Policy and Details:
Correctness and reliability of the tests and/or calibrations performed have many contributing factors including:

- human factors (see section 5.2)
- accommodation and environmental conditions (see section 5.3)
- test and calibration methods and method validation (see section 5.4)
- instrumentation (see section 5.5)
- measurement traceability (see section 5.6)
- sampling (see section 5.7)
- handling of test and calibration items (see section 5.8)

5.2.2 Measurement Uncertainty

Policy:
When developing test and calibration methods and procedures, total measurement uncertainty must be accounted for in the training and qualification of personnel, and in the selection and calibration of instrumentation.

Details:
The extent to which the factors contribute to total measurement uncertainty differs between (types of) tests and between (types of) calibrations.

See section 5.4.6 for more details.

5.2 Personnel

York recognizes that all laboratory personnel affect data quality. This manual has been prepared so that staff members will be cognizant of the procedures adopted by York for the production of analytical data, and so they will be aware of their responsibilities.

Staff are properly trained and qualified for their positions and specific procedures.

5.2.1 Competence and Qualification

Policy:
Management ensures the competency of all personnel charged with analysis and those evaluating results and signing test reports. Appropriate supervision is provided for employees undergoing training. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required.

In addition, personnel responsible for the opinions and interpretations included in test reports also have:

- relevant knowledge of the technology used for the analysis, materials
- knowledge of the general requirements expressed in the legislation and standards
- an understanding of the significance of deviations found with regard to the normal use of the data

Details:
Management defines the minimum levels of qualification and experience necessary for all posts within the laboratory. In some technical areas it may be required that the personnel performing certain tasks be certified. The laboratory is responsible for fulfilling specified certification requirements of personnel. The requirements for personnel certification might be regulatory, might be included in the standards for the specific technical field, or required by the client.

Continued competence is monitored and where this is not achieved, the need to retrain personnel is considered. Where a method or technique is not in regular use, verification of personnel performance prior to testing may be necessary.

5.2.2 Training Policies and Procedures

Policy:
Management will formulate the goals with respect to the education and the skills of the laboratory personnel. The training program is relevant to the present and anticipated tasks

of the laboratory. SOP# ADMIN Training Revision No. 1.4 09/04/2014 is utilized to identify training needs and providing the necessary training for personnel. The effectiveness of the training actions taken is evaluated.

Details:
The skills and knowledge are defined in the job description for each job function as described in section 5.2.4. Management compares the job description to the skills and knowledge of the new incumbent to determine the training needs.

Training in the laboratory must include all methods or parts of methods and techniques that personnel are asked to perform. Minimally, the analyst must demonstrate competency (Initial Demonstration of Capability) through observation by management and verification using replicate and/or check samples. For technicians who perform only parts of the method, confirmation of competency may be verified by observation only. Re-verification of all personnel must be performed annually on all methods or techniques pertinent to their job description.

In some cases it may be appropriate to define competence related to a particular technique or instrument rather then methods. If so, it will be necessary to define for each method, the necessary technique-based competence required together with any additional requirements.

5.2.3 Employees

Policy:
Competent permanent or part-time employees are employed in the laboratory. No contract labor is used. The Managing Director ensures that all technical employees, and key support personnel are supervised and work in accordance to the policies and procedures of this Quality Manual.

Details:
Testing must be either performed or supervised by an experienced person qualified to degree level. Personnel have relevant practical work experience and training before being allowed to perform accredited work.

5.2.4 Job Descriptions

Policy:
Current job descriptions for managerial, technical and key support personnel involved in laboratory analyses are maintained centrally on the Network with appropriate access.

Details:
Minimum contents of job descriptions include:
- the duty of performing preparation/analysis
- the act of planning analyses and evaluation of results
- the responsibility of developing and validating new methods as / when requested
- expertise and experience
- qualifications and training programs
- managerial duties if applicable

Job descriptions are dated and signed to demonstrate that each incumbent has read it and is in agreement. They are maintained current on the Network.

5.2.5 Authorized Personnel

Policy:
Management authorizes specific personnel to perform particular types of analysis, to issue test reports, to give opinions and interpretations and to operate particular types of instrumentation. Records of the relevant competence, educational and professional qualifications, training, skills and experience of all technical personnel and contracted personnel are maintained. This information is readily available and includes the date on which authorization and/or competence was confirmed and the criteria on which the authorization is based and the confirming authority.

Details:
The purpose of these records is to provide evidence that personnel have been adequately trained and their competence to perform particular tests has been assessed. In some cases it may be pertinent to state any particular limitations to competence. The records are maintained in a registry of skills and include:
- academic and professional qualifications
- external and internal courses attended
- relevant on-the-job training and retraining as necessary (i.e., demonstration of capability)
- skills and experience (i.e., resume-maintained in employee administration file)
- relevant authorizations

Records are held centrally in the Employee Training Records Log.

5.3 Accommodation and Environmental Conditions

5.3.1 Facility

Policy:
Laboratory facilities are appropriate to attain correct performance of all analyses. This may include, but not limited to, energy sources, lighting, heating, ventilation and any other environmental conditions.

Appropriate care is taken to ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement. The technical requirements for accommodation and environmental conditions that can affect the results of tests and calibrations are documented.

Details:
This section deals with the test areas in the laboratory and premises for support such as sample receipt and storage. Central laboratory supplies and services, such as water purification systems, air supply, vacuum source, and sample storage, are appropriate to facilitate proper performance of analyses.

5.3.2 Monitoring

Policy:
Critical environmental conditions are monitored, controlled and recorded as required by the relevant specifications, methods, and procedures or where they may influence the quality of the results. Due attention is paid, for example, to the potential for cross contamination by methylene chloride, acetone and hexanes which are used in the Extractions processes, as appropriate to the technical activities concerned. Analyses are stopped when the environmental conditions jeopardize the results. O

Details:
Laboratories are ventilated to reduce the levels of contamination, lower humidity, and control temperature. Laboratories' test areas are air-conditioned. The relative humidity in test areas is 45-50 and the temperature is 20-25 °C. Volatiles analyses are conducted in a separate laboratory where the air conditioning system produces a positive pressure in the laboratory and the air intake (economizer) is disabled. In addition, samples for volatiles are stored in a separate Sample Control room in their own refrigerators to minimize potential for cross contamination.

Bench tops and floors are made of impervious, smooth easily cleaned materials. There is at least two linear meters workspace per analyst while working. Walls and ceilings are made of materials that are smooth and easily cleaned.

5.3.3 Separation of Incompatible Activities

Policy:
Effective separation between neighboring areas is made when the activities are incompatible. Measures are taken to prevent cross-contamination.

Details:
Reference materials and certified reference materials must be kept separated from samples (log-in and storage). Sample log-in and storage must are segregated, in separate areas from the testing laboratory, and include proper sanitation to exclude the possibility of cross-contamination. Segregation of activities is achieved through time and space allocations.

An example of space segregation would be for a trace volatiles analysis. Physical separation of the trace volatiles analysis from Extractions using solvents is achieved through the use of separate rooms. This also applies to samples for VOA analysis.

An example of time segregation would be the coordination of activities at different times. It may be appropriate to perform work on “cleaner” samples first before starting “dirtier” type samples.

5.3.4 Controlled Access

Policy:
Access to and use of areas affecting quality of the analyses is defined and controlled.

Details:
Access to the laboratory is restricted to authorized personnel. The authorized personnel are made aware of the following items:

- the intended use of the area
- the restrictions imposed on working within such areas
- the reasons for imposing the restrictions

5.3.5 Good Housekeeping

Policy:
Measures are taken to ensure good housekeeping in the laboratory. Special procedures are prepared when necessary.

Details:
Controlled use of cleaning and pest control materials is exercised. The laboratory complies with the local health and safety requirements.

5.4 Tests and Calibration Methods and Method Validation

5.4.1 General

Policy:
Methods and procedures used for all analyses are appropriate as per:
- courier handling, transport, storage, and preparation of items to be tested
- an estimation of the measurement of uncertainty as well as statistical techniques for analysis of test data where appropriate

Instructions on the use and operation of all relevant instrumentation and on the handling and preparation of items for testing are available. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and readily available to personnel. Deviation from SOP and test methods must be documented, technically justified, authorized, and accepted by the client.

Details:
There are SOPs for sample handling, transport, storage, preparation, QA/QC procedures, and standards for approving / rejecting results. These may be combined with or separate from the method. The content of a test method or SOP generally includes:
- scope
- description of test items
- holding times
- quantities to be tested
- materials and instrumentation required
- physical environmental conditions required (temperatures, pH requirements)
- description of procedures

- sample identification
- method of recording observations and results
- safety measures
- waste management/pollution prevention
- documentation
- method for data analysis and presentation
- sensitivity of method
- quality control plan

National or state standards or other recognized specifications that contain sufficient and concise information on how to perform the analyses are not necessarily supplemented or rewritten as an internal procedure when they are written in a way that can be used as published by laboratory staff. Consideration may need to be given to providing additional documentation for optional steps in the method.

5.4.2 Selection of Methods

Policy:
Preparation and analysis methods meet the needs of the client and are appropriate for the analysis undertaken. Preference is given to reference methods published as international, Federal, or State standards. The laboratory ensures that the latest edition of a standard is used unless it is not appropriate or possible to do so. When necessary, the standard is supplemented with additional details to ensure consistent application.

Details:
Methods that have been published either in international, Federal, or State standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer are selected when the client does not specify the method to be used. These methods may be adopted from the Environmental Protection Agency, ASTM, Standard Methods for the Examination of Water and Wastewater, Various State agencies, etc.
The ability of the laboratory to achieve satisfactory performance against documented performance characteristics is verified before samples are analyzed.

Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated. The client is informed as to the method chosen. The laboratory confirms that it can properly operate standardized methods before introducing the samples for analysis.

The client is informed when the method proposed by the client is considered to be inappropriate or out of date.

5.4.3 Laboratory-Developed Methods

Policy:
Introduction of test methods developed internally is a planned activity and is assigned to qualified personnel equipped with adequate resources. Plans are updated as development proceeds and ensure effective communication among all personnel involved.

Details:
Methods developed in-house are validated and authorized before use. Where available, Certified Reference Materials (CRMs) are used to determine any systemic bias, or where possible results are compared with other techniques, preferably based on different principles of analysis. Determination of uncertainty must be part of this validation process and is essential for ongoing quality control.

5.4.4 Non-Standard Methods

Policy:
Utilization of non-standard methods is subject to agreement with the client and includes a clear specification of the client's requirements and the purpose of the test. The developed method is validated appropriately before use.

Details:
Discussion and agreement for the use of non-standard methods is recorded as part of contract review procedures (see section 4.4).

All non-standard and new tests are validated for their intended purpose. Qualitative test methods must be validated to demonstrate estimated sensitivity and specificity, relative accuracy to official methods (if appropriate), positive and negative deviation, limit of detection, matrix effect, repeatability, and reproducibility.

Quantitative test methods are validated to demonstrate specificity, sensitivity, relative accuracy, positive and negative deviation, repeatability, reproducibility, and limit of determination.

For new methods where procedures are developing rapidly, especially for emergency situations, it may be necessary to circumvent normal validation procedures. Minimally, this must be a demonstrated recovery in replicate.

New test and/or calibration methods are documented prior to providing test and/or calibration results to clients and contain at least the following information:

- appropriate identification
- scope
- description of the type of item to be tested or calibrated
- parameters or quantities to be determined
- apparatus and instrumentation, including technical performance requirements
- reference standards and reference materials required
- environmental conditions required and any stabilization period needed
- description of the procedure, including:
    - affixing identification marks, handling, transporting, storing and preparing of items
    - ensuring checks are made before the work is started
    - checking that the instrumentation is working properly and, where required, calibrating and adjusting the instrumentation before each use
    - listing method of recording the observations and results
    - indicating any safety measures to be observed
- criteria and/or requirements for approval/rejection (quality control plan)
- data to be recorded and method of analysis and presentation
- uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods

5.4.5.1 Performance Characteristics

Policy:

Validation of a method establishes, by systematic laboratory studies, that the performance characteristics of the method meet the specifications related to the intended use of the test results.

Details:

The performance characteristics of a validation plan includes, as applicable:

- selectivity and specificity
- range
- linearity
- sensitivity
- limit of detection
- limit of quantitation
- ruggedness
- accuracy
- precision
- reporting limit
- repeatability
- reproducibility
- recovery

- confirmation techniques
- criteria for the number of samples tested to validate method as per defined scope of method
- action levels where defined by regulation
- quality control incorporating statistics as applicable
- interpretation of population results as applicable

Performance characteristics that are selected take into account the intended use of the method, whether for screening, confirmatory analysis, or quantitation.
The design, verification of the method and documentation procedures for validation are planned and conducted by qualified personnel, equipped with adequate resources.

This section lists a few acceptable validation procedures. The choice of the procedure depends on the extent of the deviation from the published method.
Validation of methodology is a value judgment in which the performance parameters of the method are compared with the requirements for the test data. A prerequisite for a valid method is that data produced by the method must attain a state of statistical control. Such a state is obtained when the mean value of a large number of individual values tends to approach a limiting value called the limiting mean.

Methods may be validated by one or more alternative procedures. Some of these procedures are described below. Apparent differences can be analyzed statistically to confirm their significance. In all cases, the reasons for choosing one or more alternatives must be documented.

- analysis of standard reference materials (SRM) that are identical or almost identical to the test samples
- in the absence of suitable SRMs, analysis of reference materials that are similar in all respect to the test samples; the use and validity of this reference material must be documented
- using an alternative method to measure the same parameter provides a very high level of confidence if results are confirmed
- recovery studies by the addition of a known concentration of the parameter of interest to some of the replicates being measured

The parameters to be determined include:

- the scope of the method and any known interference
- detection limit
- the range of concentration where the method is valid
- precision and bias
- intra-laboratory variations
- inter-laboratory variations

Judgment is required to determine if some or all of the above is required. Requirements will depend largely on the extent of deviation from the original method.

Developments in methodology and techniques require methods to be changed from time to time. The difference in performance between revised and obsolete methods is established so that it is possible to compare old and new data.

Where a change in method involves only minor adjustments, such as sample size, or different reagents, the amended method is validated and the changes brought to the attention of the accreditation body at the next accreditation audit. Where the proposed change involves technology or methodology, the laboratory seeks the approval of the accreditation body.

Records are kept on all validation activities. The records include any of the performance characteristics chosen, reference procedures or guidance documents followed to validate the method or custom validation procedure, and a final confirmation (memo to file) that the method validation results are acceptable for continued use of the method. An example statement would be "This memo serves as record that the validation of the XYZ Test Method has been approved for use by [name and title of approver]".

5.4.5.2 Fit for Use

Policy:

The laboratory validates non-standardized methods, laboratory-designed/developed methods, standardized methods used outside their intended range, and amplifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs in the given application or field of application (may include procedures for sampling, handling, and transportation). The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

Details and Procedure:

Validation records are kept as in section 5.4.5.1. Included in these records is the validation procedure. The procedure used for the validation is likely to vary between different methods. Therefore, the procedures included in the laboratory records are not as detailed as a typical SOP, but are sufficient enough to re-create how the method was validated.

The techniques used for the determination of the performance of a method, are one of, or a combination of, the following:

- calibration using reference standards or reference materials

- comparison of results achieved with other methods
- inter-laboratory comparisons
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience

When changes are made in the validated non-standard method, the influence of such changes carried out is documented and if appropriate a new validation is performed.

5.4.5.3 Client's Needs

Policy:
The range and accuracy of the values obtainable from validated methods (e.g., the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object) as assessed for the intended use is relevant to the client's needs.

Details:
Validation includes the specification of the requirements, determination of the characteristics of the methods, the comparison of the requirements with the values of the characteristics of the method, and a statement on the validity.

As method development proceeds, regular review is required to verify that the needs of the client are still being fulfilled. Changing requirements requiring modifications to the development plan are approved and authorized.

Validation is always a balance between costs, risks, and technical possibilities.

5.4.6 Uncertainty of Measurement

5.4.6.1 Calibration

Policy:
Physical and chemical standards and instrumentation are calibrated or characterized internally and by subcontractors where appropriate.

Details and Procedures:
Repeatability and reproducibility data are components of measurement uncertainty and are determined as a first step towards producing estimates of this parameter. The uncertainty of measurement is available on the certificate of analysis or calibration certificate from a subcontractor.
Note – in-house calibrations include procedures for uncertainty of measurement estimates where this is common practice.

5.4.6.1.1 CALIBRATION PRACTICES

Instruments and instrumentation used at York are controlled by a formal calibration program. The program verifies that instrumentation is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and instrumentation which measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration may be performed by York personnel using reference standards, or externally by calibration agencies or instrumentation manufacturers.

This section of the Quality Manual prescribes the practices used by York to implement a calibration program. Specifics are not provided herein because the requirements for the calibration of instruments and instrumentation are dependent upon the type and expected performance of individual instruments and instrumentation. Such details are provided in the specific SOPs. Implementation is the responsibility of the Group Leaders and Analysts. The Quality Assurance Officer shall review the implementation of the program as discussed in previously.

Two types of calibration are discussed in this section:

- Operational calibration which is routinely performed as part of instrument usage, such as the development of initial calibration curves for GC, GC/MS, etc. Operational calibration is generally performed for instrument systems.

- Periodic calibration which is performed at prescribed intervals for instrumentation, such as balances and critical temperature measurement devices.

5.4.6.1.2 CALIBRATION SYSTEM

The following is a discussion of the elements comprising the calibration system.

5.4.6.1.3 Calibration Procedures

Written procedures are developed by York within the requirements of this manual for all instruments and instrumentation subject to calibration. Whenever possible, recognized procedures, such as those published by ASTM or the USEPA, or procedures provided by manufacturers are adopted. If established procedures are not available, a procedure shall be developed considering the type of instrumentation, stability characteristics of the instrumentation, required accuracy, and the effect of operational error on the quantities measured. As a minimum, the procedures shall include:

- Instrumentation to be calibrated
- Reference standards used for calibration
- Calibration technique and sequential actions
- Acceptable performance ranges
- Frequency of calibration
- Calibration documentation format

5.4.6.1.4 Instrumentation Identification

Instrumentation that is subject to calibration shall be uniquely identified so that calibration records can be designated with a specific instrument. Instrumentation identification can be by manufacturer's serial number, York inventory control number, or a unique number assigned by York.

5.4.6.1.5 Calibration Frequency

Instruments and instrumentation shall be calibrated at prescribed intervals and/or as part of the operational use of the instrumentation. Frequency shall be based on the type of instrumentation, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended use, effect of error upon the measurement process, and prior experience.

5.4.6.1.6 Calibration Reference Standards

Two types of reference standards are used within the York laboratory for calibration:

- Physical standards, such as weights for calibrating balances and certified thermometers for calibrating working thermometers and ovens, which are generally used for periodic calibration.

- Chemical standards such as Standard Reference Materials (SRMs) provided by the National Bureau of Standards NIST or NIST-traceable standards which are primarily used for operational calibration.

Whenever possible, physical reference standards shall have known relationships to nationally recognized standards (e.g., NIST) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference standards shall be documented.
Whenever possible, chemical references standards shall be directly traceable to NIST SRMs and/or EPA. If SRMs are not available, compounds of certified high purity will be used to prepare calibration standards.

5.4.6.1.7 Calibration Failure

Instrumentation that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use, or shall be tagged to indicate it is out of service. Such instrumentation shall be repaired and satisfactorily recalibrated before reuse

Scheduled calibration of instrumentation does not relieve the laboratory staff of the responsibility for using properly functioning instrumentation. If an instrumentation malfunction is suspected, the instrumentation shall be tagged and removed from service and recalibrated. If it fails recalibration, the above process shall apply.

5.4.6.1.8 Calibration Records

Records shall be prepared and maintained for each piece of instrumentation subject to calibration. Records demonstrating accuracy of reference standards shall also be maintained.

Records for periodically calibrated instrumentation shall include, as appropriate:

- Identification number of instrumentation and type of instrumentation.

- Calibration frequency and acceptable tolerances.

- Identification of calibration procedure used.

- Date calibration was performed.
- Identity of York personnel and/or external agencies performing the calibration.
- Reference standards used for calibration.
- Calibration date.
- Certificates or statements of calibration provided by manufacturers and external agencies, and traceability to national standards.
- Information regarding calibration acceptance or failure and any repair of failed instrumentation.

Records for periodically calibrated instrumentation shall be maintained in the Quality Assurance Folder Records. Records for each instrument/instrumentation and physical reference standard shall be kept in a separate folder. The title sheet for each file shall be a summary of calibrations performed. It is recommended that an index precede the instrumentation files which lists in matrix form all instrumentation and physical standards, calibration frequency, and dates for upcoming calibration. The use of a calibration due date matrix provides ready reference so that calibration can be maintained by the Group Leaders.

For instruments and instrumentation that are calibrated on an operational basis, calibration generally consists of determining instrumental response against compounds of known composition and concentration or the preparation of a standard response curve (either linear or average response factor) of the same compound at different concentrations. Records of these calibrations are be maintained in several ways:

- The calibration data for all GC, GC/MS, ICP/ICPMS, Ion Chromatography is kept in a uniquely numbered QUALITY BATCH (QB) file. These files include all initial calibrations and continuing calibrations, as well as method blanks, spikes, duplicates and control (LCS) data. The nomenclature for these files follows this example:
    - For a volatiles run on April 1, 2010 on Volatiles GC/MS # 1, the batch QA/QC data is placed in a QB file identified as QBV1040110A. The A represents the first batch of the day. If two batches are run, a B is affixed, etc.

- This unique QB number appears on all sample headers to allow for cross referencing all QA data for a particular batch to each sample.

➢ A log book for each parameter documents all calibration and QA data for each wet chemistry, gravimetric or spectrophotometric analysis.

For operational calibration, the following is recommended:

As above, calibration data must be included in a batch file system. If samples from different projects are processed together, calibration data is included in a batch folder.

- The specific SOPs detail:

- Calibration instructions (curve preparation, linear ranges, etc.).

- Procedures for chemical standards preparations.

5.4.6.1.9 <u>OPERATIONAL CALIBRATION</u>

Operational calibration is generally performed as part of the analytical procedure. Included may be the analysis of a method blank and the preparation of continuing calibration verification standard or curve. Operational calibration is dependent upon the instrumentation within York, and as previously discussed, the laboratory uses a specific SOP for this purpose.

Following is a brief discussion of the analysis of method blanks and preparation of calibration curves. Guidelines for the major instrument systems within the York laboratory follow:

5.4.6.1.10 <u>General Calibration Procedures</u>

The initial phase of a laboratory testing program requires the selection and certification of the method best suited for an individual parameter. Certification, or verification, is the elimination, or minimizing, of determinate errors which may be due to Analyst's error, the use of less-than-optimum instrumentation, reagents, solvents, or gases. The quality of materials, even though they are AR grade or better, may vary from one source to another. The Analyst must determine, through the use of reagent and/or solvent blanks, if materials are free from interfering substances which could affect the analysis. Other steps in certifying the method include the determination of a method blank and the preparation of a standard calibration curve.

5.4.6.1.11 Method Blank

After determining the individual reagent or solvent blanks, the Analyst defines the method blank to determine if the cumulative blank interferes with the analysis. The method blank is defined by following the procedures step by step, including the addition of all of the reagents and solvents, in the quantity required by the method. If the cumulative blank interferes with the determination, steps must be taken to eliminate or reduce the interference to a level that will permit the combination of solvents and reagents to be used. If the blank interference cannot be eliminated, the magnitude of the interference must be considered when calculating the concentration of specific constituents in the samples analyzed.

A method blank must be determined whenever an analysis is made. The number of blanks is determined by the method of analysis and the number of samples analyzed at a given time, but is typically one per 20 samples or one per batch whichever is less.

5.4.6.1.12 Preparation of Standard Calibration Curve

Concurrent with the preparation of reagent and method blanks, a standard calibration curve is accomplished by using calibration standards. The process is summarized as:

- Preparation of a standard calibration curve is accomplished by using five calibration standards prepared by mixing the species to be analyzed into the "solvent" that is to be introduced into the instrument.
- The concentration of the calibration standards are chosen to cover the working range of the instrument.
- All sample measurements are made within this working range.
- The calibration curve is prepared by plotting instrument response versus concentration of the species analyzed. Acceptable linearity or RSDs are defined in the analysis specific SOPs.
- Concentrations of the sample prepared with the same procedure are read directly from the calibration curve or average response factor as detailed in the SOPs.

5.4.6.1.13 GC/MS CALIBRATION PROCEDURES

This section outlines the minimum operations necessary to satisfy analytical requirements associated with the determination of various target lists of organics compounds in air, water and soil/sediment samples. The following operations must be performed routinely (as specified in the SOPs) in the laboratory:

- Documentation of GC/MS mass calibration and abundance pattern.
- Documentation of GC/MS response factor stability.
- Internal standard response and retention time monitoring.

6.2.2.1 Tuning and GC/MS Mass Calibration

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of decafluorotriphenylphosphine (DFTPP) for base/neutral and acid (BNA) compounds or p-bromofluorobenzene (BFB) for volatile compounds. The ion abundance criteria as listed in the methods or SOPs for each calibration compound should be met before samples, blanks, or standards can be analyzed.

DFTPP (decafluorotriphenylphosphine)

Each GC/MS system used for the analysis of semivolatile compounds must be tuned to meet the abundance criteria of the method for a 50 nanogram (ng) injection of DFTPP. DFTPP may be analyzed separately or as part of the calibration standard, and the criteria must be demonstrated each (12) hours of use. Documentation of the calibration must be provided in the form of a bar graph plot and as a mass listing.

BFB (p-bromofluorobenzene)

Each GC/MS system used for the analysis of volatile compounds must be tuned to meet the proper abundance criteria for a 50 ng injection of BFB. The criteria should be demonstrated each (12) hours of use. Documentation of the calibration should be provided in the form of a bar graph plot and as a mass listing.

Analysts obtain a system generated GC/MS Tuning and Mass Calibration each time an analytical system is tuned.

5.4.6.1.14 Calibration of the GC/MS System

Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system must be initially calibrated at a minimum of five concentrations to determine the linearity of response utilizing standards. For GC/MS analysis, typical linear ranges are 0.05(SIM) to 200 ng for base neutrals, 5 to 400 ng for certain phenols, and 0.1 to 1,000 ng for volatiles.

Calibration standards are prepared to cover the linear range and are detailed in the SOPs.

Semivolatiles (B/N/A)

Initial calibration of semivolatile compounds is recommended at 5 to 140 ng for SCAN analysis with SIM covering the range 0.05 to 2 ng.

Pesticides & PCB

Pesticides by GC/ECD are calibrated at five levels from 0.001 ng to 0.2 ng.

PCB's by GC/ECD are calibrated at five levels from 1 ng to 10 ng.

In all cases reference is made to the specific SOP for preparation directions.

Continuing Calibration (GC/MS and GC)

A continuing calibration standard containing all volatile or semivolatile compounds as well as all required internal standards and surrogates, is performed each 12 hours during analysis. This applies to all matrices except air, whose requirements are detailed in EPA methods TO14A/15. Compare the RF data from the standards each 12 hours with the average RF from the initial calibration for a specific instrument. A system performance check must also be made each 12 hours. If the SPCC criteria are met, a comparison of RFs is made for all compounds. This is the same check that is applied during the initial calibration. If the minimum response factors are not met, the system should be evaluated and corrective action should be taken before sample analysis begins. See the specific SOP for criteria.

5.4.6.1.15 Calibration of the Gas Chromatograph

Calibration of the gas chromatograph (GC) for pesticide and polychlorinated biphenyl (PCB) or other organic compound analyses is performed with the standardization of the instrument. A five-point standard curve is utilized.

Response factors are to be calculated for each compound at each concentration level. These RF will be averaged to generate the mean daily RF for each compound over the range of the standard curve. The mean response factor will be used to calculate the sample concentration of the compound of interest. When sample responses exceed the range of the standard curve, the sample will be diluted to fall within range of the standard curve and be reanalyzed. The results of the daily GC standardization will be tabulated and filed with the corresponding sample analyses or batch file.

5.4.6.1.16 Calibration of Inductively Coupled Plasma Spectrometer (ICP) and Inductively Coupled Argon Plasma/Mass Spectrometer (ICP/MS) and Cold Vapor AAS

The ICP and ICP/MS are standardized for the metal of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. A single standard is used to calibrate the ICP, three standards are used for ICP/MS, while five working standards of mercury (Cold Vapor AAS) are prepared by dilution of the stock standard. The concentration of the calibration standards is chosen so as to cover the working range of the instrument. Subsequently all sample measurements are made within this working range. Once the working standards are prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in micrograms of metal per milliliter of water or parts per million.

Once the instrument has been initially calibrated, the analysis of initial calibration verification (ICV) is performed. Continuing calibration verification (CCV) standards are repeated after every ten samples during sample analysis to verify instrument response during analysis and to confirm the calibration. A typical analysis sequence is presented below:

< Working standards are prepared by dilution of a stock standard solution of the metal of interest.

< A calibration curve within the working range of the instrument is established by analysis of five working standards (one for ICP).

< The working standards (ICV, CCV and blank) are reanalyzed to confirm calibration. If the calibration is not confirmed, within SOP limits, the instrument is recalibrated.

< The samples are analyzed for the metals of interest.

< Following completion of the sample analyses, the working standards are reanalyzed to confirm calibration. If calibration is confirmed, the analysis is

completed. However, if the calibration is not confirmed, the problem is corrected, and the affected samples are reanalyzed.

5.4.6.1.17 PERIODIC CALIBRATION

Periodic calibration shall be performed for instrumentation such as balances, thermometers, ovens, and furnaces that are required in analytical methods, but which are not routinely calibrated as part of the analytical procedure. Documentation of calibration is kept for each instrumentation item.

Calibration requirements are determined within the York laboratory depending upon the instrumentation used and its operating function. Following are brief example discussions for the calibration of balances and thermometers with examples of calibration data sheets to serve as a guideline for the preparation of laboratory-specific procedures.

5.4.6.1.18 Balances (Example Procedure)

All balances are verified by using weights traceable to the National Bureau of Standards (NIST) on use. Calibration weights shall be Class S or better and shall be recertified every year. If balances are calibrated by an external agency, verification of their weights shall be provided.

Calibration of balances shall be over the range in which they are most commonly used. The weighs used for calibration of each balance shall be 0.5g, 2.0g, 10.0g, 20.0g, and 100g. Acceptance for balances which are direct reading to 0.01 gram shall be $\pm$ 0.01g, to 0.0001g shall be $\pm$ 0.007g, and to 0.00001g shall be $\pm$ 0.0007g.

5.4.6.1.19 Thermometers (Example Procedure)

Certified, or reference, thermometers shall be maintained for use in calibrating working thermometers including other temperature measurement devices such as thermocouples, probes and infrared temperature sensors. Reference thermometers shall be provided with NIST traceability for initial calibration and shall be recertified every year with instrumentation directly traceable to the NIST. Working thermometers shall be compared with reference thermometers every 12 months. In addition, working thermometers shall be visually inspected by laboratory personnel prior to use.

Calibration temperatures and acceptance criteria shall be based upon the working range of the thermometer and the accuracy required for its use.

5.4.6.2 Testing Uncertainties

Policy:
The SOP ADMINESTUNCERT043010 is utilized to estimate uncertainties of measurement in testing, except when the test methods preclude such rigorous calculations. For most environmental analyses these uncertainties have been established and this procedure will be unnecessary.

In certain cases it is not possible to undertake metrologically and statistically valid estimations of uncertainty of measurement. In these cases the laboratory attempts to identify all the components of uncertainty and make the best possible estimation, and ensure that the form of reporting does not give an exaggerated impression of accuracy. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of previous experience and validation data.

Details:
The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

- requirement of the test method
- requirement by the client
- if there are narrow limits on which decisions on conformity to a specification are based

In cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the estimation uncertainty of measurement by following the reporting instructions (see section 5.10).

5.4.6.3 Uncertainty Components

Policy:
When estimating the uncertainty of measurement, all uncertainty components that are of importance in the given situation are taken into account using accepted methods of analysis.

Details:
Sources contributing to the uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and instrumentation used, the environmental conditions, the item being tested or calibrated and the operator.

The predicted long-term behavior of the tested and/or calibrated item is normally not taken into account when estimating the measurement uncertainty.

For further information, see ISO 5725 and the Guide to Expression of Uncertainty in Measurement.

5.4.7 Control of Data

5.4.7.1 Calculations and Data Transfers

Policy:
Calculations and data transfers are subject to appropriate checks in a systematic manner.

Details:
Test data are validated through the following to determine accuracy of calculations, conversions, and data transfers

- checks for transcription errors, omissions, and mistakes
- checks to determine consistency with normal or expected values

For those analyses where manual data reduction is required, it is performed according to the instructions provided in the test method or SOP.

5.4.7.2 Computers and Automated Instrumentation

Policy:
When computers or automated instrumentation are used for the acquisition, processing, manipulation, recording, reporting, storage or retrieval of test or calibration data, the laboratory ensures that:

- computer software developed by the user is documented in sufficient detail and suitably validated or otherwise checked as being adequate for use
- procedures are established and implemented for protecting the integrity of data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing (see section 4.13.1.4)
- computers and automated instrumentation are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test and calibration data
- data is securely maintained by preventing unauthorized access to, and unauthorized amendment of, computer records
- Data are backed up both on-site and off site at a frequency that allows minimal loss in the event of catastrophic failure

Details and Procedures:
Data generated using computer software programs that are interfaced directly to instruments incorporates all dilutions and calculations, thereby eliminating the need for manual data reduction. This coupled with preparation parameters done through the LIMS system yield the final results.

Commercially developed software in general use within its designed application range may be considered sufficiently validated. Laboratory software configuration / modifications are validated and documented.

Electronic records, electronic signatures, and handwritten signatures executed to electronic records must be equivalent to proper records and handwritten signatures to paper and are validated by procedures in 21 CFR. Part II (Docket No. 92NO251) RIN0910-AA29; Federal Register: March 20, 1997, Volume 62, Number 54), Rules and Regulations, pages 13429-13466. For further details see:

http://www.fda.gov/ora/compliance_ref/part11/

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	06/29/2012	Modified balance calibration procedure, tolerances.

5.5 Instrumentation

5.5.1 Required Instrumentation

Policy:
The laboratory is furnished with all items for preparation and analysis required for the correct performance of the analyses. When instrumentation is used outside the laboratory's permanent control, it ensures that the requirements of this Quality Manual are met.

Details:
Instrumentation is used in an environment appropriate to its proper performance. All instrumentation required by a test is described in each method, including the instrumentation's tolerances.

5.5.2 Required Accuracy

Policy:
Instrumentation and software used for testing are capable of achieving the accuracy required and comply with specifications relevant to the tests and/or calibrations concerned. Calibration programs are established for key quantities or values of the instruments where these properties have a significant affect on the results. When received, instrumentation, including that used for sampling, is checked to establish that it meets the laboratory's specification requirements, complies with the relevant standard specifications, and is checked and/or calibrated in accordance with section 5.6 before use.

Details:
The procedures for checking newly received instrumentation are as determined by manufacturers' specification and/or those determined by the laboratory during procurement.

5.5.3 Authorized Personnel

Policy:
Instrumentation is operated by authorized personnel. Up-to-date instructions on the use and maintenance of instrumentation (including any relevant manuals provided by the manufacturer of the instrumentation) are readily available for use by the appropriate laboratory personnel.

Details:
Access to laboratory instrumentation is controlled to ensure that only authorized personnel use instrumentation.

5.5.4 Unique Identification

Policy:
Each item of instrumentation used for testing is uniquely identified as appropriate.

Details:
Measuring and testing instrumentation is uniquely identified through an asset number of ID. Measuring and testing instrumentation includes any instrument that could affect the quality of test results. Components that can be interchanged between various instruments are tracked in instrumentation logbooks but are not assigned individual asset numbers.

5.5.5 Inventory and Maintenance Records

Policy:
Records are maintained for each item of instrumentation significant to the tests and/or calibrations performed. The records include the following:
- identity of the item of instrumentation (and its software)
- manufacturer's name, type identification, and serial number and/or other unique identification
- checks that instrumentation complies with the specification (see section 5.5.2)
- current location, where appropriate
- the manufacturer's instructions, if available, or reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and due date of next calibration
- maintenance carried out to date and the maintenance plan (includes calibration)
- damage, malfunction, modification or repair to the instrumentation

Details:
Either manual log books are maintained or a database is used to capture the above inventory information. The above information related to service and maintenance is kept in individual instrumentation files and/or binders. Other information kept in these files and/or binders may include:
- date received and date placed in service
- condition when received (e.g., new, used, refurbished)
- dates and results of calibration and/or verification and date of next calibration and/or verification
- performance history, where appropriate (e.g., response time, drift, noise level)

5.5.6 Instrumentation Procedures

Policy:
The laboratory has as an established plan for use and maintenance (including calibration) of measuring instrumentation, and appropriate use of correction factors to ensure proper functioning and in order to prevent contamination or deterioration.

Details and Procedures:
The procedures for each piece of measuring instrumentation are located in the appropriate room where the instrumentation is located or in the SOP. These procedures detail any information for safe handling, transport, storage, use, and maintenance of measuring instrumentation.

5.5.7 Out of Service Instrumentation

Policy:
Instrumentation that has either been subjected to overloading or mishandling, or gives suspect results, or has been shown to be defective or outside specified limits, is taken out of service, clearly marked, and appropriately stored until it has been repaired and shown by calibration or test to perform correctly.

Details:
Routine testing work is completely discontinued on instrumentation that even shows minor nonconformances. Not only do we do this for ethical reasons in support of our client, but minor nonconformances are often indicative of major breakdowns in expensive instrumentation. These breakdowns need to be avoided wherever possible.

Out of service instrumentation is clearly marked as outlined in section 5.5.8.

The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the “Control of Nonconforming Work” procedure as outlined in section 4.9.

5.5.8 Calibration Status

Policy:

Instrumentation requiring calibration is labeled to indicate the calibration status and/or operational status and the date when re-calibration is due when appropriate. This is not normally applicable to organics analysis instrumentation.

Details:
Calibration labels have a write-on surface and a pressure sensitive adhesive. The areas that are filled out include the person who performed the calibration, the date it was performed, the date it is due for re-calibration, and the instrumentation's identification number.

Date Calibrated:	ID#
Performed by:	
Correction:	
Calibration due:	

Measuring instrumentation that has failed calibration or is deemed out of service is labeled with one of the following labels:

CALIBRATION VOID

DO NOT USE

OUT OF SERVICE

DO NOT USE

A piece of instrumentation that is not calibrated or checked is labeled with the following label:

FOR REFERENCE ONLY

5.5.9 Return to Service

Policy:
When instrumentation goes outside the direct control of the laboratory for a period, the laboratory ensures that the function and calibration status of the instrumentation are checked and validated and shown to be satisfactory before the instrumentation is returned to service.

Details and Procedures:
The procedures used to check and ensure that the function and calibration status of the instrumentation are satisfactory before the instrumentation is returned to service are

outlined in the manufacturer's instrumentation manual. Any additional quality control checks are outlined in the applicable section of the appropriate SOP and/or test method.

5.5.10 Periodic Checks

Policy:
When intermediate checks are needed to maintain confidence in the calibration status of instrumentation, these checks are carried out periodically according to defined procedure.

Details and Procedures:
As stated in section 5.5.6, the procedures for each piece of measuring instrumentation are detailed in the related SOPs. Internal quality control checks are specified in individual test methods that are located in the appropriate laboratory areas thereby providing procedures for intermediate checks.

5.5.11 Correction Factors

Policy
Calibrations that give rise to a set of correction factors are updated along with all copies of this data (e.g., in computer software).

Details and Procedures:
The updating of correction factors, including all copies, is assured by following the appropriate test method or SOP. It is the responsibility of the Group Leaders to ensure that all copies are updated.

5.5.12 Safeguards against Adjustments

Policy:
Test instrumentation, including hardware and software, are safeguarded from adjustments that invalidate test and/or calibration results/status.

Details:
Safeguards against adjustment for laboratory instrumentation include:
- detailed SOPs and manufacturer's manuals on the operation of the instrumentation
- policies permitting only fully trained and competent personnel to operate instrumentation
- access to the laboratory is restricted to authorized personnel

Safeguards against adjustment for software include:

- password protection for important files and packages
- access to the laboratory is restricted to authorized personnel

5.6 Measurement Traceability

5.6.1 General

Policy:
All measurement and test instrumentation having an effect on the accuracy or validity of tests is calibrated and/or verified before being put into service.

Details:
The program includes a system for selecting, using, calibrating, checking, controlling, and maintaining:
- measurement standards
- reference standards used as measurement standards
- measuring and test instrumentation used to perform tests and calibrations

Procedures are documented where appropriate. All measurements that play a defining role in testing accuracy are based directly or indirectly on reference standards, reference materials, certified reference materials, or other standards or materials having appropriate traceability.

Records are maintained for each standard. These records include, as applicable:
- supplier, grade, batch#
- dates of preparation or verification
- measurement of weights, volumes, time intervals, temperatures, and pressures and related calculations
- relevant processes (e.g., pH adjustment, extraction)
- verification results
- identification of personnel involved

Reagents prepared in the laboratory are labelled to identify substance, concentration, solvent (where not water), any special precautions or hazards, restrictions of use, Lot no., and date of preparation and/or expiry. The person responsible for the preparation of the reagent is identified either from the label or from records.

5.6.2 Specific Requirements

5.6.2.1 Calibration

Policy:
The program for calibration of instrumentation is designed and operated to ensure that calibration measurements are traceable to the Système International (SI) units of measurement or NIST, where appropriate or practical.

Details:
Traceability of measurement is assured by the use of calibration services, internal and from sources that can demonstrate competence, measurement capability and traceability. The calibration certificates issued by these sources show that there is a link to a primary standard traceable to NIST. The calibration certificates contain the measurement results including the measurement uncertainty and/or a statement of compliance with an identified metrological specification (see also section 5.10.4.2).

Calibration vendors accredited to ISO 17025 or A2LA or equivalent are considered competent to provide the appropriate calibration services.

The term “identified metrological specification” means that it must be clear from the calibration certificate against which specification the measurements have been compared with, by including the specification or by giving an unambiguous reference to the specification.

When the terms “international standard” or “national standard” are used in connection with traceability, it is assumed that these standards fulfil the properties of primary standards for the realization of SI units.

Maintain certificates of all reference standards, measuring instrumentation, or certified reference material used in ensuring traceability. Where traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence of correlation of results, for example by participation in a suitable program of inter-laboratory comparisons or proficiency testing.

Reference standards, such as thermometers and weights, are traceable to a national or international standard (e.g., NIST).

5.6.2.2 Testing

5.6.2.2.1

Policy:
The requirements given in section 5.6.2.1 apply to measuring and test instrumentation with measuring functions used, unless it has been established that the associated calibration uncertainty contributes little to the total uncertainty of the test result. When this situation arises, the laboratory ensures that instrumentation used can provide the accuracy of measurement needed.

Details:
The extent to which the requirements in section 5.6.2.1 are followed depends on the relative contribution of calibration uncertainty to the total uncertainty. If calibration is the dominant factor, the requirements are strictly followed. If, however, calibration is not one of the major contributors to the total uncertainty, other ways for providing confidence may be used, as given in section 5.6.2.2.2.

5.6.2.2.2

Policy:
Where traceability to SI units of measurement is not possible and/or not relevant, other means for providing confidence in the results are applied such as:

- the use of suitable reference materials certified to give a reliable characterization of the material
- mutual-consent standards or methods which are clearly specified and agreed upon by all parties concerned
- participation in a suitable program of inter-laboratory comparisons or proficiency testing

Details:
Reliable characterization involves an estimate of recovery.

The laboratory participates in proficiency testing and/or check sample programs. The list of programs is maintained by the Quality Assurance Officer and includes NYSDOH NELAP, CTDOH Proficiency Program, and NJDEP Office of Quality Assurance for TO-15 air.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

Policy:
Reference standards are obtained or calibrated by a body that can provide traceability as described in section 5.6.2.1. For our use traceability to NIST is acceptable for most applications. Such reference standards of measurement held by the laboratory are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

Details:
Reference standards are obtained from the National Institute of Standards and Technology (NIST), if applicable.

5.6.3.2 Reference Materials

Policy:
Where possible, reference materials are traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable.

Details:
Reference materials, including calibration standards, used in chemical measurement are prepared so that the point of measurement is similar or equivalent to that of the samples. The matrix, prior to the addition of the analyte does not have a detectable concentration of the analyte. Reagents used in the preparation of reference materials, including calibration standards are of certified purity.

5.6.3.3 Intermediate Checks

Policy:
Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials are carried out according to defined procedures and schedules.

Details and Procedures:
The control check standards (Laboratory Control Samples) used to verify the accuracy of all the other standards are prepared independently from all the other standards used to establish the original calibration. These control check standards are prepared from a separate lot # or second source. It is the responsibility of the Group Leader to establish and maintain the individual schedule for each SOP and/or test method.

5.6.3.4 Transport and Storage

Policy:
The safe handling, transport, storage and use of reference standards and reference materials in order to prevent contamination or deterioration and in order to protect their integrity are defined.

Details:
Proper conditions are established for housing, handling, and care of reference standards/reference materials. All information needed to properly identify references appears on their housing, containers or in the SOP where applicable.

5.7 Sample Handling, Receipt and Initiation

Laboratory analyses are performed to produce data representative of conditions when the sample was obtained. To provide representative samples for analysis, both field and laboratory personnel must satisfactorily perform their activities. Although the purpose of this manual is to define the laboratory Quality Systems, the interrelationship of field and laboratory operations in maintaining sample integrity is briefly discussed because the effect of field operations upon resulting data quality cannot be totally separated from laboratory operations.

5.7.1 CHAIN-OF-CUSTODY

An overriding consideration for resulting data is the ability to demonstrate that the samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt and laboratory custody until disposal must be documented to accomplish this. Documentation is accomplished through a chain-of-custody record that records each sample and the individuals responsible for sample collection, shipment, and receipt.

- A sample is considered in custody if it is:
- In a person's actual possession.
- In view after being in physical possession.

- Secured so that no one can tamper with it after having been in physical custody.
- In a secure area, restricted to authorized personnel.

A chain-of-custody form is used by York personnel when shipping samples to subcontractors. This form is also used by all York's clients when submitting samples procured by the client. York does not accept samples collected by any outside or inside source without a correctly prepared chain-of-custody form.

The chain-of-custody form shall be signed by each individual who has the samples in their possession. Preparation of the chain-of-custody shall be as follows:

- The chain-of-custody record shall be initiated in the field by the person collecting the sample, for every sample. Every sample shall be assigned a unique identification number or name that is entered on the chain-of-custody form. Samples can be grouped for shipment and use a common form. The form allows for ten samples per page. If more than ten samples are shipped in the same container, more than one chain-of-custody form is required.
- The record shall be completed in the field to indicate project, sampling location, etc.
- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for Relinquished By , Received By shall be completed in the field.
- The person transporting the samples to the laboratory or delivering them for shipment shall sign the record form as Relinquished By .
- If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form shall be sealed in a watertight zip-lock bag, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier.
- If the samples are directly transported to the laboratory, the chain-of-custody may be kept in possession of the person delivering the samples.
- For samples shipped by commercial carrier, the waybill shall serve as an extension of the chain-of-custody record between the final field Control Group and receipt in the laboratory.
- Upon receipt in the laboratory, the Sample Control Group, or representative, shall open the shipping containers, compare the contents with the chain-of-

custody record, and sign and date the record. Any discrepancies shall be noted on the chain-of-custody form. Discrepancies are immediately discussed with the Project Manager for resolution.

- Chain-of-custody and any shipping records shall be maintained with the records for a specific project, becoming part of the project file.

5.7.2 FIELD COLLECTION AND SHIPMENT

York does not provide Field Collection services. Prior to collecting samples, the client'scollection team must consider the analyses to be performed so that proper sample containers and shipping containers can be assembled and the proper preservatives added to containers. In addition, field logs and record sheets, chain-of-custody forms, and analysis request records must be assembled.

All records required for documentation of field collection must be completed by the client field team. Several of the documents that affect laboratory operations are discussed herein. The primary documenting record is the chain-of-custody as discussed above.

In addition to initiating the chain-of-custody form, field personnel are responsible for uniquely identifying (required on the chain-of-custody form) and labeling samples, providing proper preservation, and packaging samples to preclude breakage during transit by York couriers or client shipment.

Every sample shall be labeled to identify:

- Unique sample number (ex. 11F0565-01, -02, etc.)
- Sample Description (such as MW-1, etc.)
- Sampling date and time
- Person obtaining sample
- Container types and methods of sample preservation/conditioning
- Analyses required (e.g., VOC 8260B, etc.)

Samples must be placed in containers compatible with the intended analysis and properly preserved. Also, collection of samples must consider the time interval between acquiring the sample and analysis (holding time) so that the sample is representative. The requirements for various analytical parameters with respect to the type of container, quantity of sample, preservation method, and maximum holding time between collection and analysis, quantity of sample, are dictated by the Federal Register, EPA SW-846 or the specific Quality Assurance Project Plan (QAPP).

It is recommended to field personnel that shipping containers are to be sealed prior to shipment, whether shipped by direct transport by field personnel or commercial carrier. The only exception to this is if sufficient holding time exists so that the samples can be held in the field and it is necessary to re-ice the containers prior to or during transport.

As soon as field personnel are ready to hand off samples from the field to the courier, the courier takes custody of them and transfers them into a cooler containing ice or ice packs sufficient to maintain 2-6^{o}C until arrival at the laboratory. Upon receipt at the laboratory, the temperature (as measured by an infrared temperature probe) is recorded on the Chain-of-Custody form. In the LIMS log-in module, all other sample related conditions are noted in the appropriate fields.

It is imperative that the analyses requested by the client be clearly provided so that analytical requirements are maintained with respect to sample holding times and limits of detection needed.

5.7.3 LABORATORY SAMPLE RECEIPT

The first step in the laboratory receipt of samples is obtaining the proper information. The information is taken by the Client Services group, documented in ELEMENT and passed on (if not) immediately to the Sample Control. The Sample Control Group shall note that the shipment is expected and notify the Client Service sand Group Leaders when samples are received. This is especially important for HOLDING TIMES SENSITIVE parameters and RUSH requests where coordination is essential to meet project deadlines. These communications are done via the RUSH NOTIFICATION and HOLDING TIME SENSITIVE parameters forms.

Upon sample receipt, the Sample Control Group performs the following:

< 5.7.3.1 Examine all samples and determine sample temperature using an Infrared thermometer. This documents that proper temperature has been maintained during shipment (if applicable). Note this on the Chain-of-Custody. If samples have been damaged during shipment, the remaining samples shall be carefully examined to determine whether they were affected. Any samples affected shall be also considered damaged. It will be noted on the chain-of-custody record that specific samples were damaged and that the

samples were removed from the sampling program. Field personnel will be notified as soon as possible that samples were damaged and that they must be re-sampled, or the testing program changed, and an estimate of the cause of damage.

5.7.3.2< Compare samples received against those listed on the chain-of-custody. Note any deviations or problems and clarify with the Project Manager or Client Services. CONFIRM preservations has been properly done (chemical preservation) by the client in the field. If this is not the case, enter this into the appropriate field in Element and preserve the samples accordingly. The client receives a Sample Condition/Receipt Report detailing any issues encountered. The lab does not confirm the following chemical preservations upon receipt which are done at the bench: Oil & Grease and Volatile Organics.

5.7.3.4 Sign and date the chain-of-custody form and attach any shipping receipts to the chain-of-custody.

5.7.3.5 Log the project into the lab LIMS system.

<
< 5.7.3.6 Open a laboratory project number and pendaflex file which will contain:

- Project identification number
- Completed Chain-of-Custody record
- Shipping receipts
- Any correspondence related to the project
- WORK ORDER which will include:
  - Client Name
  - Client Project ID
  - Lab Sample numbers
  - Client Sample Identifiers
  - Type of samples (matrix)
  - Date received in laboratory
  - Parameters to be analyzed
  - Project Pricing
  - Any special instructions (such as EDDs, ASP B deliverables, etc.)

If samples collected by Clients arrive without chain-of-custody or incorrect chain-of-custody records, the following shall be done by the Sample Control Group:

If the chain-of-custody is incorrect, a memorandum to the Project Management/Client Services is prepared stating the inaccuracy and correction in the form of a Corrective Action (CA). The CA must be signed and dated by the person originating the chain-of-custody and the Sample Control Group. The memorandum will serve as an amendment to the chain-of-custody. If the information on the chain-of-custody form cannot be corrected by the Sample Control Group or the field personnel, the samples affected shall be removed from the sampling program.

< If the chain-of-custody is not shipped with the samples, the Client personnel shall be contacted and a memorandum prepared which lists the persons involved in collecting, shipping, and receiving the samples and the times, dates, and events. Each person involved must sign and date this memorandum. The complete memorandum will be maintained in lieu of the chain-of-custody.

5.7.4 LABORATORY STORAGE OF SAMPLES

The primary considerations for sample storage are:

< Maintenance of prescribed temperature, if required, which is typically $4^{o}C \pm 2^{o}C$; some parameters may require freezing (<0.0C)

< Extracting and/or analyzing samples within the prescribed holding time for the parameters of interest.

The requirements for temperatures and holding times shall be met. Placing of samples in the proper storage environment is the responsibility of the Sample Control Group, who should notify the Group Leaders if there are any samples which must be analyzed immediately because of holding time requirements. This is accomplished by issuing a HOLDING TIME SENSITIVE NOTIFICATION FORM.

5.7.5 INITIATION OF TESTING PROGRAM

As stated previously, the chain-of-custody form is prepared by the client and submitted with the samples to the laboratory. If the analytical program is not defined with the sample shipment, Sample Control shall immediately notify the Client Services who will contact the client to determine/clarify the testing program.

The analytical program or any changes requested shall be re-entered onto the original chain-of-custody form, signed and dated. This record serves as the master analytical request form for samples and the clients' authorization to proceed.

Client Services and the Group Leaders are responsible for prioritizing samples on the basis of holding time and required reporting time into the laboratory sample stream.

5.7.6 SAMPLE DISPOSAL

The LIMS allows us to set a sample status for disposal. These records are then maintained on a sample basis in the database. There are several possibilities for sample disposition:

< The sample may be completely consumed during analysis.

< Samples may be returned to the client or location of sampling for disposal.

< The samples may be stored after the analysis. Proper environmental control and holding time must be observed if reanalysis is anticipated. If reanalysis is not anticipated, environmental conditions for storage will not be observed.

The samples may be transferred to proper drums or waste containers for final disposal by licensed waste disposal firms.

The Sample Control Group shall determine disposition of samples if not specified in the project file.

In general, York will not maintain samples and extracts longer than thirty (30) days beyond completion of analysis, unless otherwise specified.

5.8 Assuring the Quality of Test and Calibration Results

5.8.1 Quality Control / Quality Assurance

Policy:
Quality control procedures are utilized to monitor the validity of test results. These procedures are for each test method utilized in the laboratory. The resulting data are recorded so that trends are detectable (and where practicable, statistical techniques are applied to the reviewing of the results). This monitoring is planned and reviewed and may include, but not limited to, the following:

- regular use of certified reference materials and/or internal quality control using secondary reference materials
- participation in inter-laboratory comparisons or proficiency testing programs
- replicate tests or calibrations using the same or different methods
- re-testing or re-calibration of retained items
- correlation of results for different characteristics of an item

Details:
The methods utilized from the above list will be appropriate for the type and volume of the work undertaken. Records are maintained of assurance activities and any actions taken.
As a guide, for routine analyses the level of internal quality control is typically 5% of the sample throughput. For more complex procedures, 20% is not unusual and on occasions even 50% may be required. For analyses performed infrequently the use of a reference material containing a certified or known concentration of analyte, followed by replicate analyses of the sample and spiked sample is done. For analyses undertaken more frequently, systematic quality control procedures incorporating the use of control charts and check samples are implemented. These procedures are documented in the SOP for each test method.

Internal quality control schemes using statistics include:

- design of experimental/factorial analysis
- variation/regression analysis
- safety evaluation/risk analysis
- tests of significance
- quality control charts
- statistical sampling inspection

Proficiency testing helps to highlight not only repeatability and reproducibility performance between laboratories, but also systematic errors such as bias. It is important to monitor proficiency testing results as a means of checking quality assurance and take action as necessary.

The Quality Assurance Officer maintains a list of all the current proficiency testing programs the laboratory participates in, monitors the results, and notifies the appropriate personnel of both problematic and successful results.

Technical personnel use certified reference materials and reference materials to evaluate test performance on a daily basis and include daily process control checks. These data are used to evaluate the validity of the test results.

Replicate tests may be used if suitable reference material is available. These materials and proficiency test materials are available for improving repeatability.

Re-testing of test items is performed occasionally at the discretion of the supervisor or when test results seem anomalous.

5.8.2 Correction and Prevention

Policy and Details:
Quality control data are analyzed and, where they are found to be outside pre-defined criteria, planned action is taken to correct and to prevent incorrect results from being reported.

5.9 Reporting of Results

Policy:
The results of each test or series of tests are reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test or calibration methods.
The results are reported, normally in a Technical Report and include all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used or regulatory body reviewing the data. This information may include what is outlined in section 5.9.2, 5.9.3 and 5.9.4.
In the case of tests performed for internal purposes, and in the case of a written agreement with the client, the results may be reported in a simplified way. The information listed in section 5.9.2 to 5.9.4, and not reported, is kept readily available.

Details:
Test reports are issued as either hard copy, by electronic data transfer (email or web access).

5.9.2 Test reports

Policy:
Test reports (Technical Reports) include the following information, as appropriate:

- a title (e.g., “Technical Report”
- name and address of laboratory, and location where tests were carried out if different from the address of the laboratory
- unique identification of the test report (such as a project no.), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report
- name and address of the client
- identification of the method(s) used
- description, condition, and unambiguous identification of the sample(s) tested
- date of receipt of samples and date(s) of performance of the analyses
- reference to sampling procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results
- test results with, where appropriate, units of measurement
- the name(s), function(s) and signature(s) or equivalent of person(s) authorizing the test report
- a statement to the effect that the results relate only to the items tested
- Notations for Certification by analyte, data qualifiers, and sample qualifiers

Details:
Signing authority for test reports is the responsibility of the Laboratory Director. Records for individuals with signing authority for test reports are approved by the Laboratory Director and maintained by the Quality Assurance Officer.

Hard copies and electronic copies of test reports include the page number and total number of pages.

A statement is included specifying that the test report is not to be reproduced except in full, without written approval of the laboratory. Data reported to the client contains the appropriate significant digits for each test method. Low level data are identified as being below specified limits by utilizing appropriate flags.

5.9.3 Test Reports

5.9.3.1

Policy and Details:
In addition to the requirements listed in section 5.9.2, test reports include the following, where necessary for the interpretation of results:

- deviations from, additions to, or exclusions from the test method
- where relevant, a statement of compliance/non-compliance with requirements and/or specifications
- where applicable, a statement on the estimated uncertainty of measurement of the test result; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a client's instruction so requires, or when uncertainty affects compliance to a specification limit
- where appropriate and needed opinions and interpretations (see section 5.9.5)
- additional information required by specific methods, clients, or regulatory authorities.

5.9.3.2

Policy and Details:
In addition to the requirements listed in sections 5.9.2 and 5.9.3.1, test reports containing the results of sampling include the following, where necessary for the interpretation of test results:

- date of sampling
- unambiguous identification of substance, matrix, material sampled

- details of any environmental condition during sampling that may affect the interpretation of the test results
- any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

5.9.5 Opinions and Interpretations

Policy:
When opinions and interpretations are included in the test report, the basis upon which the opinions and interpretations have been made is documented. Opinions and interpretations are clearly marked as such in the test report.

Note - Opinions and interpretations should not be mixed-up with inspections and product certifications as intended in ISO/IEC 17020 and ISO/IEC Guide 65.

Details:
Opinions and interpretations included in a test report may comprise, but not be limited to the following:
- opinion on conformity of the results with requirements
- fulfilment of contractual requirements
- recommendations on how to use the results
- guidance to be used for improvements

In many cases it is appropriate to communicate the opinions and interpretations by direct dialogue with the client. This dialogue is documented in writing.

5.9.6 Test Results Obtained from Subcontractors

Policy and Details:
Test reports containing the results of tests performed by subcontractors are clearly identified for the subcontracted results. The subcontractor reports the results either in writing or electronically to our laboratory.

5.9.7 Electronic Transmission of Results

Policy:
In the case of transmission of test results by telephone, facsimile or other electronic or electromagnetic means, the requirements of the policies and procedures of this Quality Manual continue to apply (see also 5.4.7).

Details:
Reports that are "published" electronically contain a digital signature.

5.9.8 Format of Reports

Policy:
The format of reports is designed to accommodate each type of test carried out and to minimize the possibility of misunderstanding or misuse.

Details:
The layout of the test report is such that the presentation of the test data facilitates ease of assimilation by the reader.

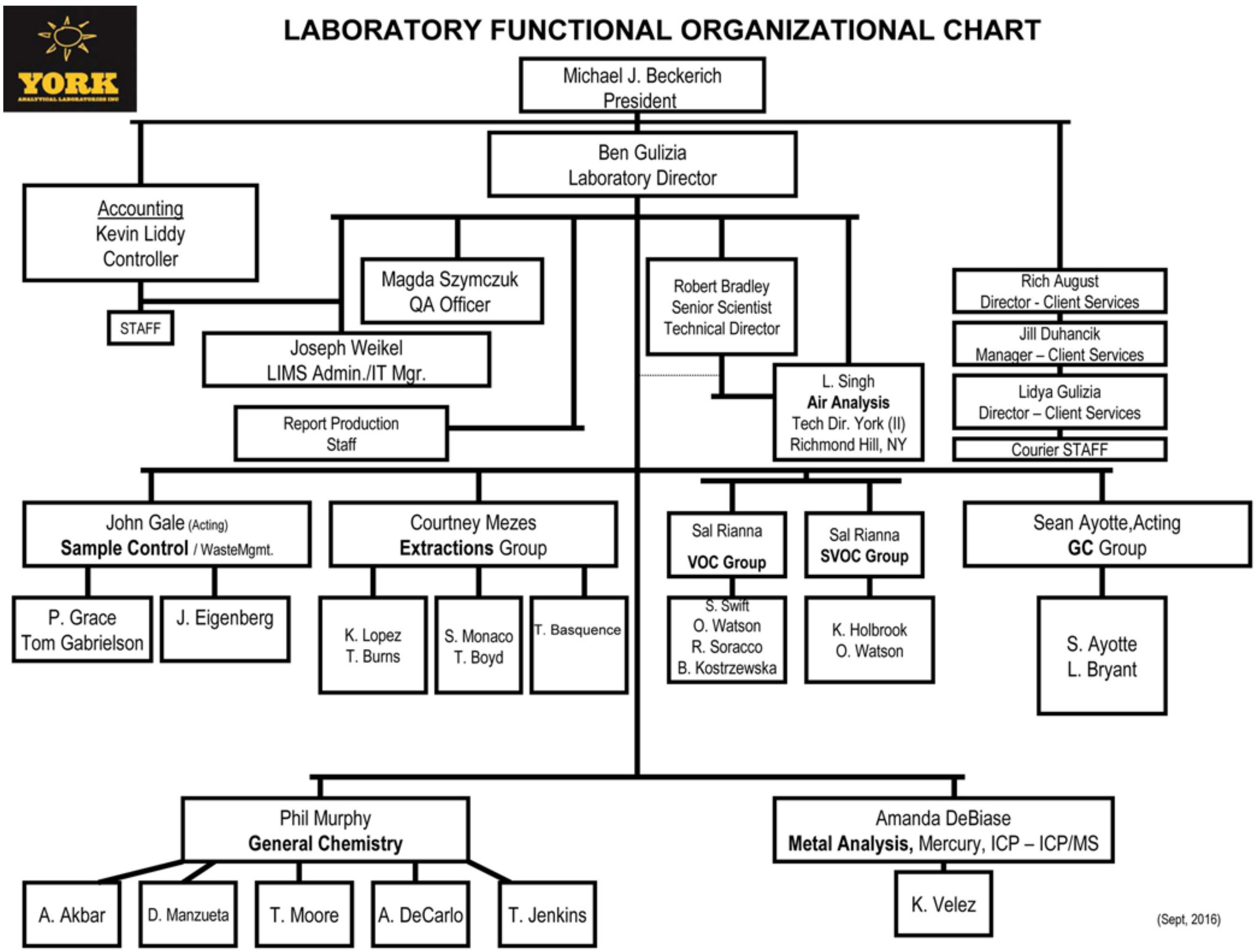
The headings are standardized as far as possible.

5.9.9 Amendments to Reports

Policy:
Material amendments to a test report after issue are made only in the form of a further document, or data transfer, which includes the statement "Revision no.   and includes a description of the revision in the notes section of the report.. Such amendments meet all the requirements in this Quality Manual.

Details:
When it is necessary to issue a complete new test report, it is uniquely identified and contains a reference to the original that it replaces.

ATTACHMENT A



ATTACHMENT B

York Analytical Laboratories

SOP LISTING as of 02/23/2017

	Description	SOP Name	Revision Date
		GC/MS - Volatiles	
1	Volatile Organics using GC/MS	GCMS VOC 011700-Rev 3.4	3/16/2016
2	Volatile Organics in Drinking Water using GC/MS by EPA 524.2	GCMS VOC524.2 011700-Rev 2.0	10/7/2015
3	Soil Sampling Procedure by EPA method 5035A	GCMS VOC5035 060712-Rev 1.0	6/7/2012
4	Screening of Aqoeous and Soil Samples for Volatile Compounds by Dynamic Headspace/GC/FID	VOASCREEN121615-Rev.1.1	11/17/2016
5	Determination of Gasoline Range Organics in Aqueous and Solid Samples by method 8015D	GC GROFID 022715-Rev. 1.0	3/18/2015
		GC/MS - Semi-volatiles	
1	Semi-Volatiles using GC/MS by EPA 8270C and 8270D	GCMS SVOC-Rev 2.9	12/23/2014
		Gas Chromatography	
1	PCBs using GC/ECD by EPA 8082	GC PCB 011799-Rev 1.7	12/1/2014
2	TPH-DRO using GC/FID by EPA 8015D	GC TPHDRO 091009 Rev.1.5	1/10/2017
3	Pesticides (Chlorinated) using GC/ECD by EPA 8081	GC Pest 011799-Rev 1.6	8/5/2015
4	Herbicides using GC/ECD by EPA 8151A	GC Herb-Rev1.6	12/19/2014
6	CT ETPH	GC ETPH 111704-Rev 1.6	2/29/2012
7	NJ EPH	GC NJEPH 031313-Rev 1.0	3/13/2013

8	EDB, DBCP	GC EDB,DBCP 102413-Rev 1.3	8/27/2015

Extractions

1	Herbicide Extraction of Solids	EXT Herb-Rev 1.5	11/22/2012
1a	Extraction of Chlorinated Herbicides from Aqueous Samples and TCLP extracts by EPA SW-846 Method 8151A	EXT AQ TCLP Herb- Rev 1.3	3/5/2015
2	UltraSonic Extraction of Solids [EPA 3550]	EXT SSVOC-Rev 2.7	2/10/2017
3	ASE Extraction of Solids [EPA 3545]	EXT SVOCASE-Rev 2.4	2/10/2017
4	Aqueous Extraction [EPA 3510C]	EXT AqSVOC -Rev 2.9	5/24/2016
5	Microwave Extraction of Solids [EPA 3546]	EXT SSVOCMAE-Rev.1.1	5/24/2016
6	Extraction Laboratory Glassware Washing Procedure	EXTGP052600Rev1.1	4/3/2012
7	Soxhlet Extraction of Solids for PCBs [3540C]	EXT PCBSox-Rev 1.1	1/5/2014
8	MA EPH Extraction from Waters and Soils	EXTMAEPHAQASE121207Rev2.0	10/22/2009
9	Spike and Surrogate Standard Preparation for Extractable Organics	EXT SVOCStds-Rev 1.3	5/31/2016
10	NJEPH Extraction from Waters and Soils	EXT NJEPH-Rev 1.1	1/15/2014
11	Extraction of Herbicides [SM 6640B]	EXT HerbSM-Rev 1.1	12/3/2014
12	Glycols Extraction with SPE Tubes	EXT GlyLL-Rev 1.1	7/13/2015

	Metals		
1	ICP/MS Analysis of Sample Digestates by EPA 200.8 and SW-846 6020A	ICPMS 080106-Rev1.4	6/1/2013
2	Preparation of Samples for Metals Analysis by ICP and ICP/MS by SW-846 3010A and 3050B	M SPrep 030695-Rev1.7	6/15/2015
3	ICP Analysis of Sample Digestates by EPA 200.7 and SW-846 6010C	M ICP 031195-Rev1.7	10/9/2015
4	Mercury by Cold Vapor Technique EPA SW-846 7470 annd 7471	M Hg 120998-Rev 1.7	6/17/2014
5	Mercury by Direct Technique EPA SW-846 7473	M Hg2-Rev 1.2	6/17/2014
6	Preparation of Aqueous Environmental Samples for Target Trace Metals Analysis by ICP and ICP/MS using Microwave Assisted Digestion EPA SW846-3015A	SOP M PrepMAD 071715	7/17/2015
	Wet Chemistry		
1	Chemical Oxygen Demand	WC COD Rev 2.3	4/29/2014
2	TKN, Ammonia and TON	WC TKN-Rev. 1.6	1/5/2014
3	Reactivity-Cyanide	WC CNR-Rev 1.3	10/22/2015
4	Hexavalent Chromium	WC Cr+6-Rev 1.5	1/5/2014
5	Total Cyanide	WC CNT-Rev1.8	10/13/2015
6	Reactivity-Sulfide	WC ReacSulf-Rev 1.4	10/22/2015

7	Alkalinity	WC T-Alk 022600-Rev 1.5	6/16/2015
8	Hexane Extactable Material (O&G)	WC HemGrav-Rev.1.8	6/8/2015
9	Ion Chromatography	WC IC-Rev2.0	10/22/2015
10	Biochemical Oxygen Demand (BOD)	WC BOD-Rev1.6	2/10/2015
11	TSS / VSS in Aqueous Samples	WC TSS-Rev1.6	8/27/2014
12	pH	WC pH-Rev1.6	1/15/2014
13	Total Phosphorous and Ortho-Phosphate	WC Phos 051000-Rev-1.5	5/1/2015
14	TCLP / SPLP Extraction	WC TCLPEX-Rev1.5	11/20/2014
15	Cyanide Amenable to Chlorination	WC CNA-Rev1.4	10/15/2014
16	Flash Point	WC FP-Rev1.5	1/15/2014
17	Methylene Blue Active Substances (MBAS)	WC MBAS-Rev1.2	1/15/2014
18	TS, VS, TDS in Aqueous Samples	WC TSTDS-Rev1.5	2/15/2016
19	Color	WC COLOR 04262010 Rev1.1	12/12/2013
20	Glassware Washing	WC GlassPrep 090299Rev2.1	12/17/2232
22	Total Phenols (low level)	WC PhenolsLL-Rev1.5	1/5/2014

23	Total Phenols	WC Phenols-Rev 1.4	1/5/2014
24	Conductivity	WCCond-Rev 1.3	1/5/2014
25	Turbidity	WC Turbidity-Rev 1.5	1/28/2014
26	TS, FS, VS and % Moisture in Solid Samples	WC TS%M 022912-Rev 1.1	9/18/2012
27	Extractable Organic Halogens (EOX) in Soil Samples	WC EOX 041112-Rev 1.2	11/9/2012
28	Total Organic Carbon (TOC) in Aqueous Samples	WC TOC Rev 1.3	4/29/2014
29	Oxidation-Reduction Potential (ORP)	WC ORP 031213-Rev 1.0	3/12/2013
30	Settleable Solids	WC SetSol-Rev 1.2	1/5/2014
31	Sulfide	WC Sulfide-Rev 1.1	1/5/2014
32	Chlorine Demand	WC Cl Demand-Rev 1.0	4/9/2014
33	TKN by Skalar	WC TKN SK- Rev 1.3	2/23/2017
	General Laboratory		
1	MDL Studies, Organics	GL MDL 113005-Rev.1.3	3/12/2012
2	Chemical Expiration Dates	GL ExpDt 041812 Rev1.0	4/18/2012
3	LOQ/LOD Determination and Verification	GL LODLOQ 122812-Rev 1.4	1/27/2017

4	Balance Calibration Check Procedure	GL Balance 082514-Rev 1.0	8/25/2014
	Sample Control		
1	Sample Control Procedures (Receipt, Log-in, Storage, Archival, Disposal)	SC Proc 011501-Rev 2.5	5/27/2015
3	Sample Handling and Chain-of-Custody for Sample Couriers	Couriers091207Rev1.1	3/25/2015
	Administration		
1	Laboratory Safety and Health	ADMINSAFETY011600Rev1.1	6/8/2015
2	Purchasing	ADMIN Purchasing 043010-Rev1.2	4/11/2013
3	Contract Review	ADMINCONTRACT043010 Rev. 1.1	10/17/2014
4	QC Review/Evaluation of Data	QC040202Rev1.1	9/28/2016
5	Education and Training in Ethics and Legal Responsibilities	ADMIN Ethics-Rev1.5	9/27/2016
6	Training of Personnel	ADMIN Training-Rev 1.4	9/4/2014
7	Manual Integration of Chromatographic Data	Admin Integration 091107 Rev. 2.2	9/28/2016
8	Laboratory Notebook Control and Use	ADMIN LabNote 091107-Rev 1.1	1/13/2013
9	Control of Records	ADMIN Records 043010-Rev 1.1	11/9/2012
10	Control of Nonconforming Work	QSP 4-9-1 Rev1.1	11/9/2012
11	Management Review	ADMINMGMTREVIEW043010Rev1.1	9/27/2016
12	Internal Quality Audit	ADMIN IntAudit 043010Rev	2/22/2017

13	Estimation of Uncertainty	ADMINESTUNCERT043010 rev 1.1	10/17/2014
14	Document Control	ADMINDOC043010Rev1.2	6/2/2012
15	Corrective/Preventive Action	ADMIN CorrAction 043010 Rev 1.2	6/15/2016
16	Complaints	COMPLAINTS043010 Rev. 1.1	9/12/2016
17	Review of Chromatographic Data for Detection of Manual Re-Integration Issues	SOP ADMINManINTReview04302010 Rev 1.0	4/30/2010
18	Additional Policies/Procedures	Additional Policies 05/07/10 Rev1.2	10/17/2014
19	EDDs and Reports for Client Connect	ADMIN REPORT100714 Rev1.0	9/16/2010
20	Preparation of CTDEP RCP Deliverables	ADMINRCPDELIVS Rev1.0	8/2/2010
21	Preparation , Documentation and Traceability of Standards within the Element LIMS	ADMIN_STDS031816 Rev 1.0	4/15/2016
	Quality Systems		
1	York Quality Systems Manual-ISO- 17025/NELAC	Quality Manual Rev.2.8	2/23/2017