PATCHOGUE FORMER MANUFACTURED

GAS PLANT

SUFFOLK COUNTY

PATCHOGUE, NEW YORK

INTERIM SITE MANAGEMENT PLAN

NYSDEC Site Number: 1-52-182

Prepared for:

National Grid

175 East Old Country Road

Hicksville, New York

Prepared by:

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Upper Saddle River, New Jersey

(201) 574-4700

Revisions to Final Approved Site Management Plan:

Revision No.	Date Submitted	Summary of Revision	NYSDEC Approval Date
0	Jan. 15, 2016	Initial Submission	

January 2016

CERTIFICATION STATEMENT

I Marek Ostrowski certify that I am currently a NYS registered professional engineer and that this Interim Site Management Plan was prepared in accordance with applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

_____ P.E.

_____DATE

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PATCHOGUE FORMER

MANUFACTURED GAS PLANT

SUFFOLK COUNTY

VILLAGE OF PATCHOGUE, TOWN OF BROOKHAVEN, NEW YORK

INTERIM SITE MANAGEMENT PLAN

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List of Acronyms

AST	Above-ground Storage Tank
BC	Brown and Caldwell
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
BUG	Brooklyn Union Gas
CAMP	Community Air Monitoring Plan
CFR	Code of Federal Regulation
COC	Certificate of Completion
CP	Commissioner Policy
CSM	Conceptual Site Model
CY	Cubic Yards
DER	Division of Environmental Remediation
DNAPL	Dense Non-Aqueous Phase Liquid
EC	Engineering Control
ECL	Environmental Conservation Law
EWP	Excavation Work Plan
FSP	Field Sampling Plan
HASP	Health and Safety Plan
IC	Institutional Control
IHWDS	Inactive Hazardous Waste Disposal Site
ISMP	Interim Site Management Plan
ISS	In-Situ Stabilization
LILCO	Long Island Lighting Company
MGP	Manufactured Gas Plant
msl	Mean Sea Level
NAPL	Non Aqueous Phase Liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes, Rules and Regulations
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDI	Pre-Design Investigation
PRR	Periodic Review Report
PSA	Preliminary Site Assessment
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
RAO	Remedial Action Objective
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
RP	Remedial Party
RSO	Remedial System Optimization
SCG	Standards, Criteria and Guidelines
SCO	Soil Cleanup Objective
SDG	Sample Delivery Group
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System

SPDI	Supplemental Pre-Design Investigation
SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
VHB	Vanasse, Hangen, Brustlin
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

ES EXECUTIVE SUMMARY

The following provides a brief summary of the controls implemented for the Patchogue Former Manufactured Gas Plant (MGP) Site (herein referred to as "Site"), as well as the inspections, monitoring, maintenance and reporting intrusive activities required by this Interim Site Management Plan (ISMP):

Site Identification:

Site Identification No. 1-52-182

Patchogue Former MGP Site, 234 West Main Street, Village of Patchogue, Suffolk County, New York

Site Institutional Controls:	1. The Site may be used for restricted residential, commercial/industrial use in accordance with the Site use restrictions as well as the applicable local zoning regulations	
	2. Environmental Easement a. Periodic certification of institutional or engineering controls; b. Development of property for restricted residential, commercial or industrial uses as defined in Part 375-1.8(g) and in accordance with local zoning regulations. c. Restricts use of groundwater as a potable or process water d. Prohibits vegetable gardens or farming; and e. Requires compliance with this Interim Site Management Plan.	
	3. ECs must be inspected at a frequency and in a manner defined in the ISMP.	
Site Engineering Controls:	1. Cover system	
	2. Perimeter chain link fencing with lockable gates	
Inspections:		Frequency
1. Cover inspection		Annually
2. Perimeter chain link fencing with lockable gates		Annually

Monitoring:	
1. Groundwater Monitoring	Semi-Annually
2. Monitoring of Engineering and Institutional Controls	Annually
Maintenance:	
1. Cover system	As needed
2. Perimeter chain link fencing with lockable gates	Annually
Reporting:	
1. Results of Groundwater Monitoring	Semi-Annually
2. Periodic Review Report (Certification of Engineering and Institutional Controls)	Annually

Further descriptions of the above requirements are provided in detail in the latter sections of this Interim Site Management Plan.

1.0 INTRODUCTION

1.1 General

This Interim Site Management Plan (ISMP) is a required element of the remedial program for the Patchogue Former Manufactured Gas Plant (MGP) located in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York (hereinafter referred to as the "Site"). Refer to Figure 1 for Site location. The Site is currently in the New York State (NYS) Inactive Hazardous Waste Disposal Site (IHWDS) Program, Site No. 1-52-182 which is administered by New York State Department of Environmental Conservation (NYSDEC).

The use of the Site as a former MGP has resulted in impacts to soils on an off-site property located immediately adjacent to (east of) the Site. This property, located at 212 West Main Street in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York will be herein referred to as the "Off-Site Property". National Grid does not own this property. Refer to section 2.1.1 for Off-Site Property location, description and owner information.

KeySpan Gas East Corporation d/b/a National Grid (a predecessor company of National Grid) entered into an Order on Consent on September 30, 1999 with the NYSDEC to remediate the Site. KeySpan Gas East Corporation is the Remedial Party (RP, also known as the Respondent) to the Administrative Order on Consent (AOC). The Site location and boundaries of this Site are provided in Figures 2A and 2B. The boundaries of the Site will be fully described in the metes and bounds Site description that will be part of the Environmental Easement. Once established, the Environmental Easement will be provided in Appendix A. The Environmental Easement is granted by the owner of the Site (the "Grantor") to the NYSDEC.

After completion of the remedial work, some MGP-related impacts will be in the subsurface at the Site and the Off-Site Property. Site Institutional and Engineering Controls (ICs and ECs), will be incorporated into the Site remedy to control exposure to remaining MGP-related impacts to ensure protection of public health and the environment. An

Environmental Easement will be granted to the NYSDEC, by the RP and recorded with the Suffolk County Clerk, which requires compliance with this ISMP and all established ECs and ICs for the Site.

ECs and ICs will be incorporated into the remedy for the Site to control exposure to remaining MGP-related impacts to ensure protection of public health and the environment. The ECs to be established on the Site as part of the remedy include a soil cover system as well as fencing with lockable gates. ICs consist of an Environmental Easement to be granted to the NYSDEC, by the RP and recorded with the Suffolk County Clerk which requires compliance with the ISMP and all established ECs and ICs for the Site. This ISMP will be finalized into an SMP once the remedy for the Site has been implemented. Post-remedial monitoring (groundwater monitoring) to determine the success of the remedy will be conducted as well as periodic inspections of the Site to assess compliance with the provisions of the Environmental Easement, and this ISMP.

ECs and ICs will also be incorporated into the remedy for the Off-Site Property to control exposure to remaining MGP-related impacts to ensure protection of public health and the environment. The Off-Site Property owner shall not interfere with the fencing and lockable gates maintained by the RP along the property line adjacent to the Site. Following the implementation of the remedy, the RP shall repair or replace the asphalt cover and the fencing/gates on the Site, as necessary.

The ECs on the Off-Site Property include the asphalt and building cover system. The Off-Site Property will be subject to similar post-remedial monitoring as described above for the Site with regard to the cover systems. The RP (National Grid) shall replace and/or repair any of the cover system on the Off-Site Property removed or damaged during implementation of the remedy. The Off-Site Property Owner will be responsible to maintain the asphalt/building cover system to address normal wear and tear and shall replace the asphalt if broken during activities conducted on the Off-Site Property (e.g., utility installation). The Off-Site Property owner agrees to execute and record with the Suffolk County Clerk a Declaration of Covenants and Restrictions (DCR) to memorialize the ISMP.

This ISMP was prepared to manage remaining MGP-related impacts at the Site until the Environmental Easement is extinguished in accordance with ECL Article 71, Title 36. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Environmental Easement and the grantor's successors and assigns. This ISMP may only be revised with the approval of the NYSDEC.

It is important to note that:

- This ISMP details the specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the ISMP is a violation of the Environmental Easement, which is grounds for revocation of the Certificate of Completion (COC);
- Failure to comply with this ISMP is also a violation of Environmental Conservation Law, 6NYCRR Part 375 and the Order on Consent (Index #D1-001-99-05; Site #1-52-182) for the Site, and thereby subject to applicable penalties.

Reports associated with the Site and the Off-Site Property can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. A list of contacts for persons involved with the Site and the Off-Site Property is provided in Appendix B of this ISMP.

This ISMP was prepared by Brown and Caldwell Associates (BC), on behalf of National Grid, in accordance with the requirements of the NYSDEC's DER-10 ("Technical Guidance for Site Investigation and Remediation"), dated May 2010, and the guidelines provided by the NYSDEC. This ISMP addresses the means for implementing the ICs and ECs at the Site that are required by the Environmental Easement to be established after the implementation of the remedy.

1.2 Revisions

Revisions to this plan will be proposed by National Grid in writing to the NYSDEC's Project Manager. Revisions may be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, upgrades to or shut-down of a remedial system, post-remedial removal of contaminated sediment or soil, or other significant change to the Site and/or Off-Site Property conditions. In accordance

with the Environmental Easement for the Site (to be established after implementation of the remedy), the NYSDEC will provide a notice of any approved changes to the ISMP, and append these notices to the ISMP that is retained in its files.

1.3 Notifications

1.3.1 Site Notification Requirements

Notifications will be submitted by the property owner (currently National Grid) to the NYSDEC and National Grid (by subsequent property owners), as needed, in accordance with NYSDEC's DER – 10 for the following reasons:

- 60-day advance notice of any proposed changes in Site use that are required under the terms of the Order on Consent, 6NYCRR Part 375 and/or Environmental Conservation Law.
- 30-day advance notice of any field activity associated with the remedial program.
- 45-day advance notice of any proposed ground-intrusive activity pursuant to the Excavation Work Plan.
- Once National Grid is made aware, notice will be provided to NYSDEC within 48-hours of any damage or defect to the foundation, structures or EC that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.
- Once National Grid is made aware, notice will be provided to NYSDEC by verbal notice by noon of the following day of any emergency, such as a fire, flood or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the ECs.

Any proposed change in the ownership of the Site, use of the Site, or the responsibility for implementing this ISMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC and National Grid (in the case of subsequent property owners) will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party (RP, also known as the Respondent) has been provided with a copy of the Order on Consent, the Record of Decision (ROD), and all approved work plans and reports, including this ISMP.
- Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing to the NYSDEC and National Grid.

Table 1A includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix B.

Table 1A: Site Notifications*

Name	Contact Information
Elizabeth Lukowski, NYSDEC Project Manager	(518) 402-9564; eblukows@gw.dec.state.ny.us
Sarah Aldridge, National Grid Project Manager	(516) 545-2568 sarah.aldridge@nationalgrid.com

* Note: Notifications are subject to change and will be updated as necessary.

1.3.2 Off-Site Property Notification Requirements

Notifications will be submitted by the Off-Site Property owner to National Grid, as needed, for the following reasons:

- 60-day advance notice of any proposed changes in the use of the Off-Site Property.
- 45-day advance notice of any proposed ground-intrusive activity to be conducted on the Off-Site Property pursuant to the Excavation Work Plan.
- Once National Grid is made aware, notice will be provided by National Grid to NYSDEC within 48-hours of any damage or defect to the foundation, structures

or EC on the Off-Site Property that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.

- Once National Grid is made aware, notice will be provided by National Grid to NYSDEC by verbal notice by noon of the following day of any emergency, such as a fire, flood or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Off-Site Property, with written confirmation by National Grid within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
- National Grid will submit follow-up status reports on actions taken to respond to any emergency event on the Off-Site property requiring ongoing responsive action submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the ECs on the Off-Site property.

Any proposed change in the ownership of the Off-Site Property, use of the Off-Site Property, or the responsibility for implementing this ISMP will include the following notifications:

- At least 60 days prior to the change, National Grid will be notified in writing of the proposed change. This will include a certification that the prospective purchaser has been provided with a copy of this ISMP.
- Within 15 days after the transfer of all or part of the Off-Site Property, the new owner's name, contact representative, and contact information will be confirmed in writing to National Grid.

Table 1B includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix B.

Table 1B: Off-Site Property Notifications*

Name	Contact Information
John Cashel	516-250-6386

* Note: Notifications are subject to change and will be updated as necessary.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

2.1 Location and Description

2.1.1 Site Location and Description

The Site is located at 234 West Main Street in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York and is identified as District 204 Section 12 Block 9 and Lot 6.4 on the Village of Patchogue Tax Map (see Figure 2A). The Site is an approximately 3.6-acre area with a maximum length (north-south) of approximately 680 feet and a maximum width (east-west) of 180 feet, and is bounded to the north by West Main Street, beyond which is a property occupied by Briarcliff College and Patchogue Lake; to the east by an unpaved access driveway and two commercial properties, beyond which is the Patchogue River; to the south by a residential area and an overflow pond to the south/southwest; and to the west by a steep slope, beyond which are a residential area and municipal storage yard (see Figure 2B – Site Layout Map). The Site has relatively flat topography with a typical elevation of approximately five feet above mean sea level (msl). The boundaries of the Site will be more fully described in Appendix A once the Environmental Easement is finalized after completion of the implementation of the remedy. Site property boundaries are provided on Figures 2A, 2B, and 3. The owner(s) of the Site parcel(s) at the time of issuance of this ISMP are: KeySpan Gas East Corporation d/b/a National Grid (a predecessor company of National Grid), 175 East Old Country Road, Hicksville, New York 11801.

2.1.2 Off-Site Property Location and Description

The Off-Site Property is located at 212 West Main Street in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York and is identified as District 204 Section 12 Block 9 and Lot 67.1 on the Village of Patchogue Tax Map (see Figure 2A). The Site is an approximately 0.9-acre area with a maximum length (north-south) of approximately 230 feet and a maximum width (east-west) of 260 feet,

and is bounded to the north by West Main Street, beyond which is a property occupied by Briarcliff College and Patchogue Lake; to the east by the Patchogue River, to the south by a portion of the Site and the Patchogue River; and to the west by the Site beyond which are a residential area and municipal storage yard (see Figures 2B and Figure 3). The Off-Site property has relatively flat topography with a typical elevation of approximately five feet above mean sea level (msl). The Off-Site Property and boundaries are provided on Figure 3. The owner of the Off-Site Property at the time of issuance of this ISMP is 210 West Main Realty Corp., 50 Gilpin Avenue, Hauppauge, New York 11788.

2.2 Physical Setting

2.2.1 Site Land Use

The Site is informally divided into three areas: the Northern Area, the Central/Core Area, and the Southern Area. The Northern Area is a rectangular area comprising the northern portion of the Site and is enclosed with a chain-link fence. This area is mostly clear of vegetation and the ground surface is comprised of two adjacent concrete slabs with a combined size of approximately 240 feet by 60 feet. The Central/Core area consists of the central portion of the Site where the majority of the former MGP structures were located. The Central/Core area is also rectangular in shape and is enclosed by a chain-link fence. This area is vegetated primarily by grass, weeds and low brush and stone installed as part of a previous remedial activity conducted at the Site. A steep slope runs along the western boundary of the Site. The Southern Area comprises the tapered southern end of the property. This area has considerable concrete debris and dense vegetation. The Site is zoned industrial and is currently undeveloped and vacant.

The properties adjoining the Site and in the neighborhood surrounding the Site primarily include commercial, residential, and industrial properties. The properties immediately south of the Site include residential properties; the properties immediately north of the Site include commercial/industrial properties; the properties immediately east of the Site include the former Above All Store Fronts and the Patchogue River; and the properties to the west of the Site include Costanza Marine Contractors. The River Avenue Elementary School is located approximately one-tenth of a mile southwest and upgradient

of the Site, with residential homes between the Site and the school. The Village of Patchogue's waste water treatment plant (WWTP) is located to the east of the Site beyond the adjacent commercial property and the Patchogue River.

Existing conditions at the Site are shown in Figure 4.

2.2.2 Site Geology

The Site is generally flat with an elevation less than five feet above mean sea level (msl). A layer of fill, consisting of sand, silt, gravel and debris, covers the Central/Core area of the Site. The fill varies in thickness but is typically approximately two to five feet thick. Beneath the fill is a layer of alluvial deposits which are likely floodplain sediments associated with the Patchogue River. These deposits consist of layers of sands, silts, clays and organic material, including peat deposits. Much of the sand in the alluvial deposits is likely derived from the underlying sand unit and locally the alluvial deposits can be similar in character to this underlying unit. The alluvial deposits are generally thin and are locally discontinuous. Underlying the alluvial deposits is a unit of sand with varying amounts of gravel. This unit is likely glacial outwash deposits deposited during the Pleistocene Epoch. The sand unit extends to a depth of at least 30 feet below ground surface (bgs), which was the depth of the deepest borings drilled during the Site investigation activities.

Geologic cross section locations are shown in Figure 5A. The geologic cross-sections are shown on Figure 5B. Site specific boring logs are provided in Appendix C.

2.2.3 Site Hydrogeology

The water table is shallow at the Site, occurring within the fill at depths typically ranging from between less than one foot to about five feet bgs. Groundwater is toward the south-southeast direction and discharges to the Patchogue River. Where it is saturated with groundwater, the glacial outwash unit described above is referred to regionally as the "upper glacial aquifer". On-site groundwater is not utilized as a drinking water source. The Village of Patchogue is serviced by a public, municipal water source. The Village of Patchogue's Department of Public Works indicated that the installation of private water wells is prohibited.

A groundwater contour map is shown in Figure 6. Groundwater elevation measurements are provided in Table 2. Groundwater monitoring well construction logs are provided in Appendix C.

2.3 Site Investigations and Remedial History

The following narrative provides a remedial history timeline and a brief summary of the available project records to document key investigative and remedial milestones for the Site. Full titles for each of the reports referenced below are provided in Section 8.0 - References.

Historical conditions of the Site are shown in Figure 7.

2.3.1 Site History

The Site was operated as a MGP from 1904 to 1926. MGPs such as this converted coal and/or petroleum products to a flammable gas which was used in the surrounding community in much the same way that natural gas is used today.

The Site was owned and operated by the Patchogue Gas Company either independently (1904 through 1926) or, from 1927, under ownership of the Long Island Lighting Company (LILCO). The MGP was constructed by the Patchogue Gas Company in approximately 1904. Identification of retorts on the earliest Sanborn Fire Insurance (Sanborn) Maps indicates that the initial gas production activities included the coal gasification process, although in Browns Directory it was reported that the Lowe water gas process was used. Furthermore, a boiler, which is a component of the water gas process, is depicted on the Sanborn map. Routine production of manufactured gas ended in 1914, and from 1922 to 1925, the facility was used for emergency gas production. In 1914, the facility was modified to store and distribute high pressure gas produced at other facilities. High pressure gas stored at, and distributed from the Site was purchased from Suffolk Gas & Electric (Bay Shore) from 1915 through 1917 and from 1918, the gas supplier is identified only as LILCO. From 1922 through 1925, emergency gas production occurred at the Site.

Review of a 1926 Sanborn Map included in the Preliminary Site Assessment (PSA) Report (Vanasse, Hangen, Brustlin [VHB], 2002) indicated a group of seven horizontal aboveground storage tanks (ASTs) were installed sometime after 1910. According to documentation from KeySpan (now National Grid), these ASTs were used for additional gas storage capacity at the Site and are incorrectly labeled as "oil tanks" on the Sanborn Maps.

The 60,000 cubic foot gas holder, initially present on the Site, is consistent with the limited production of manufactured gas at the facility; larger manufactured gas production operations would likely have required additional and larger gas holders. A gas sphere present at the Site during later operations stored gas under high pressure and is consistent with the use of the Patchogue facility for distribution of gas produced elsewhere.

The distribution facility remained until the 1970s when LILCO sold the property to third parties. From the mid-1970s through early 2005, the Site was used as a refrigeration equipment and scrap storage yard. LILCO was acquired by Brooklyn Union Gas (BUG) in 1999 and the two merged to form KeySpan. KeySpan reacquired the Site in 2005 for purposes of remediation. National Grid acquired KeySpan in 2008 and currently maintains ownership of the Site.

On September 30, 1999, KeySpan (a predecessor company to National Grid) entered into Order on Consent D1-001-99-05 with NYSDEC to conduct a PSA of the Former Patchogue MGP Site. The PSA was conducted in 2001 and the results were documented and submitted to the NYSDEC in March 2002 in the PSA Report (VHB, 2002). In 2008 and 2009, RI activities were performed and the results were documented and submitted to the NYSDEC in the Remedial Investigation Report (RIR) (TetraTech EC, December 2009).

2.3.2 Regulatory and Remedial Investigation History

The history of the Site, the findings from the assessment and investigation activities into the subsurface conditions and the nature and extent of MGP-related impacts at the Site are presented in the following documents listed on Table 3:

- "Preliminary Site Assessment Report, Order on Consent D1-0001-99-05, NYSDEC Site No. 1-52-182, Former Patchogue MGP Site, Village of Patchogue, Suffolk County, New York" prepared by Vanasse, Hangen, Brustlin and dated March 2002 (referred to as PSA);
- "Final Remedial Investigation Report for the Patchogue Former MGP Site, Patchogue, Suffolk County, New York", as prepared by TetraTech EC, Inc. and dated December 2009 (referred to as RIR);
- "Focused Feasibility Study, Patchogue Former Manufactured Gas Plant Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk" prepared by Brown and Caldwell Associates and dated May 2011;
- "Remedial Design Work Plan, Patchogue Former Manufactured Gas Plant Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York" (Brown and Caldwell Associates, February 2012);
- "Utility Corridor Work Plan (Revision 3), Patchogue Former MGP Site, Patchogue, Suffolk County, New York, Site No. 1-52-182" (Brown and Caldwell Associates, February 2012);
- "Remedial Design Report (50%-75% Submission), Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York" (Brown and Caldwell Associates, December 2012); and
- Off-Site Investigation Letter Report; Prepared by Brown and Caldwell Associates, June 2014.

The aforementioned reports are on file with the NYSDEC.

2.3.3 Conceptual Site Model (CSM)

A summary of the dense non-aqueous phase liquid (DNAPL) observations and BTEX and PAH Concentration results from the PSA (VHB, 2002), the RI activities (TetraTech EC, Inc., 2009), the Pre-Design Investigation (PDI), Supplemental PDI (SPDI) and off-site investigations are shown on Figures 5A, 5B, 8A, 8B, 8C and in Appendix E.

2.3.3.1 Site CSM

This pre-remediation Site CSM includes the results from the PSA (VHB, 2002), the RI activities (TetraTech EC, Inc., 2009), the PDI and SPDI conducted on the 234 West Main Street property (the Site).

MGP related impacts, in the form of DNAPL, were observed at investigation locations generally corresponding with the former locations of MGP-related structures located in the Central/Core Area. The DNAPL is present in two portions of the Central/Core Area as shown on the FFS Reference Figures (Figures 3-2 and Figure 3-3) in Appendix D. These areas are:

- The larger of the two areas located in the central and northeastern part of the Central/Core Area. The area is located in the vicinity of the former purifier house and east of the former gas holder extending eastward in a limited area onto the adjacent property ; and

- The smaller of the two areas (significantly smaller than the previously described area) located in the northwestern corner of the Central/Core Area.

In the central and northeastern part of the Central/Core Area, the majority of the DNAPL mass is situated in the upper ±5 to ±10 feet of the soil as shown on geologic cross-section presented as Figure 3-3 in Appendix D. Within this depth interval, DNAPL is present in zones or layers which are either saturated with DNAPL or where the DNAPL occurs at lower degrees of saturation in the form of grain coatings and blebs. The zones and layers containing DNAPL within this interval are often separated by layers where no visible impacts are discernable. At depths below approximately 10 feet bgs, DNAPL was encountered less frequently, and where present, occurs in very thin layers or lenses or as blebs or globules separated by intervals of soil where no visible impacts are discernable. Lenses, thin layers, or blebs of DNAPL were locally encountered at depths greater than 20 feet bgs in a narrow area between borings SB-128 and SB-115 and at one location in the northern portion of the Central/Core Area, in soil boring SB-122 (refer to Figure 3-2 in Appendix D). The deepest DNAPL encountered in the soil were DNAPL blebs at a depth of 22.4 feet bgs in boring SB-132 (refer to Figures 3-2 and 3-3 in Appendix D).

DNAPL was encountered in the northwest corner of the Central/Core Area within the upper approximately seven feet of soil at a few closely spaced borings (i.e., MW-2X, SB-108A, and SB-111). At MW-2X and SB-108A, DNAPL was observed as DNAPL globules, black and hardened DNAPL, and as grain coatings within the upper five feet of soil. At SB-111, DNAPL was only encountered as a 0.2 foot thick layer at a depth interval of 7.1 to 7.3 feet bgs (refer to Figure 3-3 in Appendix D).

Analyses of soil samples obtained during the investigation activities indicate that elevated BTEX and PAH concentrations (concentrations in excess of the Soil Cleanup Objective [SCO]) in the soil are associated with intervals where DNAPL was encountered (refer to Figure 3-3 in Appendix D). Concentrations of BTEX and PAH compounds in soil samples collected from intervals that are not impacted by DNAPL are typically non-detect, or if detected, are below the SCO for unrestricted use.

Some dissolved phase BTEX and PAH compounds have been detected in groundwater at concentrations above the Class GA groundwater quality criteria at well locations within the Central/Core Area (i.e., MW-5 and MW-6). On occasion, traces of DNAPL have been identified in these wells. The dissolved phase compounds are apparently attributable to contributions from the DNAPL in the subsurface. Downgradient of the Central/Core Area, concentrations of dissolved phase compounds in groundwater decrease to below the Class GA groundwater quality criteria, or to non-detect levels, before reaching the Patchogue River. This trend indicates that the BTEX and PAH compounds are undergoing natural attenuation and are not impacting the Patchogue River.

2.3.3.2 – Off-Site Property CSM

This pre-remediation CSM of Off-Site Property (212 West Main Street owned by 210 West Main Realty Corp.) CSM includes the results from the RI activities (TetraTech EC, Inc., 2009) and investigation activities conducted on the Off-Site Property by BC, on behalf of National Grid, in May 2014.

MGP related impacts, in the form of MGP DNAPL were observed at investigation locations on the Off-Site Property (212 West Main Street) located adjacent to the Patchogue Former MGP Site. The DNAPL was observed in ten investigation locations generally located east/southeast of the single building on the Site as shown on the Off-Site

Investigation Reference Figures (Figures 1, 2 and 3) in Appendix E.

The impacts encountered off-site consist of black viscous, tacky, stringy tar-like material that partially coats the sand grains and exhibits a moderate naphthalene-like odor. These impacts are generally encountered from approximately 3.5 to six feet bgs.

Analyses of soil samples obtained during the investigation activities indicate that elevated BTEX and PAH concentrations (concentrations in excess of the SCO) in the soils are associated with intervals proximal to where soils were encountered that either had an oily appearance (PASB-36 and PASB-37) or were saturated with oil (PASB-41) (refer to Figure 2 and 3 in Appendix E). Concentrations of BTEX and PAH compounds in soil samples collected from intervals that are not oil-impacted are typically non-detect, or if detected, are below the SCO for unrestricted use.

Wells MW-9S, MW-9D, MW-3 are directly downgradient of the former MGP structures, and wells MW-4S and MW-4D are downgradient and/or sidegradient. These wells are located next to the river, on the opposite side of the off-site property from the National Grid property.

There are no wells within the Off-Site Property to allow an evaluation as to whether there is MGP-related dissolved-phase constituents extending partially onto the property. There are source materials on the National Grid property directly adjacent to the Off-Site Property. In addition, the October 2010 depth-discrete groundwater samples (GW-1, GW-2, and GW-3), located adjacent to this property, indicated concentrations above Class GA groundwater quality criteria. This suggests that groundwater data within the Off-Site Property would be required to assess whether MGP-related dissolved-phase constituents are extending partly onto the Off-Site Property. Evaluation of the data from the wells located downgradient of the Off-Site Property and adjacent to the river notes the plume does not extend to the river.

2.3.4 Impacted Media and Contaminants of Concern

2.3.4.1 – Site

Releases from process equipment, tanks and piping during the former transfer and distribution processes may have resulted in MGP-related impacts in Site soils. The

locations where MGP impacts were observed during the investigation activities are concentrated in the former locations of the MGP-related structures such as the gas holder, purifier house boiler, and tanks in the Central/Core Area of the Site. These impacts were observed in the subsurface soils, predominantly in the upper ±10 feet of soil. Locally, these impacts are present at depths up to nearly 23 feet bgs, although the intervals of deeper impact are thin and less frequent.

Groundwater sampling conducted during the RI and subsequent SPDI and quarterly monitoring activities indicates that dissolved phase BTEX and PAH compounds are present at concentrations above the Class GA groundwater quality criteria in the Central/Core Area of the Site. These elevated groundwater concentrations are coincident with the locations where DNAPL was encountered in the subsurface. As indicated in the RIR, the RI investigation indicates surface soil, soil vapor, and surface water are not significant contaminant transport mechanisms and thus are not considered impacted media. In addition, the RIR and the evaluation of the Patchogue River sediments discussed in the on-site conceptual model also support that sediment is not a medium of concern at the Site.

In summary, based on the findings of the Site investigations (i.e., the PSA, RI and PDI/SPDI), exposure assessments and the evaluation of the river sediments, the impacted media that were addressed in the FFS included surface soils, subsurface soil, source material, and groundwater. The surface soils include the areal extent of the portion of the Site subject to previous filling activities and the former MGP operations area (the Central/Core Area of the Site). The surficial soils include soils to a depth of two feet. This layer includes impacted areas presumably from the former MGP operations and other historical Site activities. The impacted subsurface soils include those soils in the two portions of the Central/Core Area (i.e., the relatively large area occupying the central and northeastern part of the Central/Core Area, and the smaller area in the northwestern corner of the Central/Core Area). The depth of impacted soil ranges from ground surface to nearly 23 feet bgs. The impacted soil contains DNAPL and associated stains, sheens and odors, as well as concentrations of BTEX and PAH compounds above SCOs. DNAPL-impacted source material (source material) is considered to be the DNAPL identified during visual observations noted as part of the investigation activities and described in the boring logs as blebs, black saturated, globs and DNAPL material. MGP DNAPL-impacts are the contaminants of concern and the source material of impacts to soils and groundwater.

Petroleum impacts, noted through visual and olfactory observations during the investigation activities, were co-mingled with the MGP-related impacts. Groundwater will be remediated by the treatment or removal of MGP DNAPL impacts as the potential source to groundwater.

2.3.4.2 – Off-Site Property

Releases from process equipment, tanks and piping during the former transfer and distribution processes may have resulted in MGP-related impacts in off-site soils. MGP-related DNAPL consisting of black viscous, tacky, stringy tar-like material that partially coats the sand grains and exhibits a moderate naphthalene-like odor, was observed at investigation locations on the Off-Site Property adjacent to the Patchogue Former MGP Site. Petroleum impacts, noted through visual and olfactory observations during the investigation activities, were co-mingled with the MGP-related impacts.

As discussed above in Section 2.3.3.2, additional groundwater quality data is necessary to evaluate the extent of MGP-related dissolved-phase constituents that may extend partially onto the Off-Site Property.

Source material is considered to be the DNAPL identified during visual observations noted as part of the investigation activities and described in the boring logs as black viscous, tacky, stringy tar-like material that partially coats the sand grains and exhibits a moderate naphthalene-like odor. MGP-related DNAPL impacts are the contaminants of concern and the source material of impacts to soils and potentially to groundwater. Potentially impacted groundwater would be remediated by the treatment or removal of MGP DNAPL impacts as the potential source to potential groundwater impacts on the Off-Site Property.

2.4 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the Site as listed in the ROD dated March 31, 2011 are as follows:

Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with contaminated groundwater.

RAOs for Environmental Protection

- Restore groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Remove the source of ground or surface water contamination.

Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

NAPL (in the form of DNAPL)

RAOs for Environmental Protection

- Remove/treat free product/DNAPL identified at the Site to the extent technically practicable.
- Eliminate through removal, treatment and/or containment of the free product/DNAPL source of contamination to other environmental media.

Soil Vapor

RAOs for Public Health Protection

- Address exposures to the public related soil vapor intrusion into buildings.

RAOs for Environmental Protection

- Eliminate, to the extent practicable, the impact of contaminants in soil or groundwater to soil vapor.

2.5 Remaining MGP-Related Impacts

2.5.1 Site Soils

Tables 4A1, 4A2 and 4A3 and Figures 8A, 8B and 8C summarize the results of remaining MGP-related on-site impacts that exceed the Unrestricted Use, Restricted Residential Use or Commercial Use SCOs, respectively, after completion of remedial action. The exceedances are observed in soil samples collected from depths that range from one to 10 feet bgs. One or more PAH compounds exceed the applicable SCOs at eight on-site soil boring locations; no exceedances of BTEX were observed at these locations.

2.5.2 Off-Site Property Soils

Table 4B1, 4B2 and 4B3 as well as Figures 8A, 8B and 8C summarize the results of remaining MGP-related off-site impacts that exceed the Unrestricted Use, Restricted Residential Use or Commercial Use SCOs, respectively, after completion of remedial action. The exceedances are observed in soil samples collected from five to seven feet bgs. One or more PAH compounds exceed the applicable SCOs at two off-site soil boring locations; no exceedances of BTEX were observed at these locations.

2.5.3 Groundwater

Isolated impacts to groundwater were detected in two monitoring wells (MW-5 and MW-6), during the RI, in the area of the former MGP operations and DNAPL-impacted soils. The isolated exceedances of the Class GA groundwater quality criteria

noted in the samples are anticipated to diminish since the DNAPL-impacted soils (source material) is addressed. Groundwater monitoring activities will continue at the Site to assess natural attenuation, as determined by the NYSDEC, until residual groundwater concentrations are found to be consistently below ambient water quality standards, the Site Standards, Criteria and Guidelines (SCGs), or have become asymptotic at an acceptable level over an extended period.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 General

Should MGP-related impacts remain at the Site/Off-Site Property after implementation of the remedy, Institutional Controls (ICs) and Engineering Controls (ECs) will be required to protect human health and the environment. This IC/EC Plan describes the procedures for the implementation and management of IC/ECs at the Site. The IC/EC Plan is one component of this ISMP and is subject to revision by the NYSDEC.

This plan provides:

- A description of IC/ECs on the Site and the Off-Site Property;
- The basic implementation and intended role of each IC/EC;
- A description of the key components of the ICs set forth in the Environmental Easement for the Site (to be established after implementation of the remedy);
- A description of the DCR for the Site as well as the Off-Site Property as established through agreement between National Grid and the owner of the Off-Site Property;
- A description of the controls to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of IC/ECs, such as the implementation of the Excavation Work Plan (EWP) (as provided in Appendix F) for the proper handling of remaining MGP-related impacts that may be disturbed during maintenance or redevelopment work on the Site;
- A description of the roles and responsibilities of each party with respect to this ISMP, and
- Any other provisions necessary to identify or establish methods for implementing the IC/ECs required by the remedy, as determined by the NYSDEC.

3.2 Institutional Controls

3.2.1 Site Institutional Controls

A series of ICs is required by the ROD to be implemented at the Site after completion of the remedy: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future exposure to remaining MGP-related impacts; and, (3) limit the use and development of the Site to restricted residential, commercial and industrial uses only. Adherence to these ICs on the Site is required by the Environmental Easement and will be implemented under this ISMP. ICs identified in the Environmental Easement may not be discontinued without an amendment to or extinguishment of the Environmental Easement. The IC boundaries are shown on Figure 9. These ICs are:

- The RP (Respondent) or Site Owner is to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8(h)(3);
- The property may be used for: restricted residential, commercial and industrial use or as defined by Part 375-1.8(g), though land use is subject to local zoning laws;
- ECs must be operated and maintained by National Grid as specified in this ISMP;
- ECs must be inspected at a frequency and in a manner defined in the ISMP.
- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the New York State Department of Health (NYSDOH) or the Suffolk County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department;
- Groundwater and other environmental or public health monitoring must be performed as defined in this ISMP;
- Data and information pertinent to Site management must be reported at the frequency and in a manner as defined in this ISMP;
- Future intrusive activities that will disturb remaining MGP-related impacted material must be conducted in accordance with this ISMP;

- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this ISMP;
- Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this ISMP;
- Access to the Site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Environmental Easement (to be established after implementation of the remedy).
- The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 9, and any potential impacts that are identified must be monitored or mitigated;
- Vegetable gardens and farming on the Site are prohibited;
- Must comply with the Department approved ISMP; and
- Must comply with the Department approved Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP).

3.2.2 Off-Site Property Institutional Controls

ICs will be implemented after completion of the remedy at the Off-Site Property, which are agreed to between National Grid and the owner of the Off-Site Property. The ICs include: (1) implement, maintain and monitor EC systems; (2) prevent future exposure to remaining MGP-related impacts; and, (3) limit the use and development of the Off-Site Property to restricted residential, commercial and industrial uses. The Off-Site Property owner agrees to execute and record a Declaration of Covenants and Restrictions (DCR) to memorialize the ISMP. The IC boundaries are shown on Figure 9. These ICs are:

- The RP (Respondent) is to complete and submit to the Department a periodic certification of institutional and engineering controls in accordance with Part 375-1.8(h)(3);
- The Off-Site Property may be used for: restricted residential, commercial and industrial use or as defined by Part 375-1.8(g), though land use is subject to local zoning laws;

- ECs must be operated and maintained by the Owner through notification to National Grid as specified in this ISMP;
- National Grid will inspect at a frequency and in a manner defined in the ISMP.
- The use of groundwater underlying the Off-Site Property will be prohibited without prior approval of National Grid in order to ensure it is safe for use as drinking water or for industrial purposes. The owner of the Off-Site Property must first notify National Grid and obtain written approval to do so from the National Grid;
- Groundwater and other environmental or public health monitoring must be performed as defined in this ISMP;
- Data and information pertinent to management of the Off-Site Property must be reported to National Grid at the frequency and in a manner as defined in this ISMP;
- The Owner of the Off-Site Property must notify National Grid prior to future intrusive activities that will disturb remaining MGP-related impacted material. The invasive activities must be conducted in accordance with this ISMP;
- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in this ISMP;
- Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this ISMP;
- Access to the Off-Site property must be provided to National Grid with reasonable prior notice to the owner of the Off-Site Property to assess compliance with the restrictions identified by the DCR.
- The potential for vapor intrusion must be evaluated for any buildings developed in the area within the IC boundaries noted on Figure 9, and any potential impacts that are identified must be monitored or mitigated;
- Vegetable gardens and farming on the Off-Site Property are prohibited;
- Must comply with the DCR and the provisions of this ISMP; and
- Must comply with National Grid's Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP).

3.3 Engineering Controls

The following engineering controls (ECs) are to be implemented after completion of the remedy on the Site and the Off-Site Property.

3.3.1 Site Engineering Controls

3.3.1.1 Site - Soil Cover System

The western portion of the Site was subject to previous remedial activities to allow for relocated on the utility poles currently on the eastern perimeter of the Site to the western side. The remedial activities included, but were not limited to, establishment of a 24 inches of clean gravel cover which minimizes potential exposure to MGP-related impacts in this area.

Exposure to remaining MGP-related impacts at the Site is prevented by a cover system placed over the Site. This cover system is comprised of a minimum of 24 inches of clean backfill. Figure 10 presents the location of the cover system and applicable demarcation layers. The EWP provided in Appendix F outlines the procedures required to be implemented in the event the cover system is breached, penetrated or temporarily removed, and any underlying remaining MGP-related impacts are disturbed. Procedures for the inspection of this cover are provided in the Monitoring and Sampling Plan included in Section 4.0 of this ISMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in a HASP and associated CAMP prepared for the Site and provided in Appendix G.

3.3.1.2 Site – Perimeter Fencing with Lockable Gates

Unauthorized access to the Site is prevented by fencing with lockable gates placed around the perimeter of the Site. The fence is 6 feet in height. Figure 10 presents the location of the fencing. Procedures for the inspection of the fencing are documented in the Monitoring and Sampling Plan (Section 4.0 of this ISMP). Figure 10 shows the location of the ECs for the Site.

3.3.2 Off-Site Property Engineering Controls – Asphalt and Building Cover System

Exposure to the remaining MGP-related impacts on the adjacent Off-Site Property are minimized by the presence of the building and its foundation system as well an asphalt cover system. Figure 10 presents the location of the cover system. Procedures for the inspection of the asphalt cover are documented in the Monitoring and Sampling Plan (Section 4.0 of this ISMP). Figure 10 shows the location of the ECs for the Off-Site Property.

3.3.3 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered complete when monitoring indicates that the remedy has achieved the remedial action objectives identified by the decision document. The framework for determining when remedial processes are complete is provided in Section 6.4 of NYSDEC DER-10.

3.3.3.1 Site - Soil Cover System

The on-site soil cover system is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in accordance with this ISMP in perpetuity.

3.3.3.2 Site – Perimeter Fencing with Lockable Gates

The on-site fencing system is a permanent control and the quality and integrity of this system, will be inspected at defined, regular intervals in accordance with this ISMP in perpetuity.

3.3.3.3 Off-Site Property – Building and Asphalt Cover System

The building and its foundation and the asphalt cover system on the Off-Site Property is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in accordance with this ISMP in perpetuity.

3.3.3.4 Monitoring Wells associated with Monitored Natural Attenuation

National Grid, as the RP, will perform post-remediation groundwater monitoring activities, via a monitoring well network, on the Site and the Off-Site Property to assess natural attenuation will continue, as determined by the NYSDEC in consultation with NYSDOH, until residual groundwater concentrations are found to be consistently below ambient water quality standards, the Site SCGs, or have become asymptotic at an acceptable level over an extended period. The monitoring well network to be utilized to perform the post-remediation monitoring will be developed during the design phase of the remedial project. Semi-annual groundwater monitoring which is currently conducted at the Site and the Off-Site Property may or may not be conducted during implementation of the remedy. In the event that monitoring data indicates that monitoring for natural attenuation may no longer be required, a proposal to discontinue the system will be submitted by the RP. Monitoring will continue until permission to discontinue is granted in writing by the NYSDEC. If groundwater contaminant levels become asymptotic at a level that is not acceptable to the NYSDEC, additional source removal, treatment and/or control measures will be evaluated.

It is the responsibility of the owner of the Off-Site Property to provide National Grid (or subsequent property owners) access to the monitoring wells located on the Off-Site Property. National Grid (or subsequent property owners) will supply the Off-Site Property owner with a minimum of three days' notice prior to the need to access the wells.

4.0 MONITORING AND SAMPLING PLAN

4.1 General

This Monitoring and Sampling Plan describes the measures for evaluating the overall performance and effectiveness of the remedy on both the Site and the Off-Site Property. National Grid, as the RP (Respondent), maintains responsibility for implementing the requirements of the Monitoring and Sampling Plan. The owner of the Off-Site Property maintains the notification requirements included in this ISMP. This Monitoring and Sampling Plan may only be revised with the approval of the NYSDEC. National Grid maintains responsibility to present proposed revisions of the plan to the NYSDEC and gain their approval. Details regarding the sampling procedures, data quality usability objectives, analytical methods, etc. for samples collected as part of Site management for the Site are included in the Quality Assurance Project Plan (QAPP) provided in Appendix H.

This Monitoring and Sampling Plan, to be implemented by National Grid, describes the methods to be used for:

- Sampling and analysis of groundwater via wells located on the Site as well as on the Off-Site Property;
- Monitoring of the cover systems on the Site and the Off-Site Property;
- Monitoring of the perimeter fencing and lockable gates on the Site;
- Assessing compliance with applicable NYSDEC SCGs, particularly groundwater standards and Part 375 SCOs for soil; and
- Evaluating Site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment.

To adequately address these issues, this Monitoring and Sampling Plan provides information on:

- Sampling locations, protocol and frequency;
- Information on designed monitoring systems;

- Analytical sampling program requirements;
- Inspection and maintenance requirements for monitoring wells;
- Inspection and maintenance requirements for the soil and asphalt cover;
- Monitoring well decommissioning procedures; and
- Annual inspection and periodic certification.

Reporting requirements are provided in Section 7.0 of this ISMP.

4.2 Site-Wide Inspection

A comprehensive site-wide inspection will be performed by National Grid's Qualified Environmental Professional (QEP) on both the Site and the Off-Site Property and documented annually by National Grid. Modification to the frequency or duration of the inspections will require approval from the NYSDEC. Site-wide inspections will also be performed by National Grid's QEP after severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form will be completed as provided in Appendix I – Site Management Forms. The form will compile sufficient information to assess the following:

- Compliance with ICs, including usage of the Site and the Off-Site Property;
- An evaluation of the condition and continued effectiveness of ECs located on the Site and the Off-Site Property;
- General conditions of the Site and the Off-Site Property at the time of the inspection;
- The management activities being conducted on the Site and the Off-Site Property including, where appropriate, confirmation sampling and a health and safety inspection; and
- Confirm that Site and Off-Site Property records are up to date.

Inspections of remedial components installed at the Site and the Off-Site Property will be conducted by National Grid's QEP. A comprehensive site-wide inspection will be conducted and documented according to the ISMP schedule, regardless of the frequency of the Periodic Review Report. The inspections will determine and document the following:

- Whether ECs located on the Site and the Off-Site Property continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this ISMP and the Environmental Easement established on the Site;
- Compliance with requirements of this ISMP and the DCR established on the Off-Site Property;
- Achievement of remedial performance criteria; and
- If Site and Off-Site records are complete and up to date.

Reporting requirements are outlined in Section 7.0 of this plan.

Inspections will also be performed by National Grid's QEP on the Site and the Off-Site Property in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs that reduces or has the potential to reduce the effectiveness of ECs in place at the Site or the Off-Site Property, once National Grid is notified by 210 West Main Realty Corp., verbal notice to the NYSDEC, by National Grid once notified, must be given by noon of the following day, to the extent possible. In addition, an inspection of the Site and the Off-Site Property will be conducted by National Grid's QEP within 5 days of the event to verify the effectiveness of the ICs and ECs . Written confirmation must be provided to the NYSDEC within 7 days of the event that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public. This confirmation will be made by National Grid.

4.3 Post-Remediation Monitoring and Sampling

National Grid's QEP will collect groundwater samples from the monitoring wells located on the Site and the Off-Site Property on a semi-annual basis. Sampling locations, required analytical parameters and schedule are provided in Table 5 – Post Remediation Groundwater Sampling Requirements and Schedule. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

Detailed sample collection and analytical procedures and protocols are provided in Appendix J – Generic Field Sampling Plan (FSP) and Appendix H – Generic QAPP.

4.3.1 Groundwater Sampling

Groundwater monitoring will be performed by National Grid's QEP using the monitoring wells located on the Site and the Off-Site Property on a semi-annually to assess the performance of the remedy. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

The network of monitoring wells will be installed to monitor upgradient, on-site and downgradient groundwater conditions at the Site. The network of wells on the Site and the Off-Site Property will be designed to determine the degree of contaminant reduction in the groundwater associated with implementation of the remedy and natural attenuation processes.

Table 6 summarizes the well identification numbers, as well as the purpose, location, depths, diameter and screened intervals of the wells. As part of the current pre-remediation groundwater monitoring, upgradient wells, on-site wells and downgradient wells are sampled to evaluate the effectiveness of the remedial system. Monitoring well construction logs are included in Appendix C of this document. A plan for the post-remediation monitoring well network will be developed during the design of the remedial plan.

If biofouling or silt accumulation occurs in the monitoring wells located on the Site and/or the Off-Site Property, the wells will be physically agitated/surged and redeveloped by National Grid's QEP. Additionally, monitoring wells will be properly decommissioned and replaced by National Grid's QEP, if an event renders the wells unusable.

Repair and/or replacement of wells in the monitoring well network will be performed by National Grid's QEP based on assessments of structural integrity and overall performance.

The NYSDEC will be notified prior to any repair or decommissioning of any monitoring well for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent Periodic Review Report. Well decommissioning without replacement will be done only with the prior approval of the

NYSDEC. Well abandonment will be performed in accordance with NYSDEC's guidance entitled "CP-43: Groundwater Monitoring Well Decommissioning Procedures." Monitoring wells that are decommissioned because they have been rendered unusable will be replaced in kind in the nearest available location, unless otherwise approved by the NYSDEC.

The sampling frequency may only be modified with the approval of the NYSDEC. This ISMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Deliverables for the groundwater monitoring program are specified in Section 7.0 – Reporting Requirements.

4.3.2 Monitoring and Sampling Protocol

Sampling activities will be recorded by National Grid's QEP in a field book and associated sampling log as provided in Appendix I - Site Management Forms. Other observations (e.g., groundwater monitoring well integrity, etc.) will be noted on the sampling log. The sampling log will serve as the inspection form for the monitoring network. Additional detail regarding monitoring and sampling protocols are provided in the Generic FSP provided as Appendix J of this document.

4.4 Engineering Control Monitoring

The cover systems and the perimeter fencing with lockable gates at the Site and the cover systems on the Off-Site Property provide a physical barrier over remaining MGP-related impacts. Annual inspections of these ECs will be performed by National Grid's QEP in order to determine their integrity, operability, and effectiveness. The ECs will be inspected to document that they continue to function as designed and intended to protect public health and safety and the environment. National Grid's QEP will conduct the inspections of the ECs on the Site and the Off-Site Property. Correction of deficiencies and/or required maintenance will be conducted in a timely manner by National Grid for the ECs on the Site. The Owner of the Off-Site Property will maintain responsibility to monitor and maintain the ECs on the Off-Site Property once established after implementation of the remedy. Each, alteration, excavation, or disturbance of the ECs is to

be addressed appropriately and in a timely manner to maintain the integrity of the engineering control. A record of inspections will be maintained by National Grid, including the inspection dates, name of the inspector, and results of inspection. During these inspections, an inspection form will be completed as provided in Appendix I – Site Management Forms.

5.0 OPERATION AND MAINTENANCE PLAN

5.1 General

The remedy does not rely on any mechanical systems, such as groundwater treatment systems, sub-slab depressurization systems or air sparge/soil vapor extraction systems to be constructed on the Site or the Off-Site Property to protect public health and the environment. Therefore, the operation and maintenance of such components is not included in this ISMP. As such, National Grid does not anticipate maintaining responsibility regarding the operation or maintenance of any active post-remedial systems.

6.0 PERIODIC ASSESSMENTS/EVALUATIONS

Periodic assessments/evaluations of the effectiveness of the implementation of a remedy or the post-remedy implementation conditions of the Site and the Off-Site Property are to be conducted in accordance with the requirement of this ISMP. National Grid will maintain responsibility to perform these assessments/evaluation on the Site and the Off-Site Property.

6.1 Climate Change Vulnerability Assessment

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the Site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding. A vulnerability assessment has not been prepared for the Site at the time of the preparation of this SMP. A vulnerability assessment will not be conducted as part of this ISMP. The assessment will be performed as part of the final design of the remedy including the stormwater management practices as well as the placement of post-remedial groundwater monitoring wells.

6.2 Green Remediation Evaluation

NYSDEC's DER-31 Green Remediation requires that green remediation concepts and techniques be considered during all stages of the remedial program including site management, with the goal of improving the sustainability of the cleanup and summarizing the net environmental benefit of any implemented green technology. This section of the ISMP provides a summary of any green remediation evaluations to be completed for the Site and the Off-Site Property during management of these sites, and as reported in the Periodic Review Report (PRR).

National Grid will maintain responsibility to perform the Green Remediation Evaluation before the implementation of additional investigation activities to be conducted on the Off-Site Property, during remedy design and implementation and throughout the duration of the management activities covered under this ISMP both on the Site and the Off-Site Property. At the time of the preparation of this ISMP, no additional investigation activities are proposed for the Site.

The major component of the remedy to be implemented at the Site is the ISS of MGP source materials. ISS is generally considered a greener remediation technology than excavation and off-site disposal. The green aspects of ISS are discussed in the following subsections of this ISMP.

Material Usage:

The ISS activities to be implemented at the Site may utilize either Portland cement or coal fired power plants byproducts. Use of coal fired power plant byproducts uses recycled materials to replace the Portland cement, minimizing waste products and the embedded energy and greenhouse gases related to production of the raw Portland cement material.

Water Conservation:

Implementing ISS at the Site will conserve local water supplies. ISS can be performed "in the wet," which eliminates the requirement for dewatering or other groundwater management during excavation. Additionally, water that is removed from an excavation footprint often requires treatment and discharge to local waterways or to a municipal sewer. This is energy intensive and can impact local water balances, depending on the amount of water that requires discharge.

Energy Conservation:

ISS requires on-site machinery and equipment usage. While there are deliveries of materials to the Site, in general, the number of equipment-hours and related fuel consumption required for completion of the remedy is less than the number of equipment-hours and related fuel consumption required for excavation and off-site transport of materials for disposal. This results in a reduction of energy used on-site in the form of

diesel fuel. ISS will also require a lesser duration of implementation, further reducing energy requirements on-site during

Impact To Community:

ISS is performed within the Site footprint, and typically does not require the large volume of truck traffic associated with remove of impacted materials for off-site disposal or the deliveries of backfill to the Site. This reduces the impacts to the neighboring community. Related impacts to the community that could be a reduced by ISS include increased traffic including that of heavy trucks, their wear-and-tear on local roadways, and related particulate emissions from their operation. There are also impacts to the community in which the final disposal facility is located in the form of long-term management of the contaminants which impact the material.

6.2.1 Timing of Green Remediation Evaluations

For major remedial system components, green remediation evaluations and corresponding modifications will be undertaken as part of a formal Remedial System Optimization (RSO), or at any time that the NYSDEC Project Manager feels appropriate (e.g., during significant maintenance events or in conjunction with storm recovery activities). No major system components are anticipated to be part of the remedy to be implemented on the Site and the Off-Site Property. If necessary, as noted above, National Grid will be responsible to perform this evaluation on both the Site and the Off-Site Property.

Modifications resulting from green remediation evaluations will be routinely implemented by National Grid, as necessary, on both the Site and the Off-Site Property and scheduled to occur during planned/routine operation and maintenance activities. Reporting of these modifications will be presented in the PRR. As noted above, no major remedial system components are to remain on the Site and the Off-Site property after completion of the implementation of the remedy.

6.2.2 Frequency of System Checks, Sampling and Other Periodic Activities

Transportation to and from the Site and the Off-Site Property and use of consumables in relation to visiting the Site and the Off-Site Property in order to evaluate

the conditions of the engineering controls, changes in Site/Off-Site Property usage and/or to collect samples, and shipping samples to a laboratory for analyses have direct and/or inherent energy costs. The schedule and/or means of these periodic activities will be prepared by National Grid so that these tasks can be accomplished in a manner that does not impact remedy protectiveness but reduces expenditure of energy or resources.

7.0. REPORTING REQUIREMENTS

7.1 Site Management Reports

Site management inspection, maintenance and monitoring events will be recorded by National Grid's QEP on the appropriate Site Management Forms provided in Appendix I. These forms are subject to revision by the NYSDEC for use on the Site or by National Grid for use on the Off-Site Property.

Applicable inspection forms and other records, including groundwater sampling reports, generated for the Site and the Off-Site Property by National Grid during the reporting period will be provided in electronic format to the NYSDEC by National Grid's QEP in accordance with the requirements of Table 7 and summarized in the Periodic Review Report (PRR).

Table 7: Schedule of Interim Monitoring/Inspection Reports

All reporting will be prepared and submitted to the NYSDEC by National Grid's QEP.

Task/Report	Reporting Frequency*
Inspection Report	Annually**
Periodic Review Report	Annually
Groundwater Monitoring Report	Semi-Annually

* The frequency of events will be conducted as specified until otherwise approved by the NYSDEC.

**As the frequency of the Inspection Report and the Periodic Review Report are both annual, the results of the annual inspection will be included in the Period Review Report. A separate Inspection Report will not be prepared.

Interim monitoring/inspection reports to be prepared by National Grid on the Site and the Off-Site Property will include, at a minimum:

- Date of event or reporting period;
- Name, company, and position of person(s) conducting monitoring/inspection activities;
- Description of the activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet);
- Type of samples collected (e.g., groundwater, soil, etc.);
- Copies of field forms completed (e.g., well sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;
- Copies of laboratory data sheets and the required laboratory data deliverables required for points sampled (to be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and
- A determination as to whether contaminant conditions have changed since the last reporting event.

National Grid is responsible to conduct the interim monitoring and inspections on the Site and the Off-Site Property. National Grid will prepare the Interim Monitoring/Inspection Reports to document the results of these interim monitoring and inspection activities. Routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting maintenance activities;
- Description of maintenance activities performed;
- Any modifications to the system;

- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and,
- Other documentation such as copies of invoices for maintenance work, receipts for replacement equipment, etc., (attached to the checklist/form).

No remedial system components are anticipated to remain on the Site and the Off-Site Property after completion of the implementation of the remedy. Therefore, the completion of maintenance event reporting forms is not anticipated.

Non-routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting non-routine maintenance/repair activities;
- Description of non-routine activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and
- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc. (attached to the checklist/form).

Data will be reported in digital format as determined by the NYSDEC. Currently, data is to be supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link http://www.dec.ny.gov/chemical/62440.html.

7.2 Periodic Review Report

A PRR will be submitted for the Site by National Grid's QEP to the Department beginning 90 days after the end of the first year after approval of this ISMP. The PRR will be prepared and submitted to the NYSDEC by National Grid and summarize activities subject to this ISMP conducted on the Site and the Off-Site Property. After submittal of the initial Periodic Review Report, the next PRR shall be submitted annually to the Department or at another frequency as may be required by the Department. In the

event that the Site or the Off-Site Property is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the Site and the Off-Site Property by National Grid described in Appendix A - Environmental Easement (Site only). The report will be prepared in accordance with NYSDEC's DER-10 and submitted within 90 days of the end of each certification period. Media sampling results will also be incorporated into the Periodic Review Report. The report, to be prepared by National Grid, will include:

- Identification, assessment and certification of ECs and ICs required by the remedy for the Site.
- Results of the required annual inspections and after severe weather condition, if applicable, inspections of the Site and the Off-Site Property conducted by National Grid's QEP.
- Applicable site management forms and other records generated for the Site/Off-Site Property by National Grid's QEP during the reporting period in electronic format, if not previously submitted.
- Data summary tables and graphical representations of contaminants of concern by media (groundwater) to be prepared by National Grid's QEP, which include a listing of compounds analyzed, along with the applicable standards, with exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends.
- Results of analyses, copies of laboratory data sheets, and the required laboratory data deliverables for samples collected by National Grid's QEP during the reporting period will be submitted in digital format as determined by the NYSDEC. Currently, data is supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link: http://www.dec.ny.gov/chemical/62440.html.
- An evaluation of the Site and the Off-Site Property by National Grid's QEP, which includes the following:
    - The compliance of the remedy with the requirements of the ROD;
    - Any new conclusions or observations regarding contamination based on inspections of the Site and the Off-Site Property conducted by National Grid's QEP or data generated by the Monitoring and

Sampling Plan for the media being monitored; and

- Recommendations regarding any necessary changes to the remedy and/or Monitoring and Sampling Plan.

The PRRs for the Site and the Off-Site Property will be submitted by National Grid, in hard-copy format, to the NYSDEC Central Office and Regional Office in which the Site/Off-Site Property is located, and in electronic format to the NYSDEC Central Office, the NYSDEC Regional Office and the NYSDOH Bureau of Environmental Exposure Investigation.

7.2.1 Certification of Institutional and Engineering Controls

Following the last inspection of the reporting period, a National Grid's New York State Professional Engineer or Qualified Environmental Professional will prepare, and include in the PRR, the following certification as per the requirements of NYSDEC DER-10:

For the Site:

"*For each institutional or engineering control identified for the Site, I certify that all of the following statements are true:*

- *The inspection of the Site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;*
- *The institutional control and/or engineering control employed at this Site is unchanged from the date the control was put in place, or last approved by the Department;*
- *Nothing has occurred that would impair the ability of the control to protect the public health and environment;*
- *Nothing has occurred that would constitute a violation or failure to comply with any ISMP for this control;*
- *Access to the Site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;*

- *If a financial assurance mechanism is required under the oversight document for the Site, the mechanism remains valid and sufficient for the intended purpose under the document;*
- *Use of the Site is compliant with the environmental easement;*
- *The engineering control systems are performing as designed and are effective;*
- *To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the Site remedial program and generally accepted engineering practices; and*
- *The information presented in this report is accurate and complete.*

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, Marek Ostrowski, of Brown and Caldwell located at 2 Park Way, Upper Saddle River, New Jersey, am certifying as the Owner's/Remedial Party's/Respondent's Designated Site Representative have been authorized and designated by the owner Remedial Party to sign this certification for the Site."

For the Off-Site Property:

"*For each engineering control identified for the Off-Site Property, I certify that all of the following statements are true:*

- *The inspection of the Off-Site Property to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;*
- *The engineering control(s) employed at this Off-Site Property is unchanged from the date the control was put in place, or last approved by the National Grid;*
- *Nothing has occurred that would impair the ability of the control to protect the public health and environment;*
- *Nothing has occurred that would constitute a violation or failure to comply with any ISMP for this control;*

- *Access to the Off-Site Property will continue to be provided to National Grid to evaluate the remedy, including access to evaluate the continued maintenance of this control;*
- *If a financial assurance mechanism is required under the oversight document for the Off-Site Property, the mechanism remains valid and sufficient for the intended purpose under the document;*
- *Use of the Off-Site Property is compliant with this ISMP;*
- *The engineering control systems are performing as designed and are effective;*
- *To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the Off-Site remedial program and generally accepted engineering practices; and*
- *The information presented in this report is accurate and complete.*

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, Marek Ostrowski, of Brown and Caldwell located at 2 Park Way, Upper Saddle River, New Jersey, am certifying as the Owner's/Remedial Party's/Respondent's Designated Site Representative have been authorized and designated by the owner Remedial Party to sign this certification for the Site."

7.3 Corrective Measures Work Plan

If any component of the remedy is found to have failed on the Site or the Off-Site Property, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a Corrective Measures Work Plan will be submitted to the NYSDEC by National Grid's Qualified Environmental Professional for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Work Plan until it has been approved by the NYSDEC.

8.0 REFERENCES

6NYCRR Part 375, Environmental Remediation Programs. December 14, 2006.

Brown and Caldwell Associates, May 2011. *Focused Feasibility Study, Patchogue Former Manufactured Gas Plant Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk.*

Brown and Caldwell Associates, February 2012. *Remedial Design Work Plan, Patchogue Former Manufactured Gas Plant Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York.*

Brown and Caldwell Associates, February 2012. *Utility Corridor Work Plan (Revision 3), Patchogue Former MGP Site, Patchogue, Suffolk County, New York, Site No. 1-52-182*.

Brown and Caldwell Associates, December 2012. *Remedial Design Report (50%-75% Submission), Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York.*

NYSDEC, 2011. DER-31 / Green Remediation. August 11, 2010 (January 20, 2011 Addendum).

NYSDEC, 2010. *DER-10 / Technical Guidance for Site Investigation and Remediation*. Office of Remediation and Materials Management. May 3, 2010.

NYSDEC, 1998. *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1.* June 1998 (April 2000 addendum).

TetraTech EC, Inc., December 2009. *Final Remedial Investigation Report for the Patchogue Former MGP Site, Patchogue, Suffolk County, New York.*

Vanessa, Hangen, Brustlin, March 2002. *Preliminary Site Assessment Report, Order on Consent D1-0001-99-05, NYSDEC Site No. 1-52-182, Former Patchogue MGP Site, Village of Patchogue, Suffolk County, New York.*

TABLES

TABLE 2
GROUNDWATER ELEVATION MEASUREMENTS
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

	6/22/2015					
Well ID	Top of Casing Elevation [(a)] (ft., NAVD)	Depth to Water (ft., BTOC)	Water Elevation (ft., NAVD)	Depth to NAPL (ft., BTOC)	Total Depth of Well (ft., BGS)	Remarks
MW-1	11.47	5.81	5.66	ND	15.22	
MW-3	5.56	2.45	3.11	ND	10.56	
MW-4S	7.97	5.07	2.90	ND	12.25	
MW-4D	7.79	4.83	2.96	ND	26.68	
MW-5	NA [(b)]	NA	NA	13.03	13.19	Red brown NAPL blebs on probe.
MW-6	5.01	0.45	4.56	4.51	18.48	Probe indicates NAPL at 4.51' BTOC,moderate tar-like odor.
MW-7S	8.45	4.52	3.93	ND	12.43	
MW-7D	8.31	4.34	3.97	ND	28.25	
MW-8S	5.08	0.93	4.15	ND	9.95	
MW-8D	4.98	0.80	4.18	ND	25.14	
MW-9S	4.47	1.55	2.92	ND	--	
MW-9D	4.66	1.51	3.15	ND	--	
SG-1	5.23	4.07	1.16	ND	NA	
SG-2	5.17	NA	NA	ND	NA	
PZ-1A	8.05	3.64	4.41	ND	10.08	
PZ-1B	8.91	4.55	4.36	ND	22.54	
PZ-2A	8.77	4.43	4.34	ND	--	Faint tar-like odor.
PZ-2B	8.29	3.92	4.37	ND	--	Moderate tar-like odor.
PZ-3A	8.78	4.88	3.90	ND	8.91	Moderate tar-like odor.
PZ-3B	8.90	5.18	3.72	ND	21.26	
PZ-4A	4.79	1.72	3.07	ND	4.88	

Notes:
NAVD - North American Vertical Datum
BGS - Below Ground Surface
BTOC - Below Top of Casing
NAPL - Non-aqueous phase liquid
NA - Not applicable
ND - Not Detected
(a) - Monitoring wells resurveyed on 7/3/12 following utility corridor construction activities. See "Construction Completion Report, Utility Corridor Work Plan Implementation (Brown and Caldwell, December 2012)".
(b) - Above ground casing at MW-5 was lowered during utility corridor construction activities, but was not resurveyed.
(--) - Not Measured

TABLE 3
HISTORICAL AND REMEDIAL DOCUMENTS
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Description	Report Date	Author
Preliminary Site Assessment Work Plan, Patchogue	May 2001	VHB/Vanasse Hangen Brustin, Inc.
Preliminary Site Assessment Report, Order on Consent D1-0001-99-05, NYDEC Site No. 1-52-182, Former Patchogue MGP Site, Village of Patchogue, Suffolk County, New York	March 2002	VHB/Vanasse Hangen Brustin, Inc.
Final Remedial Investigation Report for the Patchogue Former MGP Site, Patchogue, Suffolk County, New York	December 2009	Tetra Tech EC, Inc.
Work Plan for Pre-Design Investigation Activities	May 10, 2010	BC Associates
Supplemental Pre-Design Investigation Work Plan, Patchogue, Suffolk County, New York, Site No. 1-52-182	September 14, 2010	BC Associates
Focused Feasibility Study, Patchoge Former Manufactured Gas Plant Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk	May 2011	BC Associates
First Quarter 2011 Groundwater Monitoring Report, Patchogue Former MGP Site - Site ID No. 1-52-182, Patchgue, New York	May 2011	BC Associates
Second Quarter 2011 Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	July 2011	BC Associates
Third Quarter 2011 Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	October 2011	BC Associates
Utility Corridor Work Plan (Revision 3), Patchogue Former MGP Site, Patchogue, Suffolk County, New York, Site No. 1-52-182	February 8, 2012	BC Associates
Remedial Design Work Plan, Patchogue Former Manufactured Gas Plant Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	February 2012	BC Associates
Fourth Quarter 2011 Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	February 2012	BC Associates
First Quarter 2012 Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	May 2012	BC Associates
Second Quarter 2012 Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	September 2012	BC Associates
Remedial Design Report (50-75% Submission), Patchoge Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	December 2012	BC Associates
Construction Completion Report, Utility Corridor Work Plan Implementation, Patchogue Former Manufactured Gas Plant Site, BYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	December 2012	BC Associates
Second Half 2012 Semi-Annual Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	April 2013	BC Associates
Off-Site Investigation Work Plan	August 8, 2013	BC Associates
First Half 2013 Semi-Annual Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	October 2013	BC Associates
Second Half 2013 Semi-Annual Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	March 2013	BC Associates
First Half 2014 Semi-Annual Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	November 2014	BC Associates
Second Half 2014 Semi-Annual Groundwater Monitoring Report, Patchogue Former MGP Site, NYSDEC Site No. 1-52-182, Village of Patchogue, Suffolk County, New York	March 2015	BC Associates

TABLE 4A1
REMAINING ON-SITE SOIL SAMPLE EXCEEDANCES OF NYSPART375 UNRESTRICTED USE (UU)
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	NYSPART375UU	Units	PASB-03 4-6 PSA	PASB-08 6-10 PSA	PASB-23 3-5 RI	PASB-31 2-4 RI	PASB-33 1-3 RI	SB-112 1-3 SPDI	SB-113 1-3 SPDI	SB-114 1-3 SPDI
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	0.06	mg/kg	0.013 B	0.005 U	0.0043 U	0.0043 U	0.0043 U	0.0006 U	0.0006 J	0.0009 J
Toluene	0.7	mg/kg	0.014	0.005 U	0.0048 U	0.0048 U	0.0052 U	0.001 U	0.001 J	0.001 J
Ethylbenzene	1	mg/kg	0.005 U	0.005 U	0.0053 U	0.014 J	0.0048 U	0.001 U	0.001 J	0.002 J
Xylenes, Total	0.26	mg/kg	0.002 J	0.015 U	NA	NA	NA	0.001 U	0.001 U	0.006
Total BTEX	NE	mg/kg	0.029	ND	ND	0.014 J	ND	ND	0.0026	0.0099
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	20	mg/kg	0.33 U	0.33 U	0.17 J	9.1 D	0.24 J	0.038 U	0.17 J	0.11 J
Acenaphthylene	100	mg/kg	0.33 U	0.33 U	0.58	1.1	2.6	1.2	3.2	0.84
Anthracene	100	mg/kg	0.17 J	0.33 U	0.61	8 D	39 D	1	2.2	0.89
Benzo(a)anthracene	1	mg/kg	0.33 U	0.33 U	2	6.1	8.2	3.1	12	2
Benzo(a)pyrene	1	mg/kg	1.4	1	0.95	5.4	8	3.4	8	2.1
Benzo(b)fluoranthene	1	mg/kg	0.33 U	0.33 U	2.1	4.7	9.1	3.9	14	3.4
Benzo(g,h,i)perylene	100	mg/kg	1.1	0.55	1.4	2.5	6.5	2.7	9.1	2.1
Benzo(k)fluoranthene	0.8	mg/kg	0.69	0.25 J	0.95	1.3	3.5	1.5	4.4	1.5
Chrysene	1	mg/kg	0.33 U	0.33 U	2.1	5.1	17 D	3.7	15	2.6
Dibenzo(a,h)anthracene	0.33	mg/kg	0.71	0.4	0.34 J	0.57 J	1.2 J	0.65	1.6	0.52
Fluoranthene	100	mg/kg	1.7	0.94	3	11 D	14	2.5	14	2
Fluorene	30	mg/kg	0.71	0.34	0.27 J	6.2	1.4 J	0.16 J	0.62 J	0.16 J
Indeno(1,2,3-cd)pyrene	0.5	mg/kg	0.6	1	0.88	1.6	4.2	2.5	8.6	2
Naphthalene	12	mg/kg	1.6	0.33 U	0.19 J	4.5	0.82 J	0.087 J	1.5	0.34
Phenanthrene	100	mg/kg	1.6	0.74	1.6	23 D	11	0.52	3	0.6
Pyrene	100	mg/kg	0.2 J	0.33 U	4.6 D	19 D	18 D	4.1	19	3.7
Total PAHs	NE	mg/kg	10	5.2	22	109	145	31	116	25
Inorganic Constituents										
Cyanide, Total	27	mg/kg	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA

Notes:
NYSPART375UU - NYS Part 375 Unrestricted Use (UU) Soil Cleanup Objective.
PSA - Preliminary Site Assessment.
RI - Remedial Investigation samples
SPDI - Supplemental Pre-Design Investigation samples
Values presented with an underline exceed the NYSPART375UU
U - The analyte was analyzed for, but was not detected. Value indicates the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
B - Analyte was found in the sample as well as the associated blank.
D - Diluted
ND - Not detected.
NA - Not analyzed.
NE- Not established.

TABLE 4A2
REMAINING ON-SITE SOIL SAMPLE EXCEEDANCES OF NYSPART375 - RESTRICTED RESIDENTIAL (RR)
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	NYSPART375RR	Units	PASB-03 4-6 PSA	PASB-08 6-10 PSA	PASB-23 3-5 RI	PASB-31 2-4 RI	PASB-33 1-3 RI	SB-112 1-3 SPDI	SB-113 1-3 SPDI	SB-114 1-3 SPDI
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	2.9	mg/kg	0.013 B	0.005 U	0.0043 U	0.0043 U	0.0043 U	0.0006 U	0.0006 J	0.0009 J
Toluene	100	mg/kg	0.014	0.005 U	0.0048 U	0.0048 U	0.0052 U	0.001 U	0.001 J	0.001 J
Ethylbenzene	30	mg/kg	0.005 U	0.005 U	0.0053 U	0.014 J	0.0048 U	0.001 U	0.001 J	0.002 J
Xylenes, Total	100	mg/kg	0.002 J	0.015 U	NA	NA	NA	0.001 U	0.001 U	0.006
Total BTEX	NE	mg/kg	0.029	ND	ND	0.014 J	ND	ND	0.0026	0.0099
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	100	mg/kg	0.33 U	0.33 U	0.17 J	9.1 D	0.24 J	0.038 U	0.17 J	0.11 J
Acenaphthylene	100	mg/kg	0.33 U	0.33 U	0.58	1.1	2.6	1.2	3.2	0.84
Anthracene	100	mg/kg	0.17 J	0.33 U	0.61	8 D	39 D	1	2.2	0.89
Benzo(a)anthracene	1	mg/kg	0.33 U	0.33 U	2	6.1	8.2	3.1	12	2
Benzo(a)pyrene	1	mg/kg	1.4	1	0.95	5.4	8	3.4	8	2.1
Benzo(b)fluoranthene	1	mg/kg	0.33 U	0.33 U	2.1	4.7	9.1	3.9	14	3.4
Benzo(g,h,i)perylene	100	mg/kg	1.1	0.55	1.4	2.5	6.5	2.7	9.1	2.1
Benzo(k)fluoranthene	1	mg/kg	0.69	0.25 J	0.95	1.3	3.5	1.5	4.4	1.5
Chrysene	1	mg/kg	0.33 U	0.33 U	2.1	5.1	17 D	3.7	15	2.6
Dibenzo(a,h)anthracene	0.33	mg/kg	0.71	0.4	0.34 J	0.57 J	1.2 J	0.65	1.6	0.52
Fluoranthene	100	mg/kg	1.7	0.94	3	11 D	14	2.5	14	2
Fluorene	100	mg/kg	0.71	0.34	0.27 J	6.2	1.4 J	0.16 J	0.62 J	0.16 J
Indeno(1,2,3-cd)pyrene	0.5	mg/kg	0.6	1	0.88	1.6	4.2	2.5	8.6	2
Naphthalene	100	mg/kg	1.6	0.33 U	0.19 J	4.5	0.82 J	0.087 J	1.5	0.34
Phenanthrene	100	mg/kg	1.6	0.74	1.6	23 D	11	0.52	3	0.6
Pyrene	100	mg/kg	0.2 J	0.33 U	4.6 D	19 D	18 D	4.1	19	3.7
Total PAHs	NE	mg/kg	10	5.2	22	109	145	31	116	25
Inorganic Constituents										
Cyanide, Total	27	mg/kg	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA

Notes:
NYSPART375RR - NYS Part 375 Restricted Residential (RR) Soil Cleanup Objective.
PSA - Preliminary Site Assessment.
RI - Remedial Investigation samples
SPDI - Supplemental Pre-Design Investigation samples
Values presented with an underline exceed the NYSPART375RR
U - The analyte was analyzed for, but was not detected. Value indicates the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
B - Analyte was found in the sample as well as the associated blank.
D - Diluted
ND - Not detected.
NA - Not analyzed.
NE- Not established.

TABLE 4A3
REMAINING ON-SITE SOIL SAMPLE EXCEEDANCES OF NYSPART375 COMMERCIAL USE (C)
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	NYSPART375C	Units	PASB-03 4-6 PSA	PASB-08 6-10 PSA	PASB-23 3-5 RI	PASB-31 2-4 RI	PASB-33 1-3 RI	SB-112 1-3 SPDI	SB-113 1-3 SPDI	SB-114 1-3 SPDI
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	44	mg/kg	0.013 B	0.005 U	0.0043 U	0.0043 U	0.0043 U	0.0006 U	0.0006 J	0.0009 J
Toluene	500	mg/kg	0.014	0.005 U	0.0048 U	0.0048 U	0.0052 U	0.001 U	0.001 J	0.001 J
Ethylbenzene	390	mg/kg	0.005 U	0.005 U	0.0053 U	0.014 J	0.0048 U	0.001 U	0.001 J	0.002 J
Xylenes, Total	500	mg/kg	0.002 J	0.015 U	NA	NA	NA	0.001 U	0.001 U	0.006
Total BTEX	NE	mg/kg	0.029	ND	ND	0.014 J	ND	ND	0.0026	0.0099
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	500	mg/kg	0.33 U	0.33 U	0.17 J	9.1 D	0.24 J	0.038 U	0.17 J	0.11 J
Acenaphthylene	500	mg/kg	0.33 U	0.33 U	0.58	1.1	2.6	1.2	3.2	0.84
Anthracene	500	mg/kg	0.17 J	0.33 U	0.61	8 D	39 D	1	2.2	0.89
Benzo(a)anthracene	5.6	mg/kg	0.33 U	0.33 U	2	6.1	8.2	3.1	12	2
Benzo(a)pyrene	1	mg/kg	1.4	1	0.95	5.4	8	3.4	8	2.1
Benzo(b)fluoranthene	5.6	mg/kg	0.33 U	0.33 U	2.1	4.7	9.1	3.9	14	3.4
Benzo(g,h,i)perylene	500	mg/kg	1.1	0.55	1.4	2.5	6.5	2.7	9.1	2.1
Benzo(k)fluoranthene	56	mg/kg	0.69	0.25 J	0.95	1.3	3.5	1.5	4.4	1.5
Chrysene	56	mg/kg	0.33 U	0.33 U	2.1	5.1	17 D	3.7	15	2.6
Dibenzo(a,h)anthracene	0.56	mg/kg	0.71	0.4	0.34 J	0.57 J	1.2 J	0.65	1.6	0.52
Fluoranthene	500	mg/kg	1.7	0.94	3	11 D	14	2.5	14	2
Fluorene	500	mg/kg	0.71	0.34	0.27 J	6.2	1.4 J	0.16 J	0.62 J	0.16 J
Indeno(1,2,3-cd)pyrene	5.6	mg/kg	0.6	1	0.88	1.6	4.2	2.5	8.6	2
Naphthalene	500	mg/kg	1.6	0.33 U	0.19 J	4.5	0.82 J	0.087 J	1.5	0.34
Phenanthrene	500	mg/kg	1.6	0.74	1.6	23 D	11	0.52	3	0.6
Pyrene	500	mg/kg	0.2 J	0.33 U	4.6 D	19 D	18 D	4.1	19	3.7
Total PAHs	NE	mg/kg	10	5.2	22	109	145	31	116	25
Inorganic Constituents										
Cyanide, Total	27	mg/kg	0.5 U	0.5 U	NA	NA	NA	NA	NA	NA

Notes:
NYSPART375C - NYS Part 375 Commercial (C) Soil Cleanup Objective.
PSA - Preliminary Site Assessment.
RI - Remedial Investigation samples
SPDI - Supplemental Pre-Design Investigation samples
Values presented with an underline exceed the NYSPART375C
U - The analyte was analyzed for, but was not detected. Value indicates the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
B - Analyte was found in the sample as well as the associated blank.
D - Diluted
ND - Not detected.
NA - Not analyzed.
NE- Not established.

TABLE 4B1
REMAINING OFF-SITE PROPERTY SOIL SAMPLE EXCEEDANCES OF NYSPART375 UNRESTRICTED USE (UU)
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	NYSPART375UU	Units	PASB-37 5-7 RI	PASB-45 5-7 RI
Volatile Organic Compounds (VOCs)				
BTEX				
Benzene	0.06	mg/kg	0.11 U	0.024 J
Toluene	0.7	mg/kg	0.0054 U	0.084
Ethylbenzene	1	mg/kg	0.005 UJ	1.2 D
Xylenes, Total	0.26	mg/kg	NA	NA
Total BTEX	NE	mg/kg	ND	1.3
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	20	mg/kg	7.2	23
Acenaphthylene	100	mg/kg	4.7	16
Anthracene	100	mg/kg	14	61
Benzo(a)anthracene	1	mg/kg	22	87 D
Benzo(a)pyrene	1	mg/kg	17	81
Benzo(b)fluoranthene	1	mg/kg	15	80
Benzo(g,h,i)perylene	100	mg/kg	9	19
Benzo(k)fluoranthene	0.8	mg/kg	5.2	24
Chrysene	1	mg/kg	0.32 U	87 D
Dibenzo(a,h)anthracene	0.33	mg/kg	2.3 J	1.7 J
Fluoranthene	100	mg/kg	43 D	120 D
Fluorene	30	mg/kg	11	25
Indeno(1,2,3-cd)pyrene	0.5	mg/kg	7.5	13
Naphthalene	12	mg/kg	3.9 J	3.4 J
Phenanthrene	100	mg/kg	57 D	130 D
Pyrene	100	mg/kg	56 D	180 D
Total PAHs	NE	mg/kg	275	951
Inorganic Constituents				
Cyanide, Total	27	mg/kg	NA	NA

Notes:
NYSPART375UU - NYS Part 375 Unrestricted Use (UU) Soil Cleanup Objective.
PSA - Preliminary Site Assessment.
RI - Remedial Investigation samples
SPDI - Supplemental Pre-Design Investigation samples
Values presented with an underline exceed the NYSPART375UU
U - The analyte was analyzed for, but was not detected. Value indicates the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
B - Analyte was found in the sample as well as the associated blank.
D - Diluted
ND - Not detected.
NA - Not analyzed.
NE- Not established.

TABLE 4B2
REMAINING OFF-SITE PROPERTY SOIL SAMPLE EXCEEDANCES OF NYSPART375 RESTRICTED RESIDENTIAL (RR)
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	NYSPART375RR	Units	PASB-37 5-7 RI	PASB-45 5-7 RI
Volatile Organic Compounds (VOCs)				
BTEX				
Benzene	2.9	mg/kg	0.11 U	0.024 J
Toluene	100	mg/kg	0.0054 U	0.084
Ethylbenzene	30	mg/kg	0.005 UJ	1.2 D
Xylenes, Total	100	mg/kg	NA	NA
Total BTEX	NE	mg/kg	ND	1.3
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	100	mg/kg	7.2	23
Acenaphthylene	100	mg/kg	4.7	16
Anthracene	100	mg/kg	14	61
Benzo(a)anthracene	1	mg/kg	22	87 D
Benzo(a)pyrene	1	mg/kg	17	81
Benzo(b)fluoranthene	1	mg/kg	15	80
Benzo(g,h,i)perylene	100	mg/kg	9	19
Benzo(k)fluoranthene	1	mg/kg	5.2	24
Chrysene	1	mg/kg	0.32 U	87 D
Dibenzo(a,h)anthracene	0.33	mg/kg	2.3 J	1.7 J
Fluoranthene	100	mg/kg	43 D	120 D
Fluorene	100	mg/kg	11	25
Indeno(1,2,3-cd)pyrene	0.5	mg/kg	7.5	13
Naphthalene	100	mg/kg	3.9 J	3.4 J
Phenanthrene	100	mg/kg	57 D	130 D
Pyrene	100	mg/kg	56 D	180 D
Total PAHs	NE	mg/kg	275	951
Inorganic Constituents				
Cyanide, Total	27	mg/kg	NA	NA

Notes:
NYSPART375RR - NYS Part 375 Restricted Residential (RR) Soil Cleanup Objective.
PSA - Preliminary Site Assessment.
RI - Remedial Investigation samples
SPDI - Supplemental Pre-Design Investigation samples
Values presented with an underline exceed the NYSPART375RR
U - The analyte was analyzed for, but was not detected. Value indicates the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
B - Analyte was found in the sample as well as the associated blank.
D - Diluted
ND - Not detected.
NA - Not analyzed.
NE- Not established.

TABLE 4B3
REMAINING OFF-SITE PROPERTY SOIL SAMPLE EXCEEDANCES OF NYSPART375 COMMERCIAL (C)
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	NYSPART375C	Units	PASB-37 5-7 RI	PASB-45 5-7 RI
Volatile Organic Compounds (VOCs)				
BTEX				
Benzene	44	mg/kg	0.11 U	0.024 J
Toluene	500	mg/kg	0.0054 U	0.084
Ethylbenzene	390	mg/kg	0.005 UJ	1.2 D
Xylenes, Total	500	mg/kg	NA	NA
Total BTEX	NE	mg/kg	ND	1.3
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	500	mg/kg	7.2	23
Acenaphthylene	500	mg/kg	4.7	16
Anthracene	500	mg/kg	14	61
Benzo(a)anthracene	5.6	mg/kg	22	87 D
Benzo(a)pyrene	1	mg/kg	17	81
Benzo(b)fluoranthene	5.6	mg/kg	15	80
Benzo(g,h,i)perylene	500	mg/kg	9	19
Benzo(k)fluoranthene	56	mg/kg	5.2	24
Chrysene	56	mg/kg	0.32 U	87 D
Dibenzo(a,h)anthracene	0.56	mg/kg	2.3 J	1.7 J
Fluoranthene	500	mg/kg	43 D	120 D
Fluorene	500	mg/kg	11	25
Indeno(1,2,3-cd)pyrene	5.6	mg/kg	7.5	13
Naphthalene	500	mg/kg	3.9 J	3.4 J
Phenanthrene	500	mg/kg	57 D	130 D
Pyrene	500	mg/kg	56 D	180 D
Total PAHs	NE	mg/kg	275	951
Inorganic Constituents				
Cyanide, Total	27	mg/kg	NA	NA

Notes:
NYSPART375C - NYS Part 375 Commercial (C) Soil Cleanup Objective.
PSA - Preliminary Site Assessment.
RI - Remedial Investigation samples
SPDI - Supplemental Pre-Design Investigation samples
Values presented with an underline exceed the NYSPART375C
U - The analyte was analyzed for, but was not detected.Value indicates the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
B - Analyte was found in the sample as well as the associated blank.
D - Diluted
ND - Not detected.
NA - Not analyzed.

TABLE 5
POST REMEDIATION GROUNDWATER SAMPLING REQUIREMENTS AND SCHEDULE
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Sample Location	Analytical Parameters			Schedule
	BTEX compounds (USEPA SW-846 Method 8260B)	Methyl Tertiary Butyl Ether (MTBE) (USEPA SW-846 Method 8260B)	PAHs (USEPA SW-846 Method 8270C)	
MW-1	X	X	X	Semi-Annually
MW-3	X	X	X	Semi-Annually
MW-4S	X	X	X	Semi-Annually
MW-4D	X	X	X	Semi-Annually
MW-5	X	X	X	Semi-Annually
MW-6	X	X	X	Semi-Annually
MW-7S	X	X	X	Semi-Annually
MW-7D	X	X	X	Semi-Annually
MW-8S	X	X	X	Semi-Annually
MW-8D	X	X	X	Semi-Annually
MW-9S	X	X	X	Semi-Annually
MW-9D	X	X	X	Semi-Annually
PZ-1A	X	X	X	Semi-Annually
PZ-1B	X	X	X	Semi-Annually
PZ-2A	X	X	X	Semi-Annually
PZ-2B	X	X	X	Semi-Annually
PZ-3A	X	X	X	Semi-Annually
PZ-3B	X	X	X	Semi-Annually
PZ-4A	X	X	X	Semi-Annually

TABLE 6

MONITORING WELL CONSTRUCTION DETAILS

PATCHOGUE FORMER MGP SITE

PATCHOGUE, NEW YORK

Monitoring Well ID	Well Location	Coordinates (Easting/Northing)	Well Diameter (inches)	Elevation (above mean sea level)			
				Casing	Surface	Screen Top	Screen Bottom
MW-1	Upgradient	Easting: 1255132.538 ft Northing: 219674.03 ft	2	11.23	7.53	0.53	-4.47
MW-3	Downgradient	Easting: 1255328.742 ft Northing: 219200.312 ft	2	5.56	5.42	0.42	-4.58
MW-4S	Downgradient	Easting: 1255290.459 ft Northing: 219131.475 ft	2	7.97	4.23	-0.77	-5.77
MW-4D	Downgradient	Easting: 1255291.583 ft Northing: 219134.531 ft	2	7.79	4.36	-15.64	-20.64
MW-7S	On-Site	Easting: 1255153.2993 ft Northing: 219212.046 ft	2	8.45	5.37	1.37	-3.63
MW-7D	On-Site	Easting: 1255151.943 ft Northing: 219210.1789 ft	2	8.31	5.20	-14.80	-19.80
MW-8S	Downgradient	Easting: 1255313.690 ft Northing: 219375.899 ft	2	5.08	5.05	1.05	-3.95
MW-8D	Downgradient	Easting: 1255314.267 ft Northing: 219376.872 ft	2	4.98	5.04	-14.96	-19.96
MW-9S	Downgradient	Easting: 1255360.270 ft Northing: 219232.1222 ft	2	4.47	4.70	0.70	-4.30
MW-9D	Downgradient	Easting: 1255361.552 ft Northing: 219233.3286 ft	2	4.66	4.69	-15.31	-20.31
PZ-4A	On-Site	Easting: 1255365.3 ft Northing: 219236.5 ft	2.00	4.80	5.00	2	0.00

TABLE 9A
DECISION TREE FOR INTRUSIVE ACTIVITIES ON-SITE
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

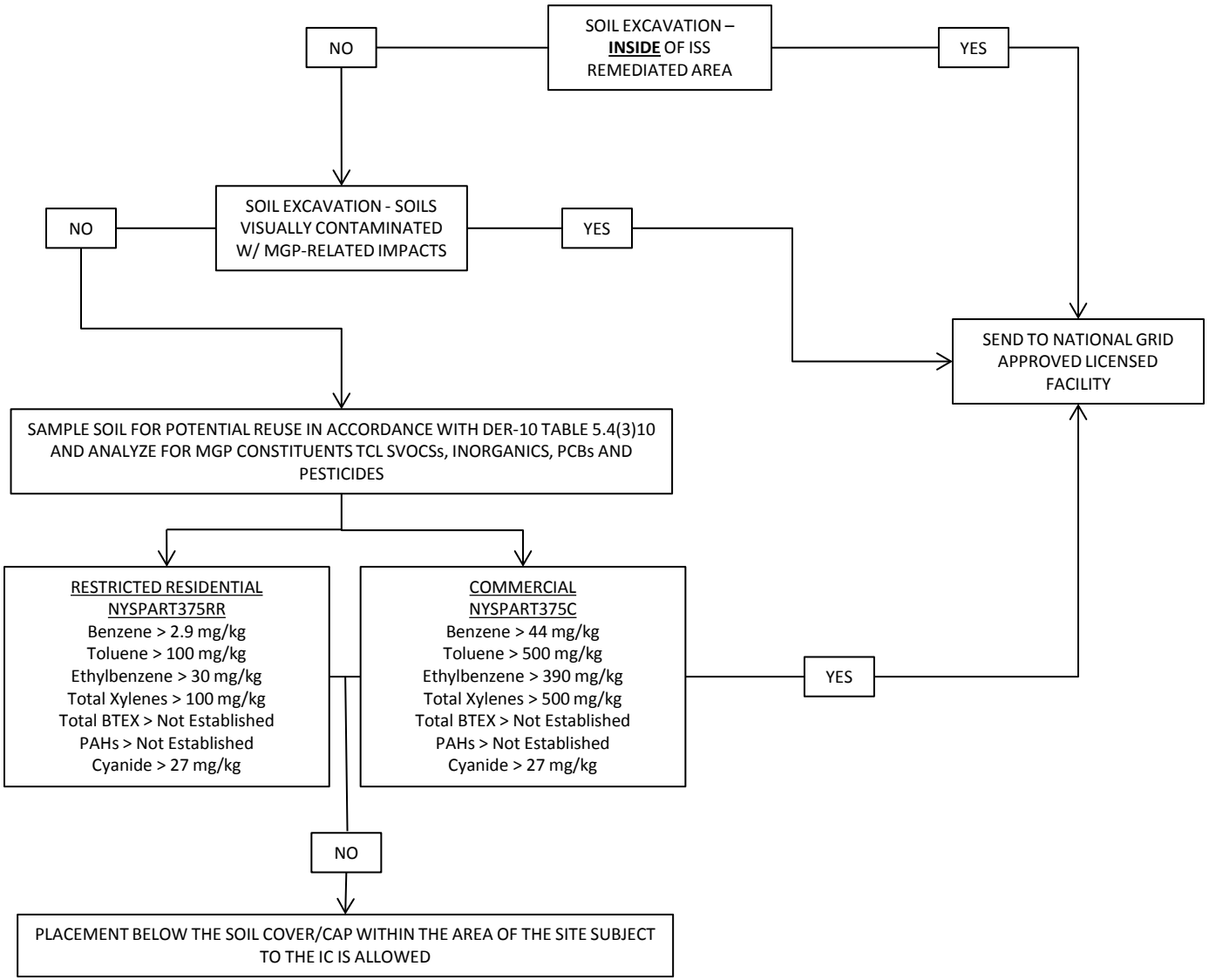

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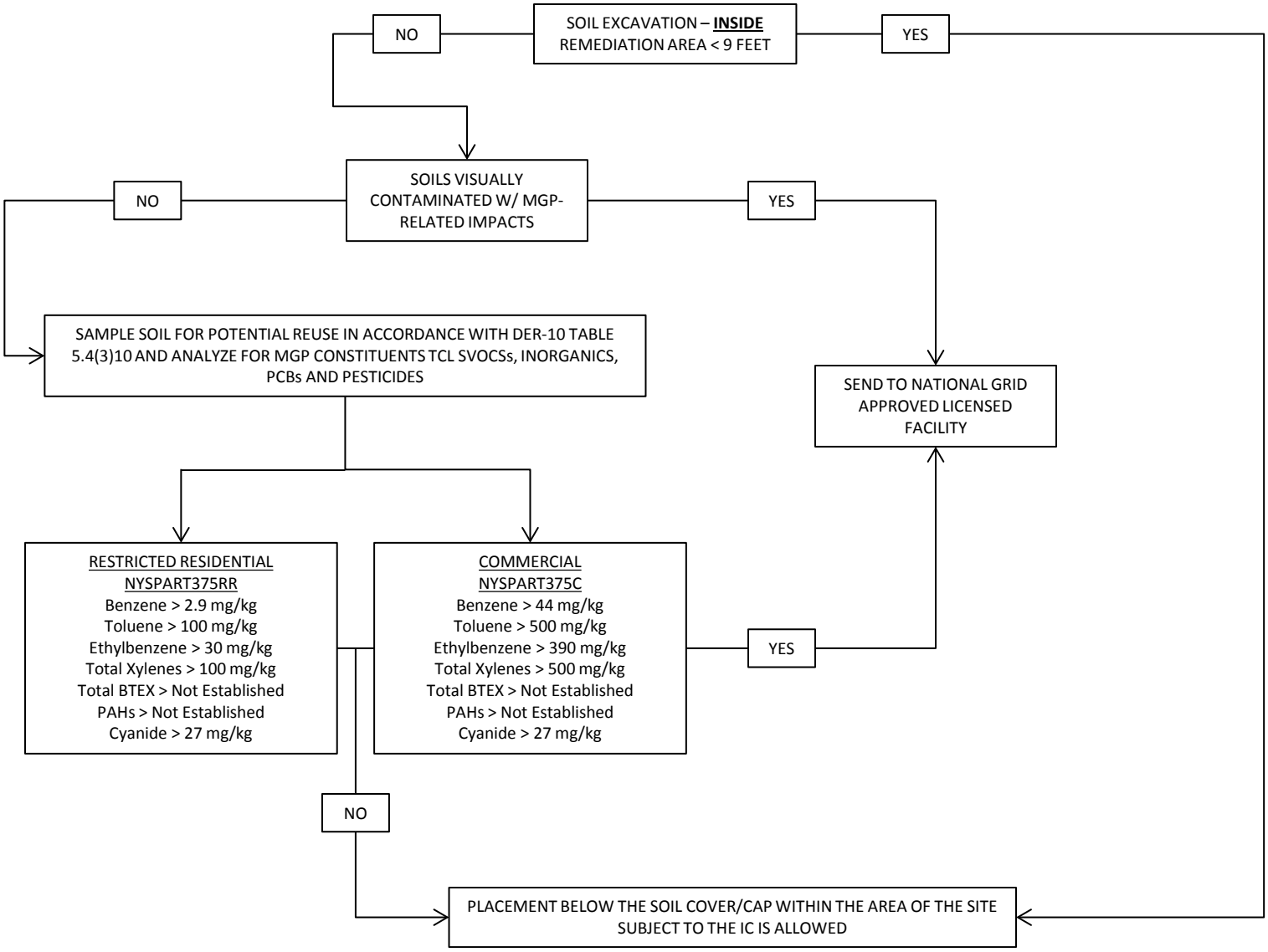
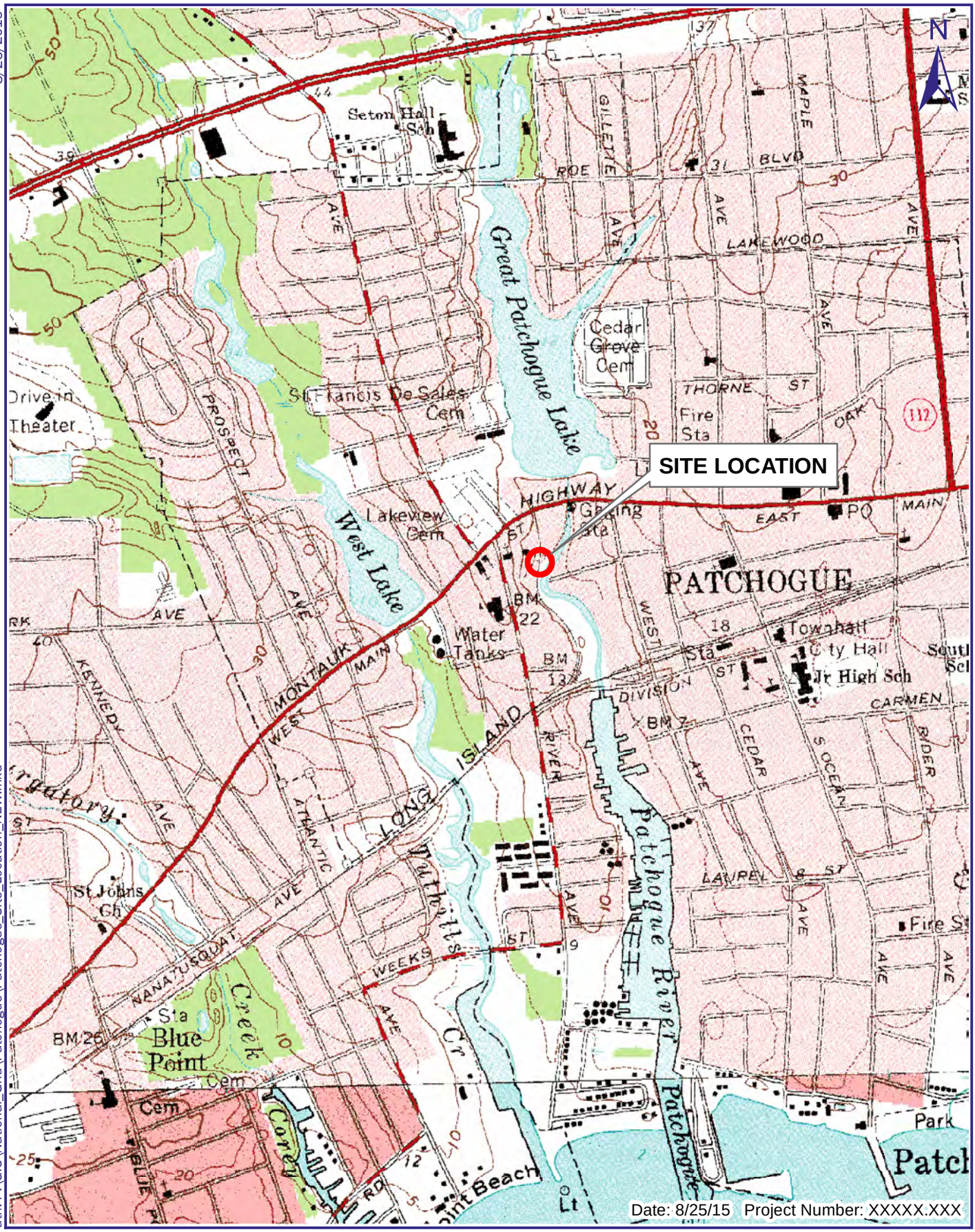
TABLE 9B
DECISION TREE FOR INTRUSIVE ACTIVITIES OFF-SITE
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK



Brown AND Caldwell

FIGURES



8/25/2015

Author: TCaputi Path: P:\GIS\National_Grid\Patchogue\Patchogue_Site_Location_NEW.mxd

Brown AND Caldwell
Associates

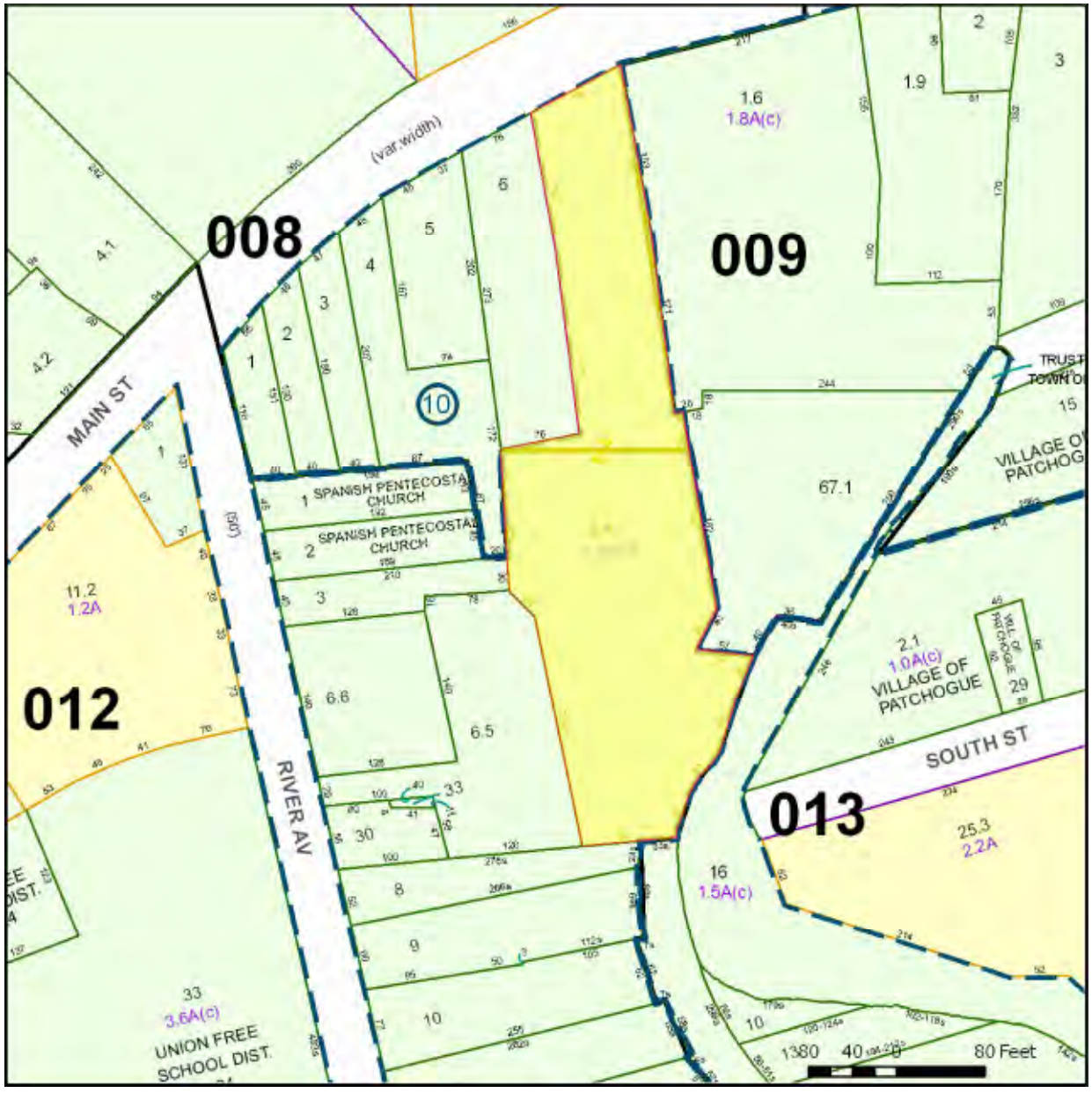
FIGURE 1
SITE LOCATION MAP
NATIONAL GRID - PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

0 210 420
Feet

COUNTY OF SUFFOLK

REAL PROPERTY TAX SERVICE AGENCY

DISTRICT 0204 - SECTION - 01200 - BLOCK - 0900 - LOT - 006004



Map

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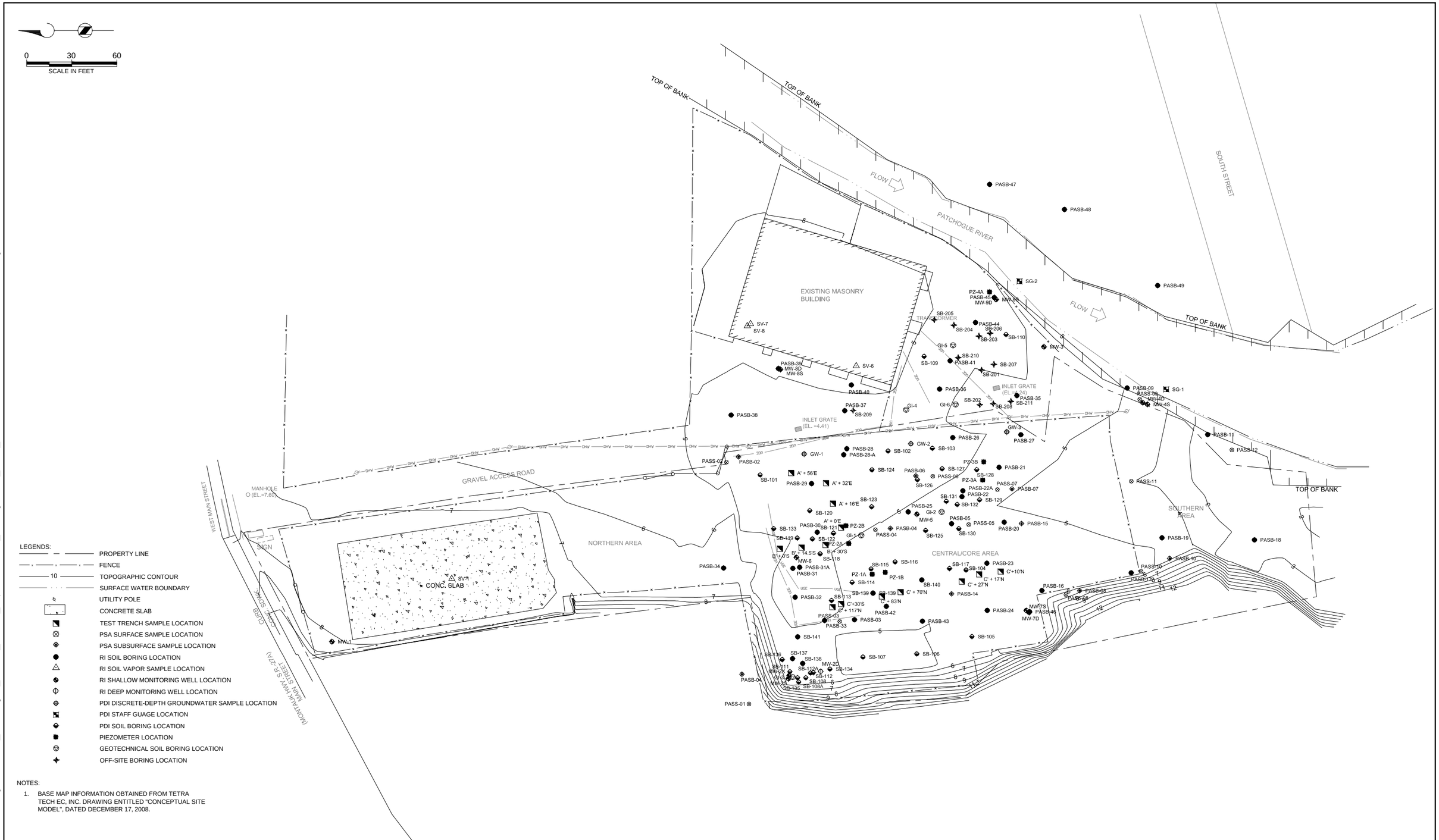
9/30/2015

FIGURE 2A
TAX MAP
NATIONAL GRID-PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

Brown AND Caldwell
Associates

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETSIC-CIVIL File Name: Fig-2B Plot Date: October 5, 2015 8:04 AM Cadd User: Near

0 30 60
SCALE IN FEET



LEGENDS:

- PROPERTY LINE
- FENCE
- 10 TOPOGRAPHIC CONTOUR
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE SLAB
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GUAGE LOCATION
- PDI SOIL BORING LOCATION
- PIEZOMETER LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- OFF-SITE BORING LOCATION

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

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SCALE: 1" = 60'

142128

DATE: October 5, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

SITE LAYOUT MAP

FIGURE

2B

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-3 Plot Date: October 5, 2015 8:10 AM Cadd User: Near, I

0 30 60
SCALE IN FEET

TOP OF BANK
FLOW
PATCHOGUE RIVER
SOUTH STREET
EXISTING MASONRY BUILDING
TRANSFORMER
INLET GRATE (EL. =4.24)
INLET GRATE (EL. =4.41)
GRAVEL ACCESS ROAD
MANHOLE (EL.=7.80)
WEST MAIN STREET
SIGN
CURB
CONC. SLAB
(MONTAUK HWY S.R.27A) MAIN STREET
NORTHERN AREA
CENTRAL/CORE AREA
SOUTHERN AREA
PASB-47
PASB-48
PASB-49
SG-2
PZ-4A
PASB-45
MW-9D
MW-9S
SB-205
SB-204
PASB-44
SB-206
SB-203
SB-110
MW-3
GI-5
SB-109
SB-210
PASB-41
SB-207
SB-201
SV-7
SV-8
SV-6
PASB-39
MW-8D
MW-8S
PASB-40
PASB-38
PASB-37
SB-209
GI-4
PASB-36
GI-6
SB-202
SB-208
PASB-35
SB-211
PASB-09
PASS-09
MW-4D
MW-4S
SG-1
PASB-11
PASS-12
PASS-11
PASB-26
PASB-27
GW-2
SB-102
SB-103
GW-1
PASB-28
PASB-28-A
PASS-02
PASB-02
SB-101
SB-124
PASB-06
SB-127
PASB-21
PZ-3B
SB-128
PZ-3A
PASS-07
PASB-07
PASB-22A
PASB-22
SB-131
SB-132
SB-129
SB-126
PASS-06
PASB-29
A' + 56'E
A' + 32'E
A' + 16'E
A' + 0'E
SB-123
SB-120
PASB-25
GI-2
MW-5
PASB-05
PASS-05
PASB-20
PASB-15
SB-133
PASB-30
SB-121
PZ-2B
PASB-04
SB-125
SB-130
SB-119
SB-122
PZ-2A
GI-1
PASS-04
B' + 30'S
B' + 14.5'S
MW-6
PASB-31A
PASB-31
SB-118
SB-115
SB-116
SB-117
PASB-23
SB-104
C'+10'N
C' + 17'N
PZ-1A
PZ-1B
SB-114
SB-140
C' + 27'N
PASB-16
PASB-32
SB-113
SB-139
SB-135
C' + 70'N
PASB-14
C'+30'S
C' + 83'N
C' + 117'N
PASB-42
PASB-03
PASB-43
PASB-24
MW-7S
MW-7D
PASB-40
PASB-33
SB-141
SB-105
SB-137
SB-138
SB-107
SB-106
MW-2D
SB-134
SB-112A
SB-112
SB-108A
SB-108
SB-136
PASB-04
PASS-01
PASB-34
PASB-19
PASB-18
PASB-10
PASS-10
MW-1
SV-9
CONC. SLAB

LEGENDS:

- PROPERTY LINE
- FENCE
- 10 TOPOGRAPHIC CONTOUR
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE SLAB
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GUAGE LOCATION
- PDI SOIL BORING LOCATION
- PIEZOMETER LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- OFF-SITE BORING LOCATION

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: October 5, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

SITE PLAN OF ON-SITE AND OFF-SITE PROPERTIES

FIGURE

3

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-4 Plot Date: October 5, 2015 8:13 AM Cadd User: Near, I

0 30 60
SCALE IN FEET

LEGEND:

- PROPERTY LINE
- FENCE
- 10 TOPOGRAPHIC CONTOUR
- UGE UGE UNDERGROUND ELECTRIC
- OHW OHW OHW OVERHEAD ELECTRIC WIRE
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE
- GRAVEL ROAD
- GRAVEL COVER
- VEGETATIVE COVER
- ASPHALT PAVEMENT
- MW-1 MONITORING WELL LOCATION
- PZ-3B PIEZOMETER LOCATION

NOTES:

1. THE UTILITIES SHOWN SHALL BE CONSIDERED APPROXIMATE. THE LOCATION OF UTILITIES MAY DIFFER FROM THAT SHOWN AND ADDITIONAL UTILITIES MAY BE PRESENT ON-SITE.
2. THE LOCATION OF UTILITIES SHALL BE VERIFIED PRIOR TO INTRUSIVE ACTIVITIES. CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING AND COORDINATING WITH NEW YORK CITY ONE CALL CENTER & LONG ISLAND AT 1-800-272-4480.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: October 5, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

EXISTING SITE CONDITIONS

FIGURE

4

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-5A Plot Date: October 5, 2015 8:17 AM Cadd User: Near

0 30 60
SCALE IN FEET

LEGENDS:

- PROPERTY LINE
- FENCE
- 10 TOPOGRAPHIC CONTOUR
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE SLAB
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GUAGE
- PDI SOIL BORING LOCATION
- PIEZOMETER LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- OFF-SITE BORING LOCATION
- NAPL/TAR OBSERVED IN SOIL
- CROSS SECTION ALIGNMENT
- (20.5) DEPTH BELOW GRADE SURFACE (FT.) WHERE DEEPEST OCCURRENCE OF NAPL WAS OBSERVED

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

Brown AND Caldwell

SCALE: 1" = 60'

142128

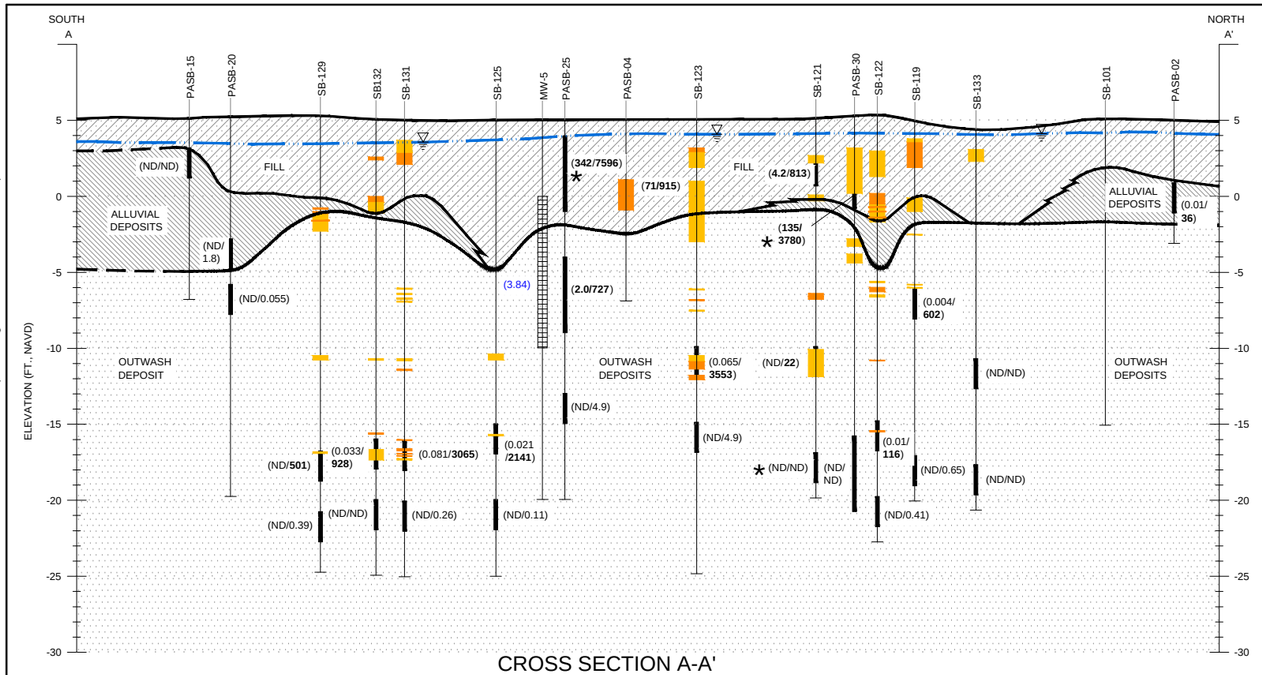
DATE: October 5, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

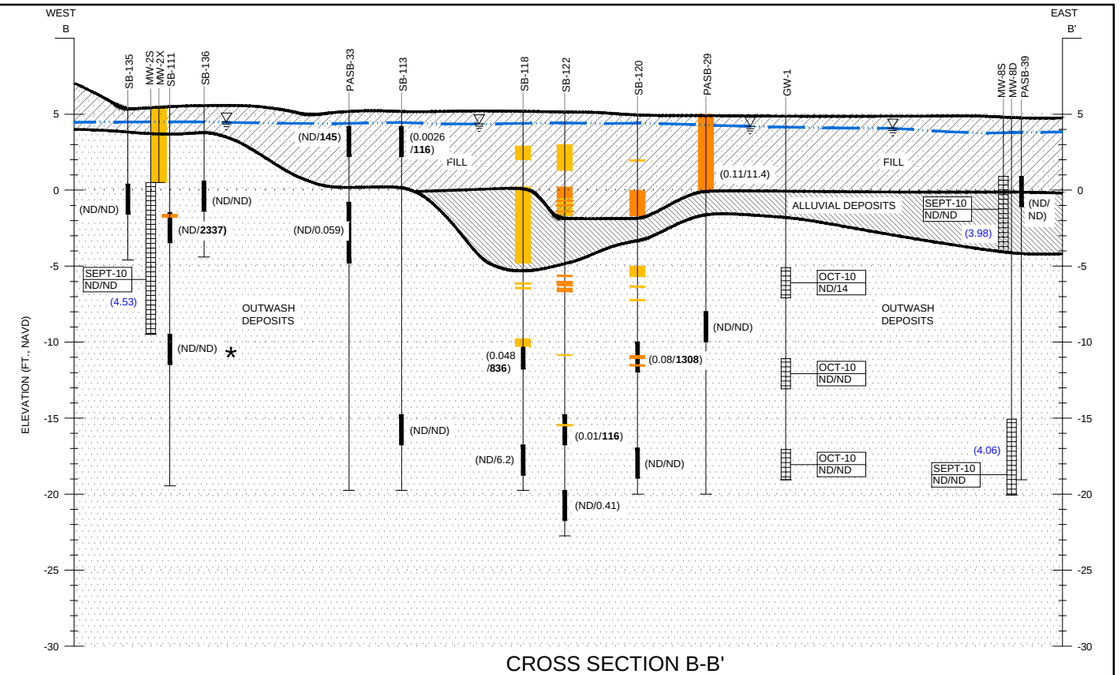
CROSS-SECTION LOCATIONS AND NAPL/TAR OBSERVATIONS LOCATIONS

FIGURE

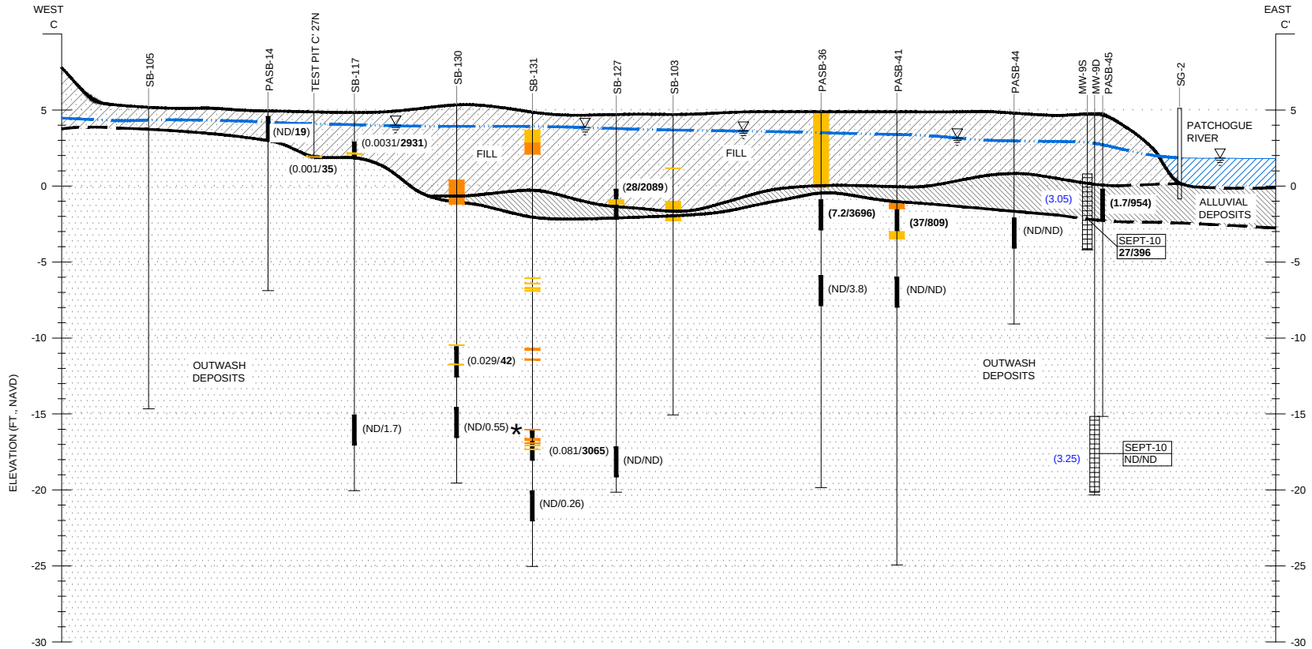
5A



CROSS SECTION A-A'

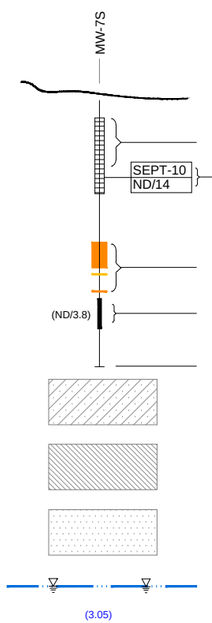


CROSS SECTION B-B'



CROSS SECTION C-C'

LEGEND:



MONITORING WELL / SOIL BORING IDENTIFICATION AND APPROXIMATE LOCATION

GENERALIZED GROUND SURFACE

WELL SCREEN INTERVAL

SEPT-10 ND/14 — TOTAL BTEX/TOTAL PAHS IN GROUNDWATER. VALUES REPORTED IN MICROGRAMS PER LITER (ug/L) BOLD VALUE INDICATES ONE OR MORE CONSTITUENT CONCENTRATIONS ABOVE CLASS GA CRITERIA.

INTERVAL/DISCRETE DEPTH WHERE NAPL/TAR OBSERVED IN SOIL. COLOR OF SYMBOL INDICATES DEGREE OF SATURATION. (DARK ORANGE -= HIGH, LIGHT ORANGE = LOW)

(ND/3.8) — TOTAL BTEX/TOTAL PAH (mg/kg) CONCENTRATION WITHIN SAMPLE INTERVAL. BOLD VALUE INDICATES ONE OR MORE CONSTITUENT CONCENTRATIONS ABOVE PART 375 UNRESTRICTED SOIL CLEANUP OBJECTIVES.

TOTAL DEPTH OF BOREHOLE

FILL

ALLUVIAL DEPOSITS

OUTWASH DEPOSITS

WATER TABLE (9/8/2010)

(3.05) — GROUNDWATER ELEVATION (FT., NAVD)

ABBREVIATIONS:

BTEX	BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE ISOMERS
PAH	POLYCYCLIC AROMATIC HYDROCARBONS
ND	NOT DETECTED
*	HIGHEST TOTAL BTEX OR TOTAL PAH VALUE LISTED FROM ORIGINAL AND DUPLICATE SAMPLE

0 5 10
SCALE IN FEET
VERTICAL

0 40 80
SCALE IN FEET
HORIZONTAL

Brown AND Caldwell

SCALE: AS NOTED

142128

DATE: October 5, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

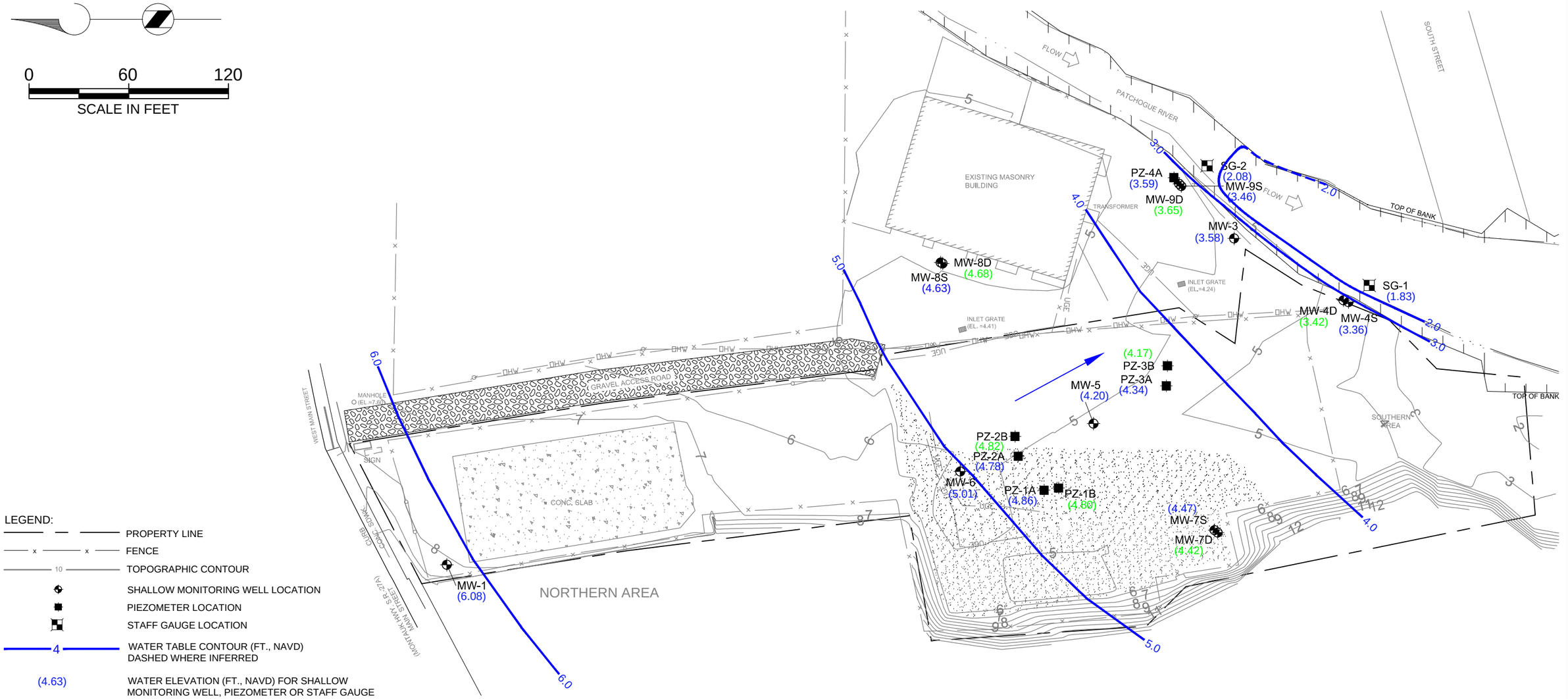
GEOLOGICAL CROSS SECTIONS

FIGURE

5B

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: FIG-5B (Geological Cross Sections) Plot Date: October 5, 2015

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: FIG-6 Plot Date: October 5, 2015 8:37 AM Cadd User: Near,



LEGEND:

- PROPERTY LINE
- FENCE
- TOPOGRAPHIC CONTOUR
- SHALLOW MONITORING WELL LOCATION
- PIEZOMETER LOCATION
- STAFF GAUGE LOCATION
- 4 — WATER TABLE CONTOUR (FT., NAVD) DASHED WHERE INFERRED
- (4.63) — WATER ELEVATION (FT., NAVD) FOR SHALLOW MONITORING WELL, PIEZOMETER OR STAFF GAUGE
- (3.41) — GROUNDWATER HEAD ELEVATION (FT., NAVD) FOR WELLS OR PIEZOMETERS SCREENED BELOW WATER TABLE (FROM DEEP MONITORING WELL OR PIEZOMETER)
- GENERALIZED DIRECTION OF GROUNDWATER FLOW

NOTES:
1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.
2. CONTOURS BASED ON GROUNDWATER ELEVATIONS OBTAINED ON 12/16/2014.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: October 5, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

GROUNDWATER CONTOUR MAP

FIGURE

6

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-7 Plot Date: October 5, 2015 8:41 AM Cadd User: Near, I

0 30 60
SCALE IN FEET

TOP OF BANK
FLOW
PATCHOGUE RIVER
SOUTH STREET
EXISTING MASONRY BUILDING
TRANSFORMER
INLET GRATE (EL.=4.24)
INLET GRATE (EL.=4.41)
RETORTS
COAL BIN
PURIFIER HOUSE
BOILER
OIL TANK
STORAGE SHED
SHED
SOUTHERN AREA
GRAVEL ACCESS ROAD
MANHOLE (EL.=7.60)
WEST MAIN STREET
SIGN
NORTHERN AREA
CENTRAL/CORE AREA
GAS HOLDER 60,000 CA
SHED
COOKE SQUARE
(MONTAUK HWY, S.R. 27A) MAIN STREET

LEGENDS:
- PROPERTY LINE
- FENCE
- 10 TOPOGRAPHIC CONTOUR
- UTILITY POLE
- FORMER STRUCTURE

NOTES:
1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: October 5, 2015

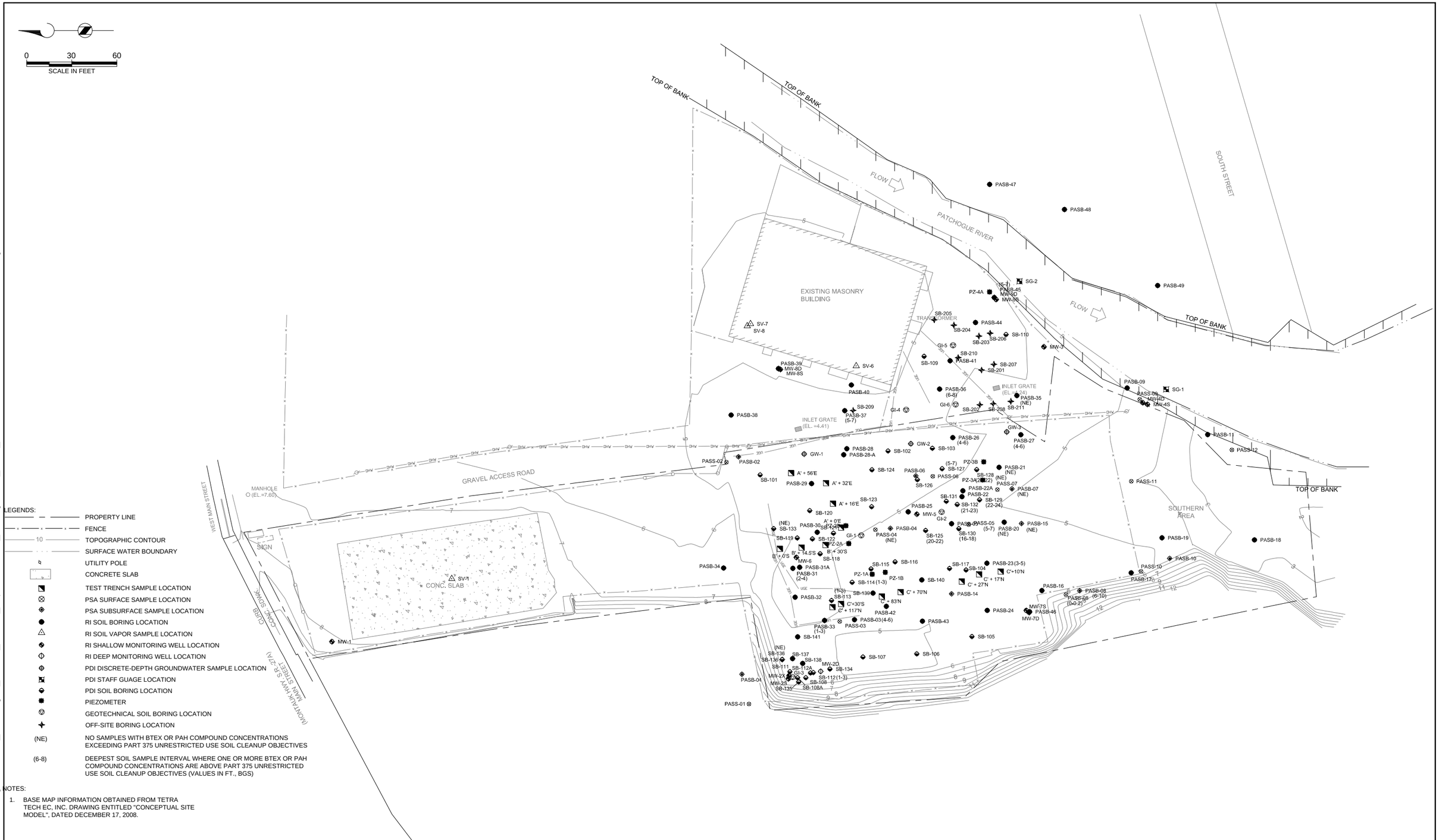
NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

HISTORICAL SITE FEATURES

FIGURE
7

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-8A Plot Date: December 9, 2015 11:16 AM Cadd User: N

0 30 60
SCALE IN FEET



LEGENDS:

	PROPERTY LINE
	FENCE
10	TOPOGRAPHIC CONTOUR
	SURFACE WATER BOUNDARY
	UTILITY POLE
	CONCRETE SLAB
	TEST TRENCH SAMPLE LOCATION
	PSA SURFACE SAMPLE LOCATION
	PSA SUBSURFACE SAMPLE LOCATION
	RI SOIL BORING LOCATION
	RI SOIL VAPOR SAMPLE LOCATION
	RI SHALLOW MONITORING WELL LOCATION
	RI DEEP MONITORING WELL LOCATION
	PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
	PDI STAFF GUAGE LOCATION
	PDI SOIL BORING LOCATION
	PIEZOMETER
	GEOTECHNICAL SOIL BORING LOCATION
	OFF-SITE BORING LOCATION
(NE)	NO SAMPLES WITH BTEX OR PAH COMPOUND CONCENTRATIONS EXCEEDING PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES
(6-8)	DEEPEST SOIL SAMPLE INTERVAL WHERE ONE OR MORE BTEX OR PAH COMPOUND CONCENTRATIONS ARE ABOVE PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES (VALUES IN FT., BGS)

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: December 9, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

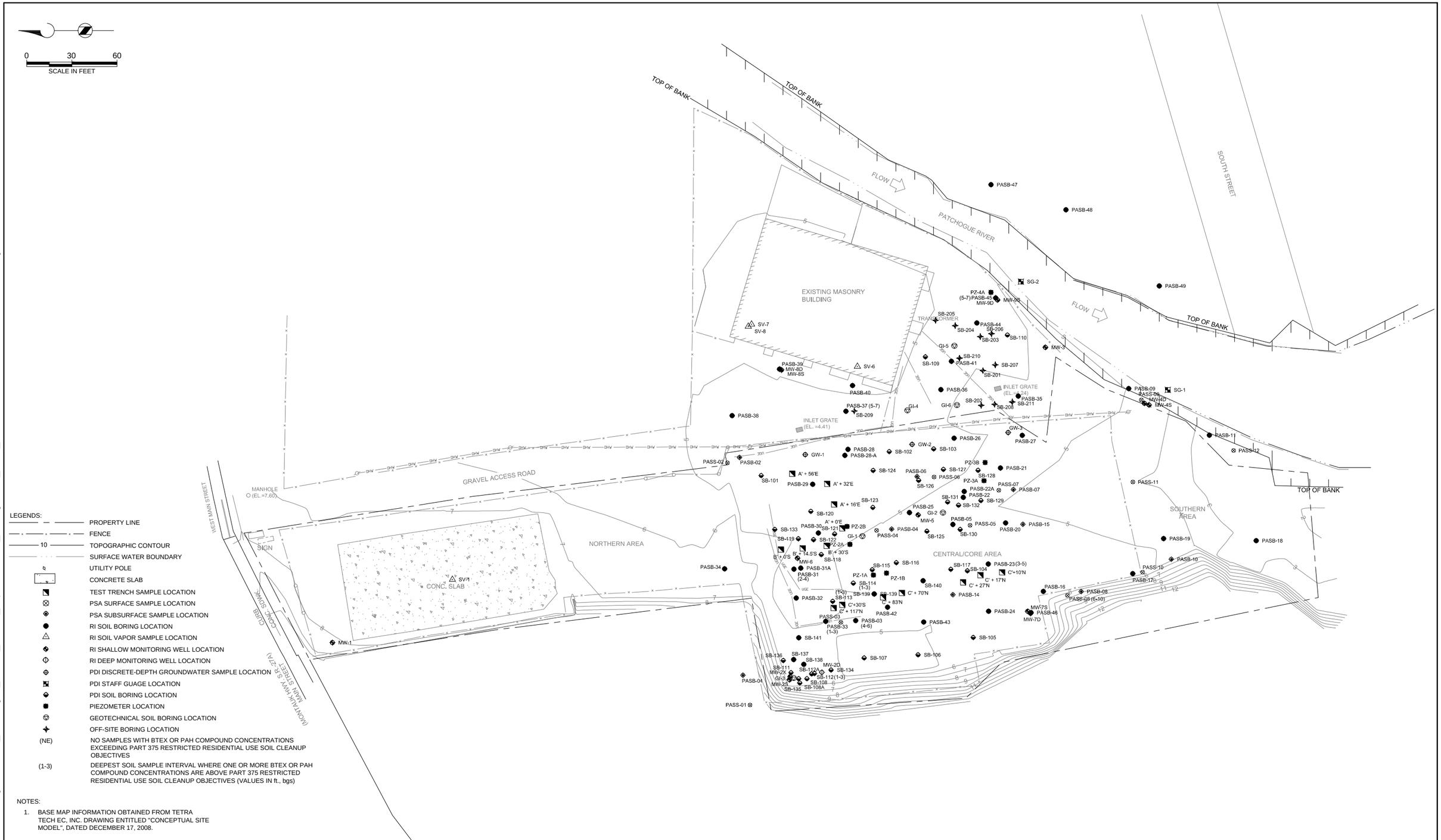
BTEX AND PAH CONCENTRATION IN SOIL ABOVE UNRESTRICTED USE (DEEPEST OCCURRENCE)

FIGURE

8A

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-8B Plot Date: December 9, 2015 11:27 AM Cadd User: N

0 30 60
SCALE IN FEET



LEGENDS:

- PROPERTY LINE
- FENCE
- 10 — TOPOGRAPHIC CONTOUR
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE SLAB
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GUAGE LOCATION
- PDI SOIL BORING LOCATION
- PIEZOMETER LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- OFF-SITE BORING LOCATION
- (NE) NO SAMPLES WITH BTEX OR PAH COMPOUND CONCENTRATIONS EXCEEDING PART 375 RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES
- (1-3) DEEPEST SOIL SAMPLE INTERVAL WHERE ONE OR MORE BTEX OR PAH COMPOUND CONCENTRATIONS ARE ABOVE PART 375 RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES (VALUES IN ft., bgs)

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: December 9, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

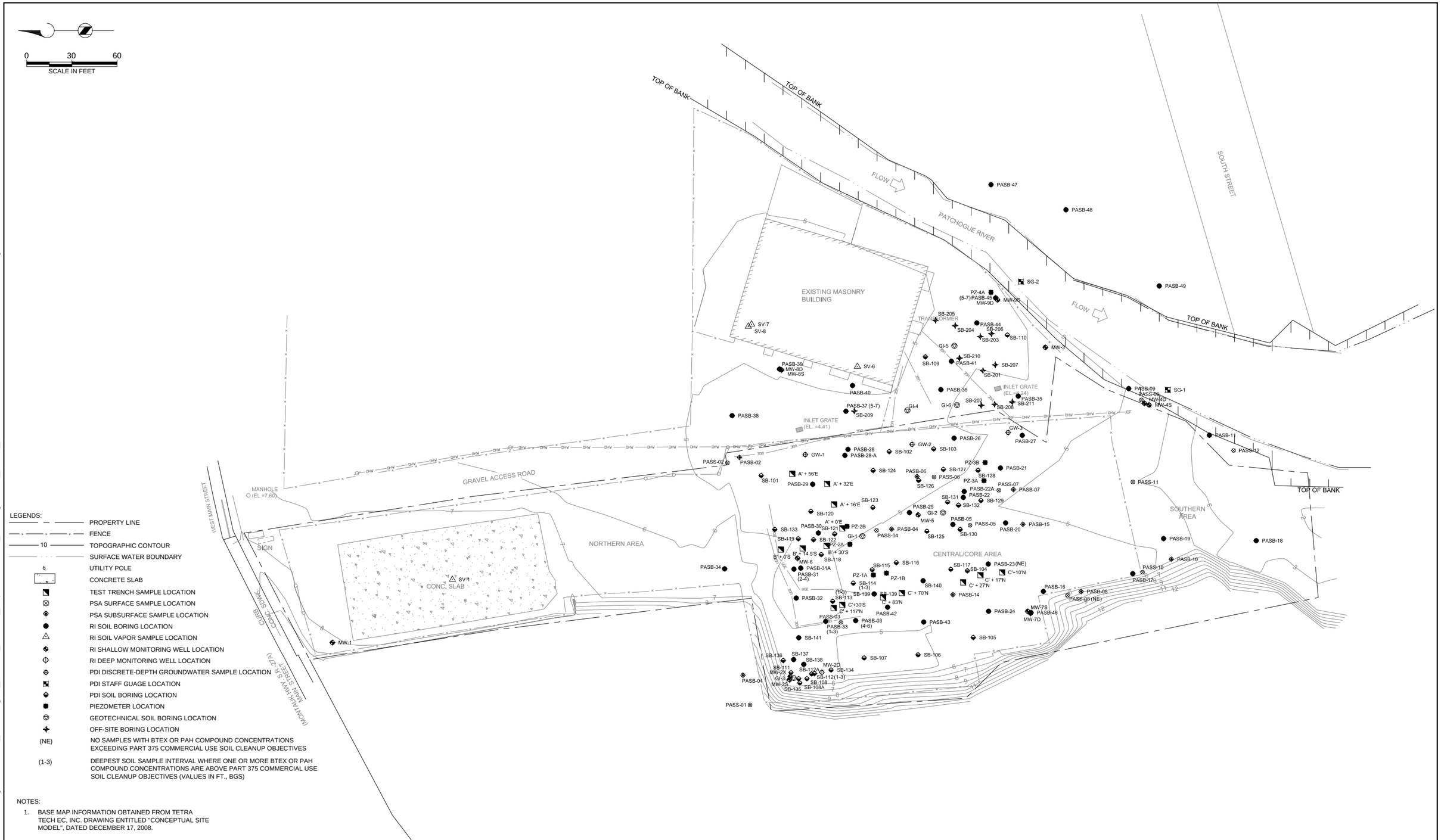
BTEX AND PAH CONCENTRATION IN SOIL ABOVE RESTRICTED RESIDENTIAL (DEEPEST OCCURRENCE)

FIGURE

8B

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETS\C-CIVIL File Name: Fig-8C Plot Date: December 9, 2015 11:49 AM Cadd User: N

0 30 60
SCALE IN FEET



LEGENDS:

- PROPERTY LINE
- FENCE
- 10 TOPOGRAPHIC CONTOUR
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE SLAB
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GUAGE LOCATION
- PDI SOIL BORING LOCATION
- PIEZOMETER LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- OFF-SITE BORING LOCATION
- (NE) NO SAMPLES WITH BTEX OR PAH COMPOUND CONCENTRATIONS EXCEEDING PART 375 COMMERCIAL USE SOIL CLEANUP OBJECTIVES
- (1-3) DEEPEST SOIL SAMPLE INTERVAL WHERE ONE OR MORE BTEX OR PAH COMPOUND CONCENTRATIONS ARE ABOVE PART 375 COMMERCIAL USE SOIL CLEANUP OBJECTIVES (VALUES IN FT., BGS)

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.

Brown AND Caldwell

SCALE: 1" = 60'

142128

DATE: December 9, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

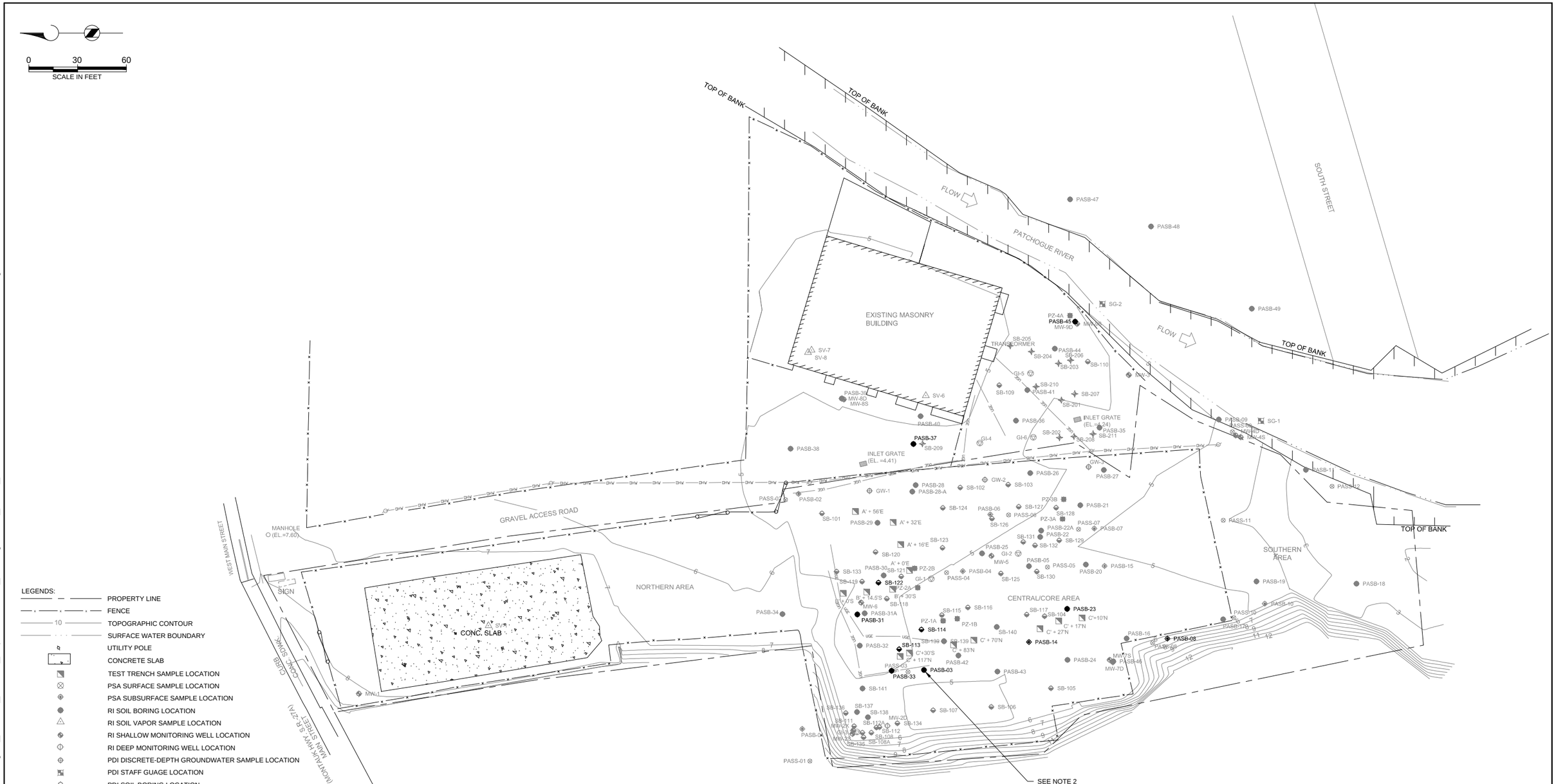
BTEX AND PAH CONCENTRATION IN SOIL ABOVE COMMERCIAL USE (DEEPEST OCCURRENCE)

FIGURE

8C

Path: P:\National_Grid\Patchogue\142128_Patchogue_UCWP_RDWP_Implement\Site_Management_Plan_CAD\2-SHEETSIC-CIVIL File Name: Fig-9 Plot Date: October 6, 2015 4:12 PM Cadd User: Near, I

0 30 60
SCALE IN FEET



LEGENDS:

- PROPERTY LINE
- FENCE
- TOPOGRAPHIC CONTOUR
- SURFACE WATER BOUNDARY
- UTILITY POLE
- CONCRETE SLAB
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GUAGE LOCATION
- PDI SOIL BORING LOCATION
- PIEZOMETER LOCATION
- GEOTECHNICAL SOIL BORING LOCATION
- OFF-SITE BORING LOCATION

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM TETRA TECH EC, INC. DRAWING ENTITLED "CONCEPTUAL SITE MODEL", DATED DECEMBER 17, 2008.
2. LOCATIONS WITH SOIL CONCENTRATIONS IN EXCEEDANCE OF RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES ARE SHOWN IN BOLD.

Brown AND Caldwell

SCALE: 1" = 60'

142128

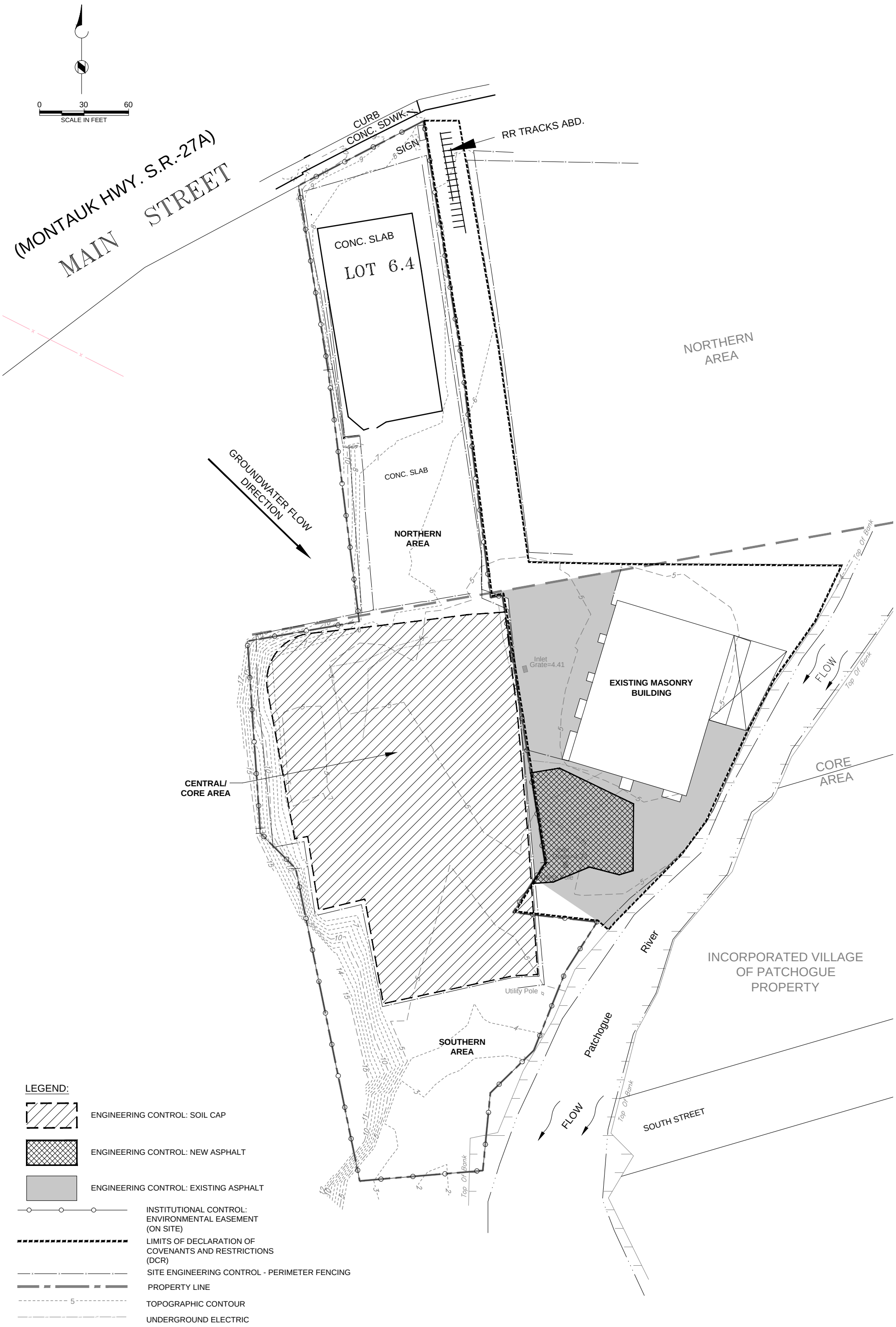
DATE: October 6, 2015

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

REMAINING SOIL SAMPLE EXCEEDANCES

FIGURE

9



Brown AND Caldwell	SCALE: 1" = 40' 142128 DATE: August 24, 2015	NATIONAL GRID PATCHOGUE FORMER MGP SITE VILLAGE OF PATCHOGUE, NEW YORK	INSTITUTIONAL AND ENGINEERING CONTROL BOUNDARIES AND LOCATION	FIGURE 10

APPENDIX A

ENVIRONMENTAL EASEMENT

(TO BE PREPARED BY THE NYSDEC FOR THE SITE AFTER COMPLETION OF THE IMPLEMENTATION OF THE REMEDY.)

New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau C, 11th Floor
625 Broadway, Albany, New York 12233-7014
Phone: (518) 402-9662 • **Fax:** (518) 402-9679
Website: www.dec.ny.gov

Joe Martens
Commissioner

William J. Ryan, Project Manager
Site Investigation and Remediation Department
National Grid
175 East Old Country Road
Hicksville, NY 11801

Re: **Environmental Easement for** Patchogue site
Site ID No.: #152182
Patchogue, Suffolk County

Dear Mr. Ryan:

The above referenced Site requires an Environmental Easement as part of the of the remediation process. There are several items which constitute the New York State Department of Environmental Conservation's standard Environmental Easement Package. These items include the following:

a) Environmental Easement Template;
b) Notice form;
c) Attorney/Applicant Checklist and Certification;
d) Title requirements; and
e) Survey Requirements.

These items can be found on the Department's web page at the following link: http://www.dec.ny.gov/chemical/48236.html. The Environmental Easement Package should be sent to your attorney. Any questions regarding the legal requirements should be addressed to the Office of General Counsel attorney assigned to your Site, Yvonne Ward, at 518-402-9507. When the package has been completed, it must be submitted in its entirety to the Attorney assigned to this matter. Please be advised that failure to include all the necessary documentation/information required in the Environmental Easement package will result in a delay of Department review and approval of the Easement.

The Environmental Easement template must be completed with site-specific information. When submitting the Environmental Easement Package for review, please note that the following additional documents will be required (refer to checklist):

a) An updated title report (current within 6 months) along with copies of any encumbrances (e.g., mortgages, judgments, easements, leases, liens etc.). See attached title requirements.

INTERNATIONAL YEAR OF FORESTS · 2011

b) Any Schedule "B" exception supporting documents (notice requirements will be needed for prior easements, rights-of-way, liens, encumbrances etc., and any interests affecting the property).
c) The current deed(s).
d) A survey covering the property as described in the current deed along with a metes and bounds of the same.
e) An ALTA survey or a survey that meets the Department's requirements of the area(s) to be addressed by the Environmental Easement, with corresponding metes and bounds description. The survey should include the information, as addressed by the attached survey requirements.
f) A commitment letter and a proposed final policy from the title company stating that it will issue the proposed title insurance policy upon recordation of the Easement.
g) A review of organizational documents and partnership agreements with evidence of successors in interest such as LLC Documents/Certificate of Incorporation papers/Limited Partnership papers, etc. of the owners of the property, where applicable.

If you have any questions concerning the technical aspects of this matter, please contact me at 518-402-9662 or eblukows@gw.dec.state.ny.us.

Sincerely,

Elizabeth B. Lukowski
Project Manager

Ec: Bill Ryan, NG
Ted Leissing NG
Joseph Giordano, NG
G. Cross
M. Ryan
N. Barber

APPENDIX B

LIST OF SITE CONTACTS

APPENDIX B – LIST OF SITE AND OFF-SITE PROPERTY CONTACTS

This Appendix should include a listing of Site contacts. The below table should be edited as necessary to include Site contacts necessary for implementation of the ISMP.

Name	**Phone/Email Address**
Site Owner: KeySpan Gas East Corporation Off-Site Property Owner: John Cashel 210 West Main Realty Corp., 50 Gilpin Avenue, Hauppauge, New York 11788	(516) 545-2568 sarah.aldridge@nationalgrid.com 516-250-6386
Remedial Party/Respondent: National Grid	(516) 545-2568 sarah.aldridge@nationalgrid.com
National Grid's Qualified Environmental Professional: Keith Bogatch	201-574-4700 kbogatch@brwncald.com
NYSDEC DER Project Manager: Elizabeth Lukowski, NYSDEC Project Manager	(518) 402-9564; eblukows@gw.dec.state.us
On and Off-Site access contacts such as tenants, adjacent property owners, etc.: See Property Owners above	See Property Owners above
Remedial Party/Respondent Attorney: Francis J. Murphy National Grid- Legal Dept. 175 East Old Country Road Hicksville, NY 11801	(516) 545-4790 Francis.Murphy@nationalgrid.com

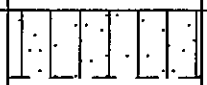
APPENDIX C

SOIL BORING AND MONITORING WELL CONSTRUCTION LOGS

	Project Name: Former Patchogue MGP	Site Id: MW-1
	Township/Range: Patchogue, New York	Coordinate X: 1255132.53
	Logged By: Tom Fowler	Coordinate Y: 219674.03
	Drilling Method: Geoprobe	Total Depth: 15.00'
		Date Started: 01/28/08
Remarks:		Date Completed: 01/28/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
1	40	FI		0–2: Dark Gray Brown fine SAND and organic silt, some decomposed wood;	01/28/08	0 ppm	Installed 2" monitoring well.
2				2–4.6: Dark Gray Brown fine to medium SAND, some silt, moist		0 ppm	
3		SM				0 ppm	
4						0 ppm	
5	96	GM		4.6–5: Dark Gray Brown GRAVEL and silty sand, little organics, wet	01/28/08		No PID hits in any portion.
6				5–10: Dark Gray Brown/Dark Brown fine to medium SAND, some organic silt, little gravel, medium dense, wet		0 ppm	
7						0 ppm	Screened 7–12' bgs.
8						0 ppm	
9						0 ppm	
10	90	SM		10–15: Gray Brown fine to medium SAND medium dense, wet	01/28/08		
11						0 ppm	
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: MW-1
Township/Range: Patchogue, New York	Coordinate X: 1255132.53
Logged By: Tom Fowler	Coordinate Y: 219674.03
Drilling Method: Geoprobe	Total Depth: 15.00'
	Date Started: 01/28/08
Remarks:	Date Completed: 01/28/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: MW-2D
	Township/Range: Patchogue, New York	Coordinate X: 1255112.75
	Logged By: Tom Fowler	Coordinate Y: 219348.84
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 02/04/08
Remarks:		Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	36	PT		0–1.5: Brown PEAT	02/04/08		
1						0 ppm	
				1.5–5: Dark Brown fine to medium SAND,			
2				medium density, moist to wet.		0 ppm	
3						0 ppm	
4						0 ppm	
5	28			5–10: Gray Brown fine to coarse SAND,	02/04/08		
				little gravel, medium density, wet			
6						0 ppm	PASBMW2D–6–10
							Full TCL
7						0 ppm	
8						0 ppm	
9						0 ppm	
10	46			10–15: Gray Brown fine to medium SAND,	02/04/08		
				medium density, wet; from 10–10.4 orange brown			
11						0 ppm	
12						0 ppm	
13		SP				0 ppm	
14						0 ppm	

	Project Name: Former Patchogue MGP	Site Id: MW-2D
	Township/Range: Patchogue, New York	Coordinate X: 1255112.75
	Logged By: Tom Fowler	Coordinate Y: 219348.84
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 02/04/08
Remarks:		Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	40			15–20: Gray Brown fine to medium SAND, medium density, wet; from 18–19 medium brown	02/04/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	40			20–25: Gray Brown fine to medium SAND, medium density, wet	02/04/08		Screened 20 – 25' bgs
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: MW-2S
	Township/Range: Patchogue, New York	Coordinate X: 1255107.89
	Logged By: Tom Fowler	Coordinate Y: 219370.35
	Drilling Method: Geoprobe	Total Depth: 15.00'
		Date Started: 01/28/08
Remarks:		Date Completed: 01/28/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	30						
1				0–4: Dark Brown PEAT	01/28/08	0 ppm	Installed a 2" well
2		PT				0 ppm	
3						0 ppm	
4				4–4.2: Dark Brown fine to coarse SAND, little gravel		0 ppm	
5	0			4.2–5: Yellow Brownfine to medium SAND, medium density, wet	01/28/08		No PID readings around backfill or empty tube
6				5–10: No Recovery			
7							Screened 5–10' bgs
8							
9							
10	0	SP		10–15: No Recovery	01/28/08		
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: MW-2S
Township/Range: Patchogue, New York	Coordinate X: 1255107.89
Logged By: Tom Fowler	Coordinate Y: 219370.35
Drilling Method: Geoprobe	Total Depth: 15.00'
	Date Started: 01/28/08
Remarks:	Date Completed: 01/28/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: MW-2X
	Township/Range: Patchogue, New York	Coordinate X: 1255109.58
	Logged By: Tom Fowler	Coordinate Y: 219369.97
	Drilling Method: Geoprobe	Total Depth: 5.00'
		Date Started: 02/04/08
Remarks:		Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	8						
1		FI		0-5: Gray Brown Silty SAND with some wood chips, some glass fragments, some tarry globules, strong odor, moist	02/04/08	28 ppm	Bottom on foot of Lexan or Macro tube is squashed. Located 15 ft. south of MW-2S.
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

	Project Name: Former Patchogue MGP	Site Id: MW-3
	Township/Range: Patchogue, New York	Coordinate X: 1255328.74
	Logged By: Tom Fowler	Coordinate Y: 219200.31
	Drilling Method: Geoprobe	Total Depth: 10.00'
		Date Started: 01/28/08
Remarks:		Date Completed: 01/28/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	70			0–4: Dark Brown/Dark Gray fine to medium SAND and silt, some gravel, medium density, moist	01/28/08	0 ppm	Install 2" well.
1							
2		SM				0 ppm	
3						0 ppm	
4						0 ppm	
		SP		4–5: Gray Brown fine to medium SAND little silt, trace gravel, medium density, wet			
5	96			5–7: Dark Brown fine to medium SAND and peat, wet	01/28/08		Screened 5–10' bgs.
6		SM				0 ppm	
7				7–8: Gray Brown fine to coarse SAND and gravel, medium density, wet		0 ppm	
8				8–9: Orange Brown/Light Gray fine to coarse SAND, medium density, wet		0 ppm	
		SP					
9				9–10: Gray fine to coarse SAND and gravel, medium density, wet		0 ppm	
10							
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: MW-4D
Township/Range: Patchogue, New York	Coordinate X: 1255291.58
Logged By: Tom Fowler	Coordinate Y: 219134.53
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/04/08
Remarks:	Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	60						
				0–5: Dark Brown PEAT, some sand, some gravel,	02/04/08		Installed 2"
1				little wood, moist		0 ppm	well
2						0 ppm	
3		PT				0 ppm	
4						0 ppm	
5	26			5–6: Dark Brown PEAT	02/04/08		PASBMW4D–5–10
							Full TCL
6				6–10: Gray Brown fine to coarse SAND, little		0 ppm	
				gravel, medium density, wet			
7						0 ppm	
8						0 ppm	
9						0 ppm	
10	18			10–15: Orange Brown fine to coarse SAND, medium	02/04/08		
				density, wet			
11						0 ppm	
12						0 ppm	
13						0 ppm	
14						0 ppm	

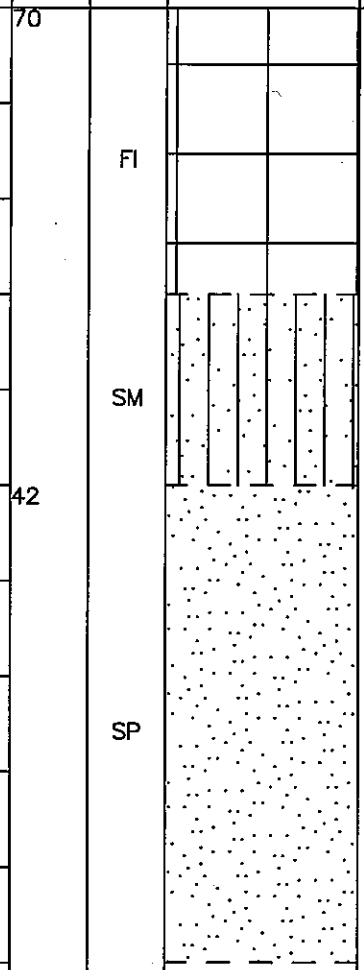
Project Name: Former Patchogue MGP	Site Id: MW-4D
Township/Range: Patchogue, New York	Coordinate X: 1255291.58
Logged By: Tom Fowler	Coordinate Y: 219134.53
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/04/08
Remarks:	Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	46	SP		15–18: Orange Brown fine to medium SAND	02/04/08		Little bog iron
16						0 ppm	
17						0 ppm	
18				18–20: Orange Brown fine to coarse SAND and gravel, medium density, wet		0 ppm	
19						0 ppm	
20	30			20–25: Light Brown fine to coarse SAND, medium density, wet	02/04/08		Screened 20 – 25' bgs
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: MW-4S
Township/Range: Patchogue, New York	Coordinate X: 1255290.45
Logged By: Tom Fowler	Coordinate Y: 219131.47
Drilling Method: Geoprobe	Total Depth: 10.00'
	Date Started: 01/28/08
Remarks:	Date Completed: 01/28/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	40						
1				0-5: Dark Brown fine to medium SAND and organic Silt, little misc. debris, brick fragments, weathered wood, medium density,wet	01/28/08	0 ppm	Install 2" well
2						0 ppm	
3						0 ppm	
4		FI				0 ppm	
5	60			5-7: Brown weathered wood, wet	01/28/08		Screened 5-10' bgs
6						0 ppm	
7				7-8.5: Dark Brown PEAT, gray fine sand zone (7.3-7.6')		0 ppm	
8		PT				0 ppm	
9		SP		8.5-10: Gray Brown fine to medium SAND, some gravel, medium density, wet		0 ppm	
10							
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: PASB-16
Township/Range: Patchogue, New York	Coordinate X: 1255166.56
Logged By: Tom Fowler	Coordinate Y: 219201.68
Drilling Method: Geoprobe	Total Depth: 10.00'
	Date Started: 02/01/08
Remarks:	Date Completed: 02/01/08



Depth	% Recovery	USCS Code	Material Description	DATE	PID	Notes
0-1	70	FI	0-3: Dark Gray Brown fine to coarse SAND and gravel, some brick	02/01/08	0 ppm	
1-2					0 ppm	
2-3					0 ppm	
3-4		SM	3-5: Brown/Dark Brown fine to medium SAND, some peat		0 ppm	
4-5						
5-6	42	SP	5-10: Gray Brown fine to coarse SAND, little to some gravel (increasing with depth), medium density, wet	02/01/08	0 ppm	
6-7					0 ppm	
7-8					0 ppm	
8-9					0 ppm	
9-10						
10-11						
11-12						
12-13						
13-14						

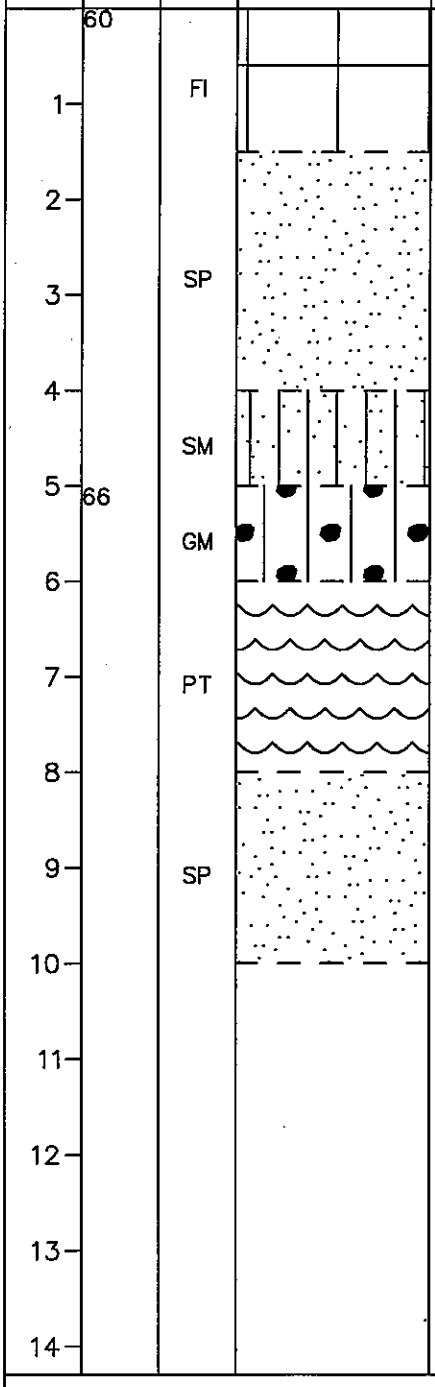
Project Name: Former Patchogue MGP	Site Id: PASB-17
Township/Range: Patchogue, New York	Coordinate X: 1255178.34
Logged By: Tom Fowler	Coordinate Y: 219142.26
Drilling Method: Geoprobe	Total Depth: 10.00'
	Date Started: 02/01/08
Remarks:	Date Completed: 02/01/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	64	FI		0–0.5: Brown silty SAND and gravel, brick	02/01/08		
1		SP		0.5–1.5: Brown fine to medium SAND		0 ppm	
				1.5–5: Brown fine to medium SAND and varying amounts of peat			
2						0 ppm	
3		SM				0 ppm	
4						0 ppm	
5	54			5–7: Brown fine to medium SAND, little peat, wet	02/01/08		
6						0 ppm	
7				7–10: Gray to Yellow Brown fine to coarse SAND,		0 ppm	
		SP		some gravel, medium density, wet			
8						0 ppm	
9						0 ppm	
10							
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: PASB-18
Township/Range: Patchogue, New York	Coordinate X: 1255200.28
Logged By: Tom Fowler	Coordinate Y: 219060.21
Drilling Method: Hand Auger	Total Depth: 7.50'
	Date Started: 02/08/08
Remarks:	Date Completed: 02/08/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
1		PT		0-1.5: Gray Black PEAT, some sand, leaves. very soft.	02/08/08	0 ppm	
2		SM		1.5-3.5: Gray Brown fine to medium SAND, some silt, wet	02/08/08	0 ppm	
3						0 ppm	
4		PT		3.5-4: Dark Brown PEAT	02/08/08		
				4-6: Gray Brown fine to coarse SAND, trace gravel, wet	02/08/08	0 ppm	
5		SP				0 ppm	
6		PT		6-6.5: Brown PEAT	02/08/08	0 ppm	
7		SP		6.5-7.5: Yellow Brown fine to coarse SAND and gravel (sub-rounded)	02/08/08	0 ppm	
8							
9							
10							
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: PASB-19
Township/Range: Patchogue, New York	Coordinate X: 1255201.64
Logged By: Tom Fowler	Coordinate Y: 219121.74
Drilling Method: Geoprobe	Total Depth: 10.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08



Depth	% Recovery	USCS Code	Material Description	DATE	PID	Notes
0	60					
1		FI	0-1.5: Dark Brown fine SAND, some gravel, brick fragments	01/29/08	0 ppm	
2			1.5-4: Gray Brown to Gray Black fine to medium SAND and gravel, some silt		0 ppm	
3		SP			0 ppm	3-4: Dark staining
4			4-5: Dark Brown fine to medium SAND, some silt		0 ppm	PASB19-2-4 Hg only
5	66	SM	5-6: Dark Brown GRAVEL and silt, some sand, wet	01/29/08		
6		GM	6-8: Dark Brown PEAT		0 ppm	PASB19-6-10 Hg only
7		PT			0 ppm	
8			8-10: Gray Brown to Orange Brown fine to coarse SAND and gravel, wet		0 ppm	
9		SP			0 ppm	
10						
11						
12						
13						
14						

Project Name: Former Patchogue MGP	Site Id: PASB-20
Township/Range: Patchogue, New York	Coordinate X: 1255212.00
Logged By: Tom Fowler	Coordinate Y: 219226.72
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	62						
1				0-3: Dark Gray Brown GRAVEL and silty sand, broken bricks	01/29/08	0 ppm	
2		FI				0 ppm	
3				3-5: Gray Black/Gray Brown fine to medium SAND, medium density, wet		0 ppm	
4						0 ppm	
5	60			5-10: Gray Brown fine to medium SAND, medium density, wet	01/29/08		
6						0 ppm	
7						0 ppm	
8						0 ppm	8-8.5: Gray-black staining, slight
9						0 ppm	odor
10	52			10-15: Yellow Brown fine to medium SAND, medium density, wet	01/29/08		PASB20-8-10 Full TCL
11						0 ppm	PASB20-11-13 Full TCL
12						0 ppm	
13						0 ppm	
14		SP				0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-20
Township/Range: Patchogue, New York	Coordinate X: 1255212.00
Logged By: Tom Fowler	Coordinate Y: 219226.72
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	26			15-20: Yellow Brown fine to medium SAND, medium density, wet	01/29/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	46			20-25: Orange Brown fine to medium SAND, medium density, wet	01/29/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-21
Township/Range: Patchogue, New York	Coordinate X: 1255248.57
Logged By: Tom Fowler	Coordinate Y: 219230.19
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	68						
				0-3: Dark Gray silty SAND and gravel-sized brick and concrete	01/30/08		
1						0 ppm	
		FI					
2						0 ppm	
3				3-5: Dark Gray Brown fine to medium SAND, some silt		0 ppm	Very slight odor
4						0.1 ppm	PASB21-3-5 Full TCL
5	48			5-8: Dark Gray Brown fine to coarse SAND, medium density, wet	01/30/08		
6						0 ppm	
7						0 ppm	
8				8-10: Yellow Brown fine to medium SAND, medium density, wet;		0 ppm	
9						0 ppm	
10	44			10-15: Yellow Brown fine to medium SAND, little gravel, wet	01/30/08		
11						0 ppm	PASB21-11-13 Full TCL
12						0 ppm	
13						0 ppm	
14		SP				0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-21
Township/Range: Patchogue, New York	Coordinate X: 1255248.57
Logged By: Tom Fowler	Coordinate Y: 219230.19
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	40			15-20: Yellow Brown fine to coarse SAND, medium density, wet	01/30/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	36			20-25: Yellow Brownfine to coarse SAND, medium density, wet	01/30/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-22
Township/Range: Patchogue, New York	Coordinate X: 1255229.01
Logged By: Tom Fowler	Coordinate Y: 219254.82
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	60						
				0-2: Gray/Red Brown GRAVEL with brick fragments	01/30/08		
1				and silty sand		3 ppm	
2				2-5: Dark Gray/Black fine to coarse SAND and gravel		ppm	
3		FI				ppm	PASB22-3-5
							Full TCL
4						ppm	moderate odor
5	46			5-5.5: Gray Black SAND with some wood fibers	01/30/08		odor
				5.5-7: Gray fine to medium SAND, medium denstiy, wet		8 ppm	
6							
7				7-10: Yellow Brown fine to coarse SAND, some gravel,		1 ppm	
				medium density, wet			
8						0 ppm	
9						0 ppm	
10	64			10-15: Yellow Brown fine to medium SAND, medium	01/30/08		
				density, wet			
11						0 ppm	PASB22-11-13
							Full TCL
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-22
Township/Range: Patchogue, New York	Coordinate X: 1255229.01
Logged By: Tom Fowler	Coordinate Y: 219254.82
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	54	SP		15-20: Yellow Brown fine to medium SAND, medium density, wet	01/30/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	36			20-25: Yellow Brown fine to coarse SAND, medium density, wet.	01/30/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-22A
	Township/Range:	Coordinate X: 1255232.92
	Logged By: T. Fowler	Coordinate Y: 219254.20
	Drilling Method: Geoprobe	Total Depth: 15.00'
		Date Started: 07/08/08
Remarks:		Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	64	SM			07/08/08		
		SM		0–0.5: Grey brown silty SAND, some gravel	07/08/08	0 ppm	
1				0.5–1: Dark brown to black fine to coarse silty	07/08/08	0 ppm	
				SAND, some gravel		0 ppm	
2		SM		1–3: Dark brown silty SAND, brick, concrete, and		0 ppm	
				cobble fragments, moist to wet		0 ppm	
3				3–5: Grey brown, fine to medium silty SAND, some	07/08/08	0 ppm	3–5: black tar
				silt, medium dense, wet			saturated wood
4		SM					shavings and soil;
							naphthalene–like
5	60			5–8: Dark brown fine to medium SAND, some silt,	07/08/08	0 ppm	odor
				concrete fragments, wet		0 ppm	5–8: black tar
6						0 ppm	saturated soil;
		SM				0 ppm	naphthalene–like
7						0 ppm	odor
						0 ppm	
8				8–10: Dark brown to black fine to medium SAND, some	07/08/08	0 ppm	8–8.2: black tar
				silt, some gravel, wood shavings, wet			saturated soil
9		SM					8.4–8.8: black
							tar saturated soil
10	40			10–13: Brown fine to coarse SAND,some gravel,	07/08/08	0 ppm	9.1–9.2: orange
				little silt, wet		0 ppm	brown staining
11						0 ppm	
		SP				0 ppm	
12						0 ppm	
13				13–14.5: Brown silty SAND, interlayered with	07/08/08		
				dark brown peat, wet			
14		SM					

	Project Name: Former Patchogue MGP	Site Id: PASB-22A
	Township/Range:	Coordinate X: 1255232.92
	Logged By: T. Fowler	Coordinate Y: 219254.20
	Drilling Method: Geoprobe	Total Depth: 15.00'
		Date Started: 07/08/08
Remarks:		Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15		SP		14.5–15: Brown, fine to coarse SAND, some gravel, medium dense, wet	07/08/08		14.5: 1 inch wide black coating
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-23
Township/Range: Patchogue, New York	Coordinate X: 1255184.73
Logged By: Tom Fowler	Coordinate Y: 219238.23
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	60						
				0-3: Dark Brown Sand and Silt, some brick and concrete fragments	01/30/08		
1						0.4 ppm	
2						ppm	
3				3-5: Gray Black fine SAND, some silt		ppm	very slight odor
4		FI				ppm	PASB23-3-5 Full TCL
5	44			5-7: Dark Gray Brown fine to medium SAND, medium density, wet	01/30/08		
6						0 ppm	
7				7-8.5: Brown Wood weathered		0 ppm	
8						0 ppm	
				8.5-8.8: Brown PEAT			
9		PT		8.8-10: Gray fine to coarse SAND, medium density, wet		0 ppm	
10	74			10-11: Gray fine to medium SAND, medium density, wet	01/30/08		
11				11-15: Yellow Brown fine to medium SAND, medium density, wet		0 ppm	
12						0 ppm	PASB23-12-15 Full TCL MS/MSD
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-23
Township/Range: Patchogue, New York	Coordinate X: 1255184.73
Logged By: Tom Fowler	Coordinate Y: 219238.23
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15				15-20: Gray Brown fine to medium SAND, medium density, wet	01/30/08		PASB23-15-20 Full TCL
16						0 ppm	
17		SP				0 ppm	
18						0 ppm	
19						0 ppm	
20				20-25: Orange Brown fine to coarse SAND, medium density, wet	01/30/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-24
Township/Range: Patchogue, New York	Coordinate X: 1255153.34
Logged By: Tom Fowler	Coordinate Y: 219238.01
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/01/08
Remarks:	Date Completed: 02/01/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	68						
				0-3: Dark Brown silty SAND, some gravel, concrete, moist	02/01/08		
1						0 ppm	
		FI					
2						0 ppm	
3				3-5: Brown fine to coarse SAND, grading to peat and sand, moist		0 ppm	
4						0 ppm	
5	72			5-7.5: Brown fine to coarse SAND and peat	02/01/08		PASB24-5-10 Full TCL (MS/MSD)
6						0 ppm	
		SM					
7						0 ppm	
				7.5-10: Gray Brown fine to coarse SAND, some peat zones			
8						0 ppm	
9						0 ppm	
10	64			10-15: Yellow Brown/Gray Brown fine to coase SAND, some gravel, medium density, wet	02/01/08		PASB24-10-15 Geotech
11						0 ppm	
12						0 ppm	
13						0 ppm	
14						0 ppm	

	Project Name: Former Patchogue MGP	Site Id: PASB-24
	Township/Range: Patchogue, New York	Coordinate X: 1255153.34
	Logged By: Tom Fowler	Coordinate Y: 219238.01
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 02/01/08
Remarks:		Date Completed: 02/01/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	60			15-20: Yellow Brown fine to medium SAND, medium density, wet	02/01/08		
16						0 ppm	
17						0 ppm	
		SP					
18						0 ppm	
19						0 ppm	
20	64			20-25: Yellow Brown/Dark Brown fine to coarse SAND, medium density, wet	02/01/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-25
	Township/Range: Patchogue, New York	Coordinate X: 1255218.90
	Logged By: Tom Fowler	Coordinate Y: 219290.60
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/30/08
Remarks:		Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	60			0-3: Dark Gray/Black fine to medium SAND, some gravel	01/30/08		moderate odor
1						6 ppm	PASB25-1-6 and
		FI					PASB25-31-36
2							(duplicate)
							Full TCL
3				3-5: Gray Black fine to medium SAND, loose, moist			
4							
5	46			5-7: Dark Reddish Brown fine to medium SAND, medium density, wet	01/30/08		Strong odor
6						120 ppm	
7				7-10: Gray/Yellow Brown fine to coarse SAND, little gravel, medium density, wet			
8						38 ppm	
9							9-9.2: red brown oily staining
10	48			10-15: Red Brown/Orange Brown fine to medium SAND, medium density, wet	01/30/08		PASB25-9-14
							Full TCL
11							
12							
13							
14		SP				4 ppm	13.8-14: Dark brown oily staining

Project Name: Former Patchogue MGP	Site Id: PASB-25
Township/Range: Patchogue, New York	Coordinate X: 1255218.90
Logged By: Tom Fowler	Coordinate Y: 219290.60
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	54			15-20: Yellow Brown fine to medium SAND, medium density, wet	01/30/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	58			20-25: Yellow Brown fine to medium SAND, medium density, wet	01/30/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-26
	Township/Range: Patchogue, New York	Coordinate X: 1255268.34
	Logged By: Tom Fowler	Coordinate Y: 219260.97
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/31/08
Remarks:		Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	74						
1				0-3: Dark Brown Silty SAND and gravel (concrete), moist	01/31/08		
2		FI					
3				3-4.5: Gray Black GRAVEL and fine to coarse sand, wet		42 ppm	Strong odor
4		GM					
				4.5-5: Gray Black fine to coarse SAND			Oily appearance
5	60			5-8.5: Dark Gray Brown fine to coarse SAND, medium density, wet	01/31/08		PASB26-4-6
							Full TCL
6						70 ppm	
7							
8							
				8.5-10: Gray to Brown fine to coarse SAND, some gravel			
9							
10	66			10-15: Yellow Brown fine to coarse SAND becoming fine to medium, medium density, wet	01/31/08		
11						0 ppm	PASB26-11-13
							Full TCL
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-26
Township/Range: Patchogue, New York	Coordinate X: 1255268.34
Logged By: Tom Fowler	Coordinate Y: 219260.97
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/31/08
Remarks:	Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	56	SP		15-20: Orange Brown fine to medium SAND, medium density, wet	01/31/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	46			20-25: Orange Brown fine to medium SAND, medium density, wet	01/31/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-27
Township/Range: Patchogue, New York	Coordinate X: 1255270.27
Logged By: Tom Fowler	Coordinate Y: 219215.68
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/30/08
Remarks:	Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	70						
1		SM		0-3: Dark Gray Brown fine to medium SAND with some silt	01/30/08	0 ppm	slight odor near top of core
2						0 ppm	
3				3-5: Gray Black fine to coarse SAND and gravel, medium density		0 ppm	
4						0 ppm	PASB27-4-6 Full TCL
5	62			5-10: Dark Gray fine to coarse SAND, little gravel, medium density, wet	01/30/08		
6						0.3 ppm	
7							
8							
9							
10	68			10-15: Yellow Brown fine to medium SAND, grayish spots at 10.5-13.5	01/30/08		
11						0 ppm	
12						0 ppm	
13						0 ppm	PASB27-13-15 Full TCL
14		SP				0 ppm	

	Project Name: Former Patchogue MGP	Site Id: PASB-27
	Township/Range: Patchogue, New York	Coordinate X: 1255270.27
	Logged By: Tom Fowler	Coordinate Y: 219215.68
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/30/08
Remarks:		Date Completed: 01/30/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	62			15-20: Yellow Brown fine to medium SAND, medium density, wet	01/30/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	46			20-25: Yellow Brown fine to medium SAND, medium density, wet	01/30/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-28
	Township/Range: Patchogue, New York	Coordinate X: 1255260.92
	Logged By: Tom Fowler	Coordinate Y: 219331.47
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/31/08
Remarks:		Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	74						
		FI		0-1: Dark Gray silty SAND and gravel (brick fragments), moist	01/31/08		
1							Moderate to strong odor PASB 28- 1-3 Full TCL
				1-3: Gray Black fine to coarse SAND, moist		34 ppm	
2		SP					
3				3-3.4: Brown PEAT			
		PT		3.4-5: Dark Gray Brown fine to coarse SAND, medium density, moist			
4							
5	40			5-10: Gray to Brown fine to coarse SAND, medium density, wet	01/31/08		
6						0 ppm	
7						0 ppm	
8						0 ppm	
9						0 ppm	
10	54			10-15: Yellow Brown fine to coarse SAND, little gravel, medium density, wet	01/31/08		
11						0 ppm	PASB28-11-13 Full TCL
12						0 ppm	
13						0 ppm	
14		SP				0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-28
Township/Range: Patchogue, New York	Coordinate X: 1255260.92
Logged By: Tom Fowler	Coordinate Y: 219331.47
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/31/08
Remarks:	Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	60			15-20: Yellow Brown fine to medium SAND, medium density, wet	01/31/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	58			20-25: Yellow Brown fine to medium SAND, medium density, wet	01/31/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-28A
Township/Range:	Coordinate X: 1255256.72
Logged By: T. Fowler	Coordinate Y: 219333.84
Drilling Method: Geoprobe	Total Depth: 5.00'
	Date Started: 07/08/08
Remarks:	Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
0	48	SP		0-5: Orange-brown, fine to medium SAND, trace gravel, medium dense, wet	07/08/08	0 ppm 0 ppm 0 ppm 0 ppm	Water Table ~0.8 feet bgs in borehole
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: PASB-29
Township/Range: Patchogue, New York	Coordinate X: 1255237.72
Logged By: Tom Fowler	Coordinate Y: 219354.91
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/31/08
Remarks:	Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	66						
1				0-3: Dark Gray fine to coarse SAND, and gravel, some silt	01/31/08	6 ppm	
2		FI					
3				3-5: Gray Black fine to medium SAND			Some odor
4		SP				6 ppm	
5	70			5-6.5: Brown PEAT, fine to coarse sand zones, wet.	01/31/08	1 ppm	
6		PT					
				6.5-9: Dark Brown fine to coarse SAND, and gravel;			
7						1 ppm	
8							
9				9-10: Brown fine to medium SAND, medium density, wet			
10	58			10-15: Light Brown fine to medium SAND, medium density, wet	01/31/08		
11						0 ppm	Dark stain 11-11.3'
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-29
Township/Range: Patchogue, New York	Coordinate X: 1255237.72
Logged By: Tom Fowler	Coordinate Y: 219354.91
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/31/08
Remarks:	Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	46	SP		15-20: Yellow Brown fine to medium SAND, medium density, wet	01/31/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	40			20-25: Yellow Brown fine to medium SAND, medium density, wet	01/31/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-30
	Township/Range: Patchogue, New York	Coordinate X: 1255205.35
	Logged By: Tom Fowler	Coordinate Y: 219351.12
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/31/08
Remarks:		Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	62						
1		FI		0-2: Dark Gray Brown GRAVEL and silty sand, slightly moist	01/31/08		
2				2-5: Dark Brown to Gray Black fine to medium SAND			
3							moderately strong odor and oily appearance
4						99 ppm	
5	52			5-10: Brown fine to coarse SAND, little gravel, medium density, wet, light gray 8-8.4	01/31/08		PASB30-4-6 and PASB30-34-36 (duplicate) Full TCL
6							
7							
8						159 ppm	
9							Gray black oily zones 8-8.5' and
10	54			10-15: Gray Brown fine to medium SAND, medium density, wet.	01/31/08		9-9.6'
11							
12							
13						8 ppm	
14		SP					

Project Name: Former Patchogue MGP	Site Id: PASB-30
Township/Range: Patchogue, New York	Coordinate X: 1255205.35
Logged By: Tom Fowler	Coordinate Y: 219351.12
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/31/08
Remarks:	Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	52			15-20: Gray to Light Brown fine to medium SAND, medium density, wet	01/31/08		
16							
17							
18						1 ppm	oily stained from 17.8-18' and 19.5-19.7'
19							
20	46			20-25: Yellow Brown fine to medium SAND, medium density, wet	01/31/08		
21							
22							PASB30-21-25 Full TCL (MS/MSD)
23						0 ppm	
24							
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-31
Township/Range: Patchogue, New York	Coordinate X: 1255181.32
Logged By: Tom Fowler	Coordinate Y: 219367.33
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	70						
		Fl		0-1: Gray Brown GRAVEL (some brick fragments) and	01/29/08		1-2: some odor
1				silty sand, wet at 1' bgs		4 ppm	iridenscent
				1-2: Gray to Black fine to medium SAND, wet			sheen ~3' bgs
2				2-5: Gray to Black fine to medium SAND, wet			2.0-4.5: moderate
							odor
3							PASB31-2-4 and
							PASB31-32-34
4							(duplicate)
							Full TCL
5	40			5-10: Light Brown to Brown fine to coarse SAND,	01/29/08		Lighter color
				medium density			with depth
6						0 ppm	
7						0 ppm	
8						0 ppm	
9						0 ppm	
10	30			10-15: Yellow Brown fine to medium SAND, medium	01/29/08		PASB31-10-15
				density, wet			Full TCL
11						0 ppm	
12						0 ppm	
13		SP				0 ppm	
14						0 ppm	

	Project Name: Former Patchogue MGP	Site Id: PASB-31
	Township/Range: Patchogue, New York	Coordinate X: 1255181.32
	Logged By: Tom Fowler	Coordinate Y: 219367.33
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/29/08
Remarks:		Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	40			15-20: Brown fine to medium SAND, medium density, wet	01/29/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	44			20-25: Yellow Brown to Gray Brown fine to medium SAND, medium density, wet	01/29/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-31A
	Township/Range:	Coordinate X: 1255182.02
	Logged By: T. Fowler	Coordinate Y: 219362.81
	Drilling Method: Geoprobe	Total Depth: 15.00'
		Date Started: 07/08/08
Remarks:		Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	66				07/08/08		
				0-3: Dark brown to grey brown fine to medium SAND,		0 ppm	
1				moist to wet		0 ppm	
		SP				0 ppm	
2						0 ppm	
						0 ppm	
3				3-4.5: Dark grey brown fine to medium SAND, wet	07/08/08	0 ppm	3-4.5: naphthalene-like odor, black staining
		SP					
4							
				4.5-5: Light grey fine to medium SAND, wet	07/08/08		4.5-5: black staining
		SP					
5	90			5-10: Dark grey brown grading to light	07/08/08	0 ppm	5-10: trace naphthalene-like odor
				grey and then light brown fine to coarse SAND, wet		0 ppm	
6						0 ppm	
						0 ppm	
7						0 ppm	
		SP				0 ppm	
8						0 ppm	8-8.5: dark brown staining
						0 ppm	
9						0 ppm	
						0 ppm	
10	52			10-10.4: Light brown medium to coarse SAND, little gravel, wet	07/08/08	0 ppm	
		SP		10.4-15: Light grey brown fine to medium SAND, wet	07/08/08	0 ppm	
11						0 ppm	
						0 ppm	
12						0 ppm	
						0 ppm	
13		SP					
14							

Project Name: Former Patchogue MGP	Site Id: PASB-31A
Township/Range:	Coordinate X: 1255182.02
Logged By: T. Fowler	Coordinate Y: 219362.81
Drilling Method: Geoprobe	Total Depth: 15.00'
	Date Started: 07/08/08
Remarks:	Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-32
Township/Range: Patchogue, New York	Coordinate X: 1255162.10
Logged By: Tom Fowler	Coordinate Y: 219365.88
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	66						
				0-2: Dark Gray to Gray Brown fine to medium SAND and	01/29/08		Slight odor
1		SM		silt, very moist		0 ppm	PASB32-0-2
							Full TCL
2				2-4.5: Medium Brown to Orange Brown fine to coarse SAND,	01/29/08	0 ppm	PASB32-2-4
				little gravel, wet at 3' bgs			Full TCL
3						0 ppm	
4						0 ppm	
				4.5-5: Light Orange Brown fine to coarse SAND, medium density			
5	44			5-10: Light Gray Brown fine to coarse SAND, medium density,	01/29/08		
				wet			
6						0 ppm	PASB32-6-10
							Full TCL
7						0 ppm	
8						0 ppm	
9						0 ppm	
10	58			10-15: Light Gray fine to medium SAND, medium density, wet	01/29/08		
11						0 ppm	
12						0 ppm	
13						0 ppm	
		SP					
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-32
Township/Range: Patchogue, New York	Coordinate X: 1255162.10
Logged By: Tom Fowler	Coordinate Y: 219365.88
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	40			15-20: Gray Brown fine to coarse SAND, medium density, wet	01/29/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	46			20-25: Light Gray fine to medium SAND, medium density, wet	01/29/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-33
Township/Range: Patchogue, New York	Coordinate X: 1255146.67
Logged By: Tom Fowler	Coordinate Y: 219346.27
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/29/08
Remarks:	Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
	66						
		Fl		0-1: Dark Gray GRAVEL and silty sand	01/29/08		slight odor
1				1-3: Dark Gray Brown fine to medium SAND, little gravel, wet		0 ppm	1-3: slight odor
							PASB33-1-3
2						0 ppm	Full TCL
3				3-5: Medium Brown to Gray Brown fine to medium SAND, trace gravel, medium density, wet		0 ppm	
4						0 ppm	
5	56			5-10: Yellow Brown fine to coarse SAND, medium density, wet	01/29/08		
6						0 ppm	PASB33-6-10
							Full TCL
7						0 ppm	
8						0 ppm	
9						0 ppm	
10	66			10-15: Light Gray Brown fine to coarse SAND, medium density, wet	01/29/08		
11						0 ppm	
12						0 ppm	
13		SP				0 ppm	
14						0 ppm	

	Project Name: Former Patchogue MGP	Site Id: PASB-33
	Township/Range: Patchogue, New York	Coordinate X: 1255146.67
	Logged By: Tom Fowler	Coordinate Y: 219346.27
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/29/08
Remarks:		Date Completed: 01/29/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	60			15–20: Light Gray Brown to Brown fine to medium SAND, grading to fine, medium density, wet	01/29/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	66			20–25: Light Gray Brown fine to medium SAND, medium density, wet	01/29/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-34
	Township/Range: Patchogue, New York	Coordinate X: 1255181.54
	Logged By: Tom Fowler	Coordinate Y: 219413.40
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 01/31/08
Remarks:		Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0	60						
1		FI		0-2: Whitish sand sized particles of broken concrete, some gravel	01/31/08	0.1 ppm	
2				2-3.5: Dark Brown fine to coarse SAND and gravel, some silt			
3		GM					
4				3.5-5: Dark Brown fine to coarse SAND, moist			
5	80			5-10: Gray Brown fine to coarse SAND, little gravel, medium density, wet	01/31/08		
6						0.1 ppm	
7							
8							
9							
10	40			10-15: Gray Brown to Light Gray Brown fine to medium SAND, medium density, wet	01/31/08		PASB34-10-15 Full TCL
11						0 ppm	
12						0 ppm	
13						0 ppm	
14		SP				0 ppm	

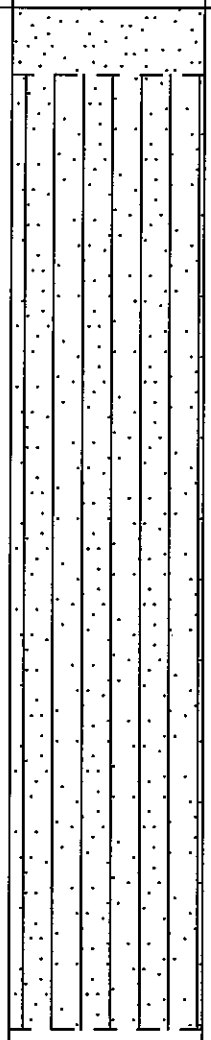
Project Name: Former Patchogue MGP	Site Id: PASB-34
Township/Range: Patchogue, New York	Coordinate X: 1255181.54
Logged By: Tom Fowler	Coordinate Y: 219413.40
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 01/31/08
Remarks:	Date Completed: 01/31/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	48			15-20: Light Brown fine to coarse SAND, medium density, wet	01/31/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	46			20-25: Light Brown fine to medium SAND, medium density, wet	01/31/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-35
Township/Range: Patchogue, New York	Coordinate X: 1255296.30
Logged By: Tom Fowler	Coordinate Y: 219218.32
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/04/08
Remarks:	Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0							
1		FI		0-2: Dark Gray silty SAND and gravel, dense	02/04/08	0 ppm	Hand augered to 5' bgs. Hit refusal the first 2 attempts. Third attempt was successful. Refusals were at 4.5' and 3.5' bgs, respectively.
2				2-5: Dark Brown fine to medium SAND, some silt, wet		0 ppm	
3						0 ppm	
4						0 ppm	
5	56	SM		5-7: Dark Brown fine to medium SAND, some fine peat strata	02/04/08		
6						0 ppm	
7				7-10: Gray Brown fine to coarse SAND, some gravel, wet		0 ppm	
8						0 ppm	
9						0 ppm	
10	30			10-15: Yellow Brown fine to coarse SAND, some gravel, medium density, wet	02/04/08		
11		SP				0 ppm	
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-35
Township/Range: Patchogue, New York	Coordinate X: 1255296.30
Logged By: Tom Fowler	Coordinate Y: 219218.32
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/04/08
Remarks:	Date Completed: 02/04/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	48			15-20: Red Brown fine to coarse SAND, some dark brown peat strata, medium density, wet.	02/04/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	62	SM		20-25: Yellow Brown fine to coarse SAND, medium density, wet	02/04/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-36
Township/Range: Patchogue, New York	Coordinate X: 1255300.61
Logged By: Tom Fowler	Coordinate Y: 219269.70
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/05/08
Remarks:	Date Completed: 02/05/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0							
1				0-5: Gray Black fine to coarse SAND and silt, some gravel, little ash, trace tarry material	02/05/08	0 ppm	Hand augered to 5' bgs.
2						0 ppm	
3		FI				0 ppm	
4						0 ppm	
5	62			5-5.5: Dark Brown PEAT	02/05/08		
6		PT		5.5-6: Dark Gray Brown GRAVEL and fine to medium SAND, oily appearance		0.2 ppm	5.5-6: Slight odor PASB36-6-8 Full TCL
7				6-10: Gray Brown fine to medium SAND, medium density, wet			7-8: Brown peat
8		GM					
9							
10	56			10-15: Orange Brown fine to coarse SAND, some gravel, medium density, wet	02/05/08		
11						0 ppm	PASB36-11-13 Full TCL
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-36
Township/Range: Patchogue, New York	Coordinate X: 1255300.61
Logged By: Tom Fowler	Coordinate Y: 219269.70
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/05/08
Remarks:	Date Completed: 02/05/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	42	SP		15-20: Yellow Brown fine to medium SAND, medium density, wet	02/05/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	28			20-25: Orange Brown fine to coarse SAND, trace gravel, medium density, wet	02/05/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

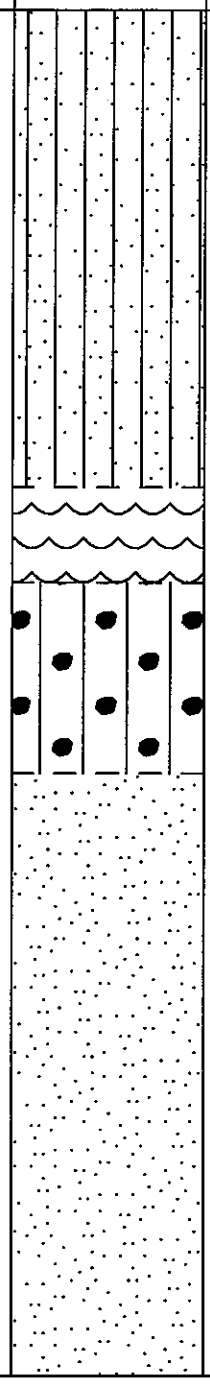
Project Name: Former Patchogue MGP	Site Id: PASB-37
Township/Range: Patchogue, New York	Coordinate X: 1255286.29
Logged By: Tom Fowler	Coordinate Y: 219332.80
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/05/08
Remarks:	Date Completed: 02/05/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
0							
1				0-5: Gray Black fine to coarse SAND and silt, some gravel, possible fly ash, slight oily appearance	02/05/08	0 ppm	Hand augered to 5' bgs.
2						0 ppm	
3		FI				0 ppm	
4						0 ppm	
5	66			5-6.5: Dark Gray Brown fine to coarse SAND and gravel, some silt, dense, wet	02/05/08		PASB37-5-7 Full TCL
6		GM				0 ppm	
7		SP		6.5-7.5: Dark Gray Brown fine to coarse SAND		0 ppm	
8		PT		7.5-8: Brown PEAT			
9		SM		8-9: Brown fine to medium SAND, some peat near top		0 ppm	
10	66			9-10: Dark Brown fine to medium SAND and peat		0 ppm	
11				10-15: Dark Brown fine to coarse SAND, medium density, wet. 10-10.5 SAND and gravel	02/05/08	0 ppm	
12						0 ppm	
13						0 ppm	
14						0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-37
Township/Range: Patchogue, New York	Coordinate X: 1255286.29
Logged By: Tom Fowler	Coordinate Y: 219332.80
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/05/08
Remarks:	Date Completed: 02/05/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	60	SP		15–20: Red Brown to Orange Brown fine to coarse SAND, medium density, wet	02/05/08		
16						0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	52			20–25: Yellow Brown to Red Brown fine to coarse SAND, medium density, wet	02/05/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-38
Township/Range: Patchogue, New York	Coordinate X: 1255283.36
Logged By: Tom Fowler	Coordinate Y: 219408.41
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/05/08
Remarks:	Date Completed: 02/05/08



Depth	% Recovery	USCS Code	Material Description	DATE	PID	Notes
0	0					
1		SM	0-3: Dark Brown silty SAND, some gravel	02/05/08	0 ppm	Hand augered to 5' bgs.
2					0 ppm	
3			3-5: Gray Brown silty SAND, some gravel		0 ppm	
4					0 ppm	
5	56	PT	5-6: Brown PEAT	02/05/08		PASB38-5-7 Full TCL
6		GM	6-8: Dark Brown to Brown fine to coarse SAND, some gravel, some peat, wet		0 ppm	
7					0 ppm	
8			8-10: Brown to Dark Brown fine to coarse SAND, little gravel, medium density, wet		0 ppm	
9					0 ppm	
10	52		10-11: Brown fine to coarse SAND, little gravel	02/05/08		
11			11-15: Gray Brown fine to medium SAND, medium density, wet		0 ppm	
12					0 ppm	
13					0 ppm	
14					0 ppm	

Project Name: Former Patchogue MGP	Site Id: PASB-38
Township/Range: Patchogue, New York	Coordinate X: 1255283.36
Logged By: Tom Fowler	Coordinate Y: 219408.41
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 02/05/08
Remarks:	Date Completed: 02/05/08

Depth	% Recovery	USCS Code	Graphic Log	Material Description	DATE	PID	Notes
15	50			15-20: Gray Brown fine to coarse SAND, medium density, wet	02/05/08		
16		SP				0 ppm	
17						0 ppm	
18						0 ppm	
19						0 ppm	
20	42			20-25: Light Brown fine to medium SAND, medium density, wet	02/05/08		
21						0 ppm	
22						0 ppm	
23						0 ppm	
24						0 ppm	
25							
26							
27							
28							

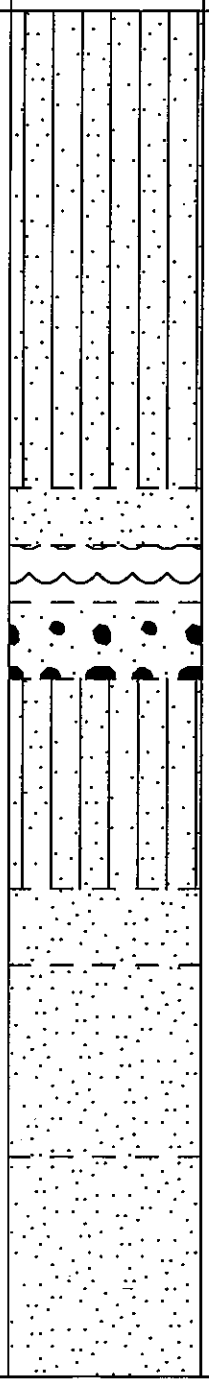
Project Name: Former Patchogue MGP	Site Id: PASB-39
Township/Range:	Coordinate X: 1255314.26
Logged By: T. Fowler	Coordinate Y: 219376.97
Drilling Method: Geoprobe	Total Depth: 24.00'
	Date Started: 07/09/08
Remarks:	Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	100				07/09/08		
1				0-4: Dark grey brown fine to medium SAND, some silt, wet at 4 feet			0-4: Hand augered
2		SP					
3							
4	50			4-5: Dark grey brown fine to coarse SAND,	07/09/08	0 ppm	PASB39-4-9:
		SP		little gravel, wet		0 ppm	VOC, SVOC,
5		SM		5-5.5: Dark brown fine SAND, some silt, wet	07/09/08	0 ppm	CN, TOC
				5.5-9: Dark brown fine to medium SAND,	07/09/08	0 ppm	
6				medium dense, wet		0 ppm	
						0 ppm	
7		SP					
8							
9	16			9-10: Light brown fine to coarse GRAVEL	07/09/08	0 ppm	
				and fine to coarse SAND, medium dense, wet		0 ppm	
10							
11							
		GP					
12							
13							
14	58			14-17: Dark grey brown fine to coarse SAND,	07/09/08	0 ppm	

	Project Name: Former Patchogue MGP	Site Id: PASB-39
	Township/Range:	Coordinate X: 1255314.26
	Logged By: T. Fowler	Coordinate Y: 219376.97
	Drilling Method: Geoprobe	Total Depth: 24.00'
		Date Started: 07/09/08
Remarks:		Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15		SM		some silt, some gravel, little peat, medium dense, wet		0 ppm	
						0 ppm	
16						0 ppm	
						0 ppm	
17						0 ppm	
				17–18: Dark brown PEAT, wet	07/09/08		
		PT					
18				18–19: Brown fine to coarse SAND, some gravel, wet	07/09/08		
		SP					
19	40			19–24: Orange brown fine to medium SAND, medium dense, wet	07/09/08	0 ppm	
						0 ppm	
20						0 ppm	
						0 ppm	
21						0 ppm	
		SP				0 ppm	
22						0 ppm	
23							
24							
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-40
Township/Range:	Coordinate X: 1255303.37
Logged By: T. Fowler	Coordinate Y: 219328.40
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 07/10/08
Remarks:	Date Completed: 07/10/08



Depth	Recovery %	USCS Code	Material Description	Date	PID	Notes
0	100			07/10/08		
1			0–5: Dark grey fine to medium SAND and SILT, little gravel, moist			0–5: Hand augered. Water Table ~0.8 feet bgs in borehole PASB40–0–5: VOC, SVOC, CN, TOC
2		SM				
3						
4						
5	50		5–5.6: Dark brown, fine to coarse SAND, some	07/10/08	0 ppm	
		SP	gravel, little silt, wet	07/10/08	0 ppm	
6		PT	5.6–6.2: Dark brown PEAT, wet	07/10/08	0 ppm	
		GP	6.2–7: Dark brown GRAVEL and fine to coarse SAND, wet		0 ppm	
7			7–9.2: Dark brown fine to medium SAND, some peat, wet	07/10/08	0 ppm	
					0 ppm	
8		SM				
9			9.2–10: Dark brown fine to coarse SAND, some	07/10/08		
		SP	gravel, wet			
10	64		10–12: Brown fine to coarse SAND, some gravel, wet	07/10/08	0 ppm	
					0 ppm	
11		SP			0 ppm	
					0 ppm	
12			12–15: Light brown fine to medium SAND, medium	07/10/08	0 ppm	
			dense, wet		0 ppm	
13					0 ppm	
		SP				
14						

	Project Name: Former Patchogue MGP	Site Id: PASB-40
	Township/Range:	Coordinate X: 1255303.37
	Logged By: T. Fowler	Coordinate Y: 219328.40
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 07/10/08
Remarks:		Date Completed: 07/10/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	70			15-20: Light brown, fine to medium SAND, trace gravel, medium dense, wet	07/10/08	0 ppm	PASB40-15-17: VOC, SVOC, CN, TOC
16						0 ppm	
17						0 ppm	
18		SP				0 ppm	
19						0 ppm	
20	22			20-25: Brown fine to medium SAND, trace gravel, medium dense, wet	07/10/08	0 ppm	
21						0 ppm	20.8: dark red brown staining
22						0 ppm	
23		SP					
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-41
	Township/Range:	Coordinate X: 1255319.48
	Logged By: T. Fowler	Coordinate Y: 219262.75
	Drilling Method: Geoprobe	Total Depth: 30.00'
		Date Started: 07/09/08
Remarks:		Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	100				07/09/08		
1		SM		0–2: Dark grey SAND and SILT, little gravel, moist			0–5: Hand augered 0–2: slight fuel–like odor
2				2–5: Light grey brown to dark grey SILT, some sand, little gravel, appears to be ash, wet	07/09/08		
3		ML					
4							
5	64			5–6: Dark brown PEAT, wet	07/09/08	5 ppm	
		PT					
6		GP		6–6.5: Dark brown to black GRAVEL, wet	07/09/08		6–6.5: saturated with oil
7		SP		6.5–8.5: Brown fine to medium SAND, some peat, wet	07/09/08	10 ppm	6.5–8: black staining
						8 ppm	
8						4 ppm	8–8.5: oil coated
9		GP		8.5–10: Light brown GRAVEL and fine to coarse SAND, wet	07/09/08		PASB-41-6-8: VOC, SVOC, CN, TOC
						0.5 ppm	
10	58	SP		10–11: Yellow brown fine to coarse SAND, medium dense, wet	07/09/08	0 ppm 0 ppm	
11				11–12.5: Orange brown and reddish brown laminations of fine SAND, wet	07/09/08	0 ppm	PASB-41-11-13: VOC, SVOC, CN, TOC
12		SP				0 ppm 0 ppm	
13				12.5–15: Dark brown fine to medium SAND, medium dense, wet	07/09/08	0 ppm	
14		SP					

	Project Name: Former Patchogue MGP	Site Id: PASB-41
	Township/Range:	Coordinate X: 1255319.48
	Logged By: T. Fowler	Coordinate Y: 219262.75
	Drilling Method: Geoprobe	Total Depth: 30.00'
		Date Started: 07/09/08
Remarks:		Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	62			15–16.5: Orange brown laminated fine to medium SAND, medium dense, wet	07/09/08	0 ppm	
						0 ppm	
16		SP				0 ppm	
				16.5–18.2: Light brown fine SAND, little gravel, medium dense, wet	07/09/08	0 ppm	
17						0 ppm	
		SP				0 ppm	
18				18.2–18.5: Dark brown fine SAND, wet		0 ppm	18.2–18.5: dark
		SP		18.5–20: Orange brown fine to medium SAND, medium dense, wet	07/09/08	0 ppm	brown staining
19					07/09/08	0 ppm	
		SP				0 ppm	
20	62			20–25: Orange brown and red brown laminated fine to medium SAND, wet	07/09/08	0 ppm	
						0 ppm	
21						0 ppm	
				21.4–21.7: Dark brown fine SAND, wet		0 ppm	
22				21.7–25: Orange brown and red brown laminated fine to medium SAND, wet		0 ppm	
		SP				0 ppm	
23						0 ppm	
24							
25	58			25–30: Yellow brown fine to medium SAND, wet	07/09/08	0 ppm	
						0 ppm	
26						0 ppm	
						0 ppm	
27						0 ppm	
		SP				0 ppm	
28							

Project Name: Former Patchogue MGP	Site Id: PASB-41
Township/Range:	Coordinate X: 1255319.48
Logged By: T. Fowler	Coordinate Y: 219262.75
Drilling Method: Geoprobe	Total Depth: 30.00'
	Date Started: 07/09/08
Remarks:	Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
29							29–29.2: dark brown staining 29.5: black staining
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							

	Project Name: Former Patchogue MGP	Site Id: PASB-42
	Township/Range:	Coordinate X: 1255156.06
	Logged By: T. Fowler	Coordinate Y: 219305.00
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 07/08/08
Remarks:		Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	68				07/08/08		
		SM		0-1: Dark grey silty SAND		0 ppm	PASB-42-0-0.2
1				1-1.5: Weathered concrete and gravel, some silt, moist	07/08/08	0 ppm	and PASB-42-0-0.5:
		Fl		1.5-2: Weathered dark brown wood fragments	07/08/08	0 ppm	VOC, SVOC,
2		Fl		2-3: Dark brown silty SAND, some gravel, peat lens	07/08/08	0 ppm	CN, TOC
		SM				0 ppm	
3				3-3.8: Dark brown silty SAND, brick and concrete fragments	07/08/08	0 ppm	
		Fl		3.8-4.2: Dark brown to black organic silt, wood shavings, wet			3.8-4.2: black
4				4.2-5: Dark brown silty SAND, brick and concrete fragments, wet	07/08/08 07/08/08		staining
		Fl					
5	58			5-7: Orange brown fine to coarse SAND, some gravel, medium dense to dense, red brown color from 6.5 to 7 feet	07/08/08	0 ppm	
						0 ppm	
6		SP				0 ppm	
						0 ppm	
7				7-10: Yellow brown fine to medium SAND, medium dense, wet	07/08/08	0 ppm	
						0 ppm	
8							
		SP					
9							
10	46			10-15: Light grey brown fine to medium SAND, trace gravel, wet	07/08/08	0 ppm	
						0 ppm	
11						0 ppm	
						0 ppm	
12						0 ppm	
		SP					
13							13-13.1: brown
							staining
14							

	Project Name: Former Patchogue MGP	Site Id: PASB-42
	Township/Range:	Coordinate X: 1255156.06
	Logged By: T. Fowler	Coordinate Y: 219305.00
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 07/08/08
Remarks:		Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	48			15–20: Grey brown fine to medium SAND, medium dense, wet	07/08/08		
16							
17							
18		SP					
19							
20	52			20–25: Light brown fine to medium SAND, medium dense, wet	07/08/08	0 ppm	
21						0 ppm	
22						0 ppm	
23		SP				0 ppm	PASB-42-23-25: VOC, SVOC, CN, TOC
24						0 ppm	
25						0 ppm	
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-43
Township/Range:	Coordinate X: 1255146.17
Logged By: T. Fowler	Coordinate Y: 219281.14
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 07/08/08
Remarks:	Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	60				07/08/08	0 ppm	
				0-2: Dark brown silty SAND, some gravel		0 ppm	PASB-43-0-0.2 and
1		SP				0 ppm	PASB-43-0-0.5:
						0 ppm	VOC, SVOC
2				2-3: Brown silty SAND, brick and concrete fragments	07/08/08	0 ppm	CN, TOC
		FI				0 ppm	
3				3-5: Brown silty SAND, brick fragments, wet	07/08/08	0 ppm	
4		FI					
5	40			5-6.5: Brown fine to medium silty SAND, little gravel, wet	07/08/08	0 ppm	
		SM				0 ppm	
6						0 ppm	
				6.5-10: Fine to medium SAND, medium dense, wet	07/08/08	0 ppm	
7						0 ppm	
8		SP					
9							
10	52			10-15: Light grey brown fine to coarse SAND, little gravel, medium dense, wet	07/08/08	0 ppm	
						0 ppm	
11						0 ppm	11: dark brown
						0 ppm	staining
12						0 ppm	
		SP				0 ppm	
13							PASB-43-13-15:
							VOC, SVOC
14							CN, TOC

Project Name: Former Patchogue MGP	Site Id: PASB-43
Township/Range:	Coordinate X: 1255146.17
Logged By: T. Fowler	Coordinate Y: 219281.14
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 07/08/08
Remarks:	Date Completed: 07/08/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	64			15-20: Light brown fine to medium SAND, medium dense, wet	07/08/08	0 ppm	14.0-14.3: dark brown staining
16						0 ppm	
						0 ppm	
17						0 ppm	
		SP				0 ppm	
18						0 ppm	
19							19.0-19.1: brown staining
20	36			20-25: Light brown to orange brown fine to coarse SAND, wet	07/08/08	0 ppm	
21						0 ppm	
						0 ppm	
22						0 ppm	
		SP					
23							PASB-43-23-25: VOC, SVOC, CN, TOC
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-44
	Township/Range:	Coordinate X: 1255344.89
	Logged By: T. Fowler	Coordinate Y: 219245.82
	Drilling Method: Geoprobe	Total Depth: 14.00'
		Date Started: 07/09/08
Remarks:		Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	100				07/09/08		
1				0-4: Grey brown silty SAND, wet at 4 feet bgs			0-4: Hand augered Slight petroleum-like odor
2		SP					
3							
4	66			4-6: Brown to grey brown fine to medium	07/09/08	0 ppm	
				SAND, medium dense, very thin 30-degree dark		0 ppm	
5		SP		brown strata at at 5 feet bgs, wet		0 ppm	
						0 ppm	
6				6-6.5: Dark grey fine to medium SAND, wet	07/09/08	0 ppm	
		SP		6.5-9: Light grey brown fine to medium	07/09/08	0 ppm	
7				SAND, some gravel, wet		0 ppm	
		SP					7.5-8: dark brown to black staining PASB44-7-9:
8							
9	62			9-11: Brown fine to coarse SAND, some	07/09/08	0 ppm	VOC, SVOC,
				gravel, wet		0 ppm	CN, TOC
10		SP				0 ppm	
						0 ppm	
11				11-14: Yellow brown fine to medium SAND,	07/09/08	0 ppm	
				medium dense, wet		0 ppm	
12						0 ppm	
		SP					
13							
14							

Project Name: Former Patchogue MGP	Site Id: PASB-45
Township/Range:	Coordinate X: 1255361.55
Logged By: T. Fowler	Coordinate Y: 219233.32
Drilling Method: Geoprobe	Total Depth: 20.00'
	Date Started: 07/09/08
Remarks:	Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	100				07/09/08		
				0-5: silty SAND			0-5: Hand augered
1							
2							
		SP					
3							
4							
5	62			5-7: Dark grey brown to black silty SAND,	07/09/08	0 ppm	PASB45-5-7:
				some gravel, grading to peat, wet		0 ppm	VOC, SVOC,
6		SP				0 ppm	CN, TOC
						0 ppm	5-7: black
7				7-10: Grey brown fine to medium SAND,	07/09/08	0 ppm	staining
				some gravel, wet		0 ppm	
8						0 ppm	
		SP					
9							
10	78			10-11: Red brown coarse SAND, wet	07/09/08	0 ppm	
		SP				0 ppm	
11				11-14: Yellow brown fine to medium SAND,	07/09/08	0 ppm	
				medium dense, wet		0 ppm	
12						0 ppm	
		SP				0 ppm	
13						0 ppm	
						0 ppm	
14				14-14.5: Red brown coarse SAND, wet	07/09/08		

	Project Name: Former Patchogue MGP	Site Id: PASB-45
	Township/Range:	Coordinate X: 1255361.55
	Logged By: T. Fowler	Coordinate Y: 219233.32
	Drilling Method: Geoprobe	Total Depth: 20.00'
		Date Started: 07/09/08
Remarks:		Date Completed: 07/09/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	64	SP		14.5–15: Yellow brown fine to medium SAND, medium dense, wet	07/09/08		
					07/09/08	0 ppm	
16				15–20: Reddish brown fine to medium SAND, medium dense, wet		0 ppm	
						0 ppm	
17						0 ppm	
		SP				0 ppm	
18						0 ppm	
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

Project Name: Former Patchogue MGP	Site Id: PASB-46
Township/Range:	Coordinate X: 1255152.27
Logged By: T. Fowler	Coordinate Y: 219210.17
Drilling Method: Geoprobe	Total Depth: 25.00'
	Date Started: 07/10/08
Remarks:	Date Completed: 07/10/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	50				07/10/08	0 ppm	
				0-1.5: Dark grey SAND, some silt, brick		0 ppm	PASB-46-0-0.2 and
1				fragments, moist		0 ppm	PASB-46-0-0.5:
		SP		1.5-3: Grey brown fine to coarse SAND, some	07/10/08	0 ppm	VOC, SVOC,
2				silt, wet		0 ppm	CN, TOC
						0 ppm	
3				3-5: Dark grey brown fine to medium SAND,	07/10/08		
				little silt, trace gravel, medium dense, wet			
4		SP					
5	82			5-7: Grey brown to dark brown fine to medium SAND,	07/10/08	0 ppm	
				little peat, wet		0 ppm	
6		SP				0 ppm	PASB46-6-8:
						0 ppm	VOC, SVOC,
7				7-7.4: Brown PEAT, some sand, wet	07/10/08	0 ppm	CN, TOC
		PT		7.4-9.6: Brown fine to medium SAND, medium dense,	07/10/08	0 ppm	
8				peat lenses at 7.5 to 7.7 feet bgs, 8.5 to 8.8		0 ppm	
		SP		feet bgs, and 9.2 to 9.3 feet bgs, wet		0 ppm	
9						0 ppm	
				9.6-10: Brown PEAT, wet	07/10/08		
10		PT					
	66			10-11.5: Light brown fine to coarse SAND, some	07/10/08	0 ppm	
		SP		gravel, medium dense, wet		0 ppm	
11						0 ppm	
				11.5-15: Light brown fine to medium SAND,	07/10/08	0 ppm	
12				medium dense, wet		0 ppm	
						0 ppm	
13						0 ppm	
		SP					
14							

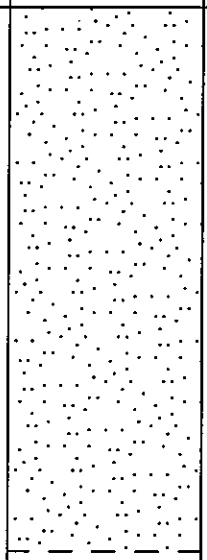
	Project Name: Former Patchogue MGP	Site Id: PASB-46
	Township/Range:	Coordinate X: 1255152.27
	Logged By: T. Fowler	Coordinate Y: 219210.17
	Drilling Method: Geoprobe	Total Depth: 25.00'
		Date Started: 07/10/08
Remarks:		Date Completed: 07/10/08

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	58			15–20: Light brown fine to medium SAND, medium dense, wet	07/10/08	0 ppm	
16						0 ppm	
						0 ppm	
17						0 ppm	
		SP				0 ppm	
18							
19							
20	30			20–25: Light brown fine to medium SAND, medium dense, wet	07/10/08	0 ppm	
21						0 ppm	
						0 ppm	
22						0 ppm	
		SP					
23							
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-47
	Township/Range:	Coordinate X: 1255436.87
	Logged By: C. DeCarlo	Coordinate Y: 219236.43
	Drilling Method: Geoprobe	Total Depth: 20.00'
		Date Started: 11/23/09
Remarks: Due to moisture, the PID was not functioning properly for the end of this boring.		Date Completed: 11/23/09

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	46				11/23/2009	0 ppm	
1				0–1.6: Dark grayish brown SILT, with some medium Sand, and shell fragments.		0 ppm	
2				1.6–4.8: Black SILT with trace medium Sand and organic plant material, wet at 2.5 feet.	11/23/2009	50.5 ppm	Petroleum–like odor present.
3		ML					
4						7.1 ppm	
5	44			4.8–5: Dark brown f SAND, wet. 5–6.3: Dark brown f SAND, wet.	11/23/2009	2.5 ppm	
6		SP				1.9 ppm	
7				6.3–10: Dark brown f–c GRAVEL, wet.	11/23/2009	2.7 ppm	
8		GW					
9							
10	70			10–15: Yellowish red f SAND, red mottling, wet.	11/23/2009		
11							
12							
13							
14							

Project Name: Former Patchogue MGP	Site Id: PASB-47
Township/Range:	Coordinate X: 1255436.87
Logged By: C. DeCarlo	Coordinate Y: 219236.43
Drilling Method: Geoprobe	Total Depth: 20.00'
	Date Started: 11/23/09
Remarks: Due to moisture, the PID was not functioning properly for the end of this boring.	Date Completed: 11/23/09

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	0	SP		15-20: Yellowish red f SAND, red mottling, wet.	11/23/2009		
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-48
	Township/Range:	Coordinate X: 1255420.16
	Logged By: C. DeCarlo	Coordinate Y: 219186.62
	Drilling Method: Geoprobe	Total Depth: 20.00'
		Date Started: 11/23/09
Remarks:		Date Completed: 11/23/09

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
	64					1 ppm	
1				0–2.3: Dark reddish brown SILT, trace f Sand, with organic matter.			
2		ML		2.3–4: Dark reddish brown SILT, trace f Sand, with organic matter, Gravel and coal fragments, wet at 2.5 feet.	11/23/2009	0 ppm 30.5 ppm	Petroleum-like odor present at 2.5 feet.
3							
4				4–5: Black f SAND with trace Gravel, wet.	11/23/2009	7.6 ppm	
5	100			5–7.4: Dark reddish brown f SAND, trace Silt, wet.	11/23/2009	0 ppm	
6		SP					
7							
8		GW		7.4–9.3: Reddish brown f–c GRAVEL with f–c Sand, wet.	11/23/2009	0 ppm	
9							
				9.3–10: Reddish brown f SAND, wet.	11/23/2009	0 ppm	
10	78			10–13.5: Very pale brown f SAND, wet.	11/23/2009	0 ppm	
11						0 ppm	
12						0 ppm	
13							
				13.5–15: Yellowish red f SAND, with red mottling, wet.	11/23/2009	0 ppm	
14							

	Project Name: Former Patchogue MGP	Site Id: PASB-48
	Township/Range:	Coordinate X: 1255420.16
	Logged By: C. DeCarlo	Coordinate Y: 219186.62
	Drilling Method: Geoprobe	Total Depth: 20.00'
		Date Started: 11/23/09
Remarks:		Date Completed: 11/23/09

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	64	SP		15–20: Yellowish red f SAND, with red mottling, wet.	11/23/2009	0 ppm	
16						0 ppm	
17							
18						0 ppm	
19						0 ppm	
20							
21							
22							
23							
24							
25							
26							
27							
28							

	Project Name: Former Patchogue MGP	Site Id: PASB-49
	Township/Range:	Coordinate X: 1255369.56
	Logged By: C. DeCarlo	Coordinate Y: 219124.62
	Drilling Method: Geoprobe	Total Depth: 20.00'
		Date Started: 11/23/09
Remarks: Due to moisture, the PID was not functioning properly for the beginning of this boring.		Date Completed: 11/23/09

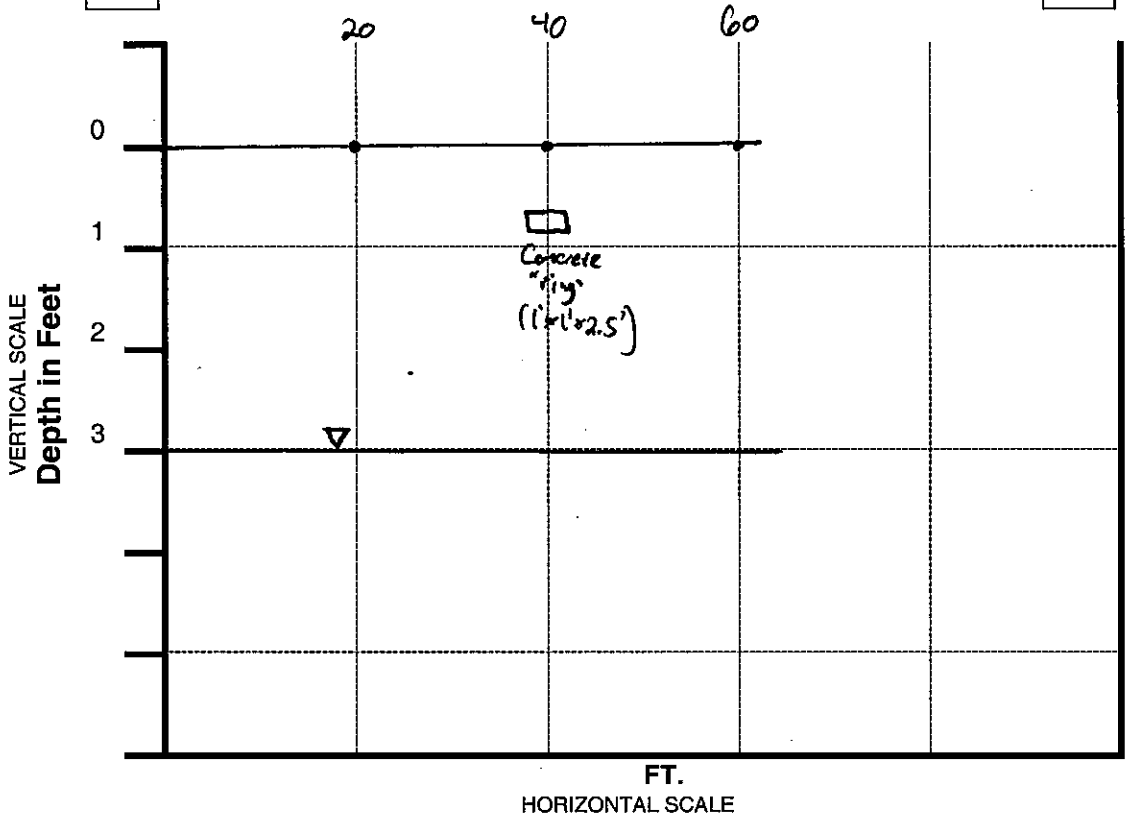
Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
1	64	ML		0–2.1: Very dark grayish brown SILT trace Sand with cinder and shell fragments.			
2					11/23/2009		
3				2.1–4.6: Brown f SAND, wet at 2.5'.			
4							
5	90	SP		4.6–5: Dark brown f SAND, trace Silt, wet.	11/23/2009		
6				5–7.1: Pale brown f SAND, trace gravel, wet.	11/23/2009		
7					11/23/2009		
8		GW		7.1–10: Yellowish brown f–c GRAVEL with c Sand, wet.			
9							
10	62			10–11.7: Pale brown f SAND, wet.	11/23/2009	0 ppm	
11						0 ppm	
12				11.7–15: Yellowish red f SAND with red banding, wet.	11/23/2009		
13						0 ppm	
14						0 ppm	

	Project Name: Former Patchogue MGP	Site Id: PASB-49
	Township/Range:	Coordinate X: 1255369.56
	Logged By: C. DeCarlo	Coordinate Y: 219124.62
	Drilling Method: Geoprobe	Total Depth: 20.00'
		Date Started: 11/23/09
Remarks: Due to moisture, the PID was not functioning properly for the beginning of this boring.		Date Completed: 11/23/09

Depth	Recovery %	USCS Code	Graphic Log	Material Description	Date	PID	Notes
15	68	SP		15-20: Yellowish red f SAND with red banding, wet.	11/23/2009	0 ppm	
16						0 ppm	
17						0 ppm	
18							
19						0 ppm	
20							
21							
22							
23							
24							
25							
26							
27							
28							

TETRA TECH EC, INC.
TEST PIT/TRENCH LOG

Project: Keyspan Patchogue
Test Pit No.: 1 Start Time: 11:10 End Time: 13:40 Weather: 70 Cloudy and Humid
Date 7/7/08 Final Length: 60' Surface Conditions: Vegetated
Geologist: Tom Fowler Final Depth: 3'
Pit Orientation: West-East Final Width:



Description of Material	PID/ FID	Sample Taken
0'-2.5- Gray fine to medium SAND, silt, some miscellaneous debris – brick and wood.	0-4 ppm	
2.5'-3' Light gray medium SAND. Water table at 3'.	0 ppm	

NOTES:

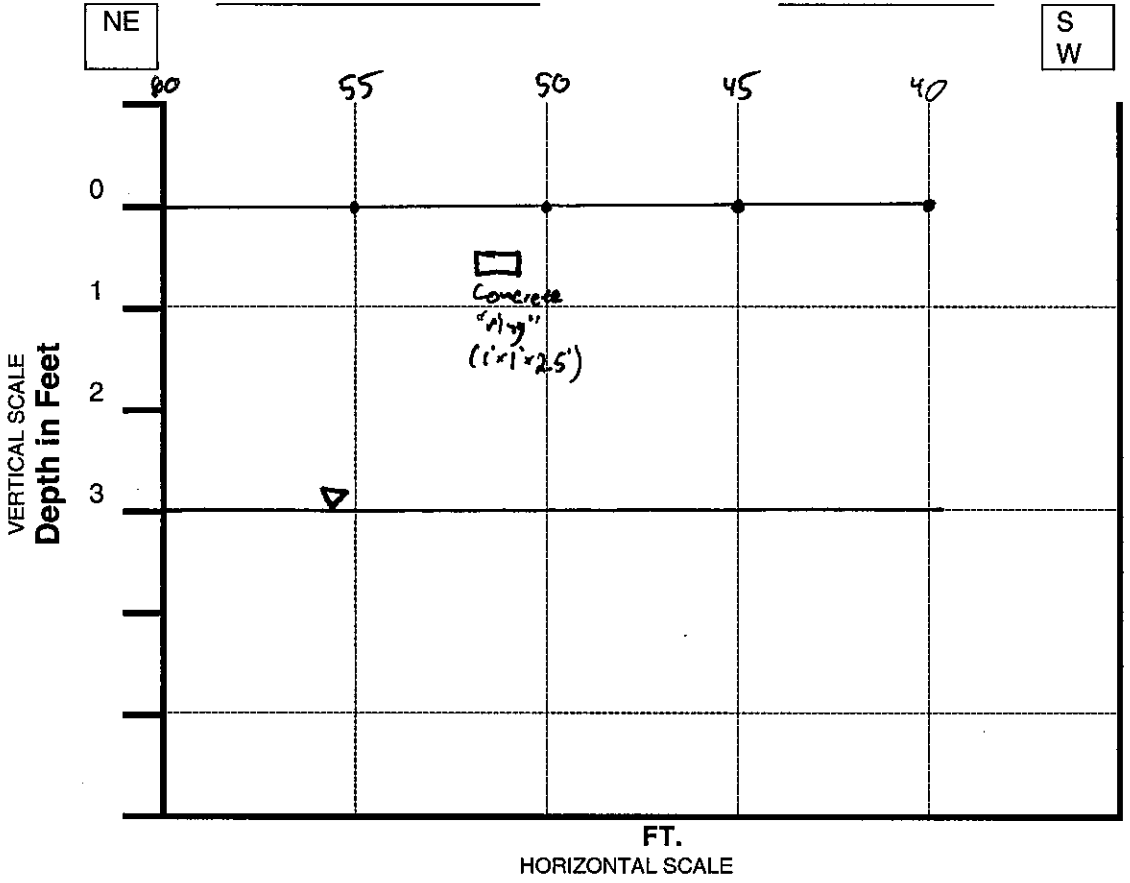
TETRA TECH EC, INC.
TEST PIT/TRENCH LOG

Project: Keyspan Patchogue
Test Pit No.: 2
Date 7/7/08
Geologist: Tom Fowler
Pit Orientation: Northeast-Southwest

Start Time: 14:15
Final Length: 20'
Final Depth: 3'
Final Width:

End Time: 15:10

Weather: 70 Cloudy and Humid
Surface Conditions: Vegetated

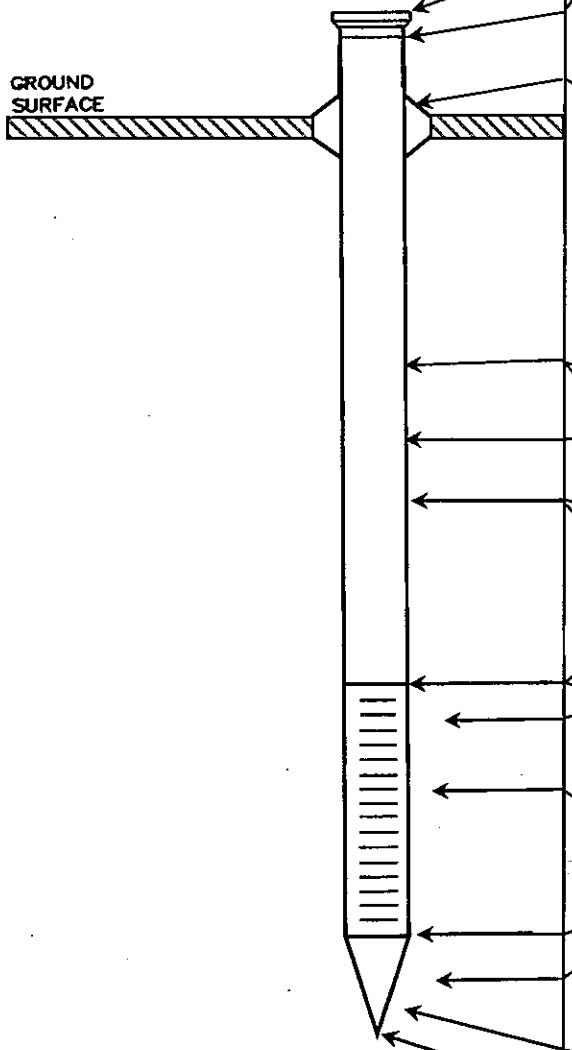


Description of Material	PID/ FID	Sample Taken
Dark gray SAND, silt, miscellaneous debris.		
Water table at 3'.		

NOTES:

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-1**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-1
BORING NUMBER:	MW-1	DATE COMPLETED:	01/28/08
ELEVATION (FT):	11.2300	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255132.53800
DRILLER:	Zebra	Y COORDINATE:	219674.03000
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	7.53
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



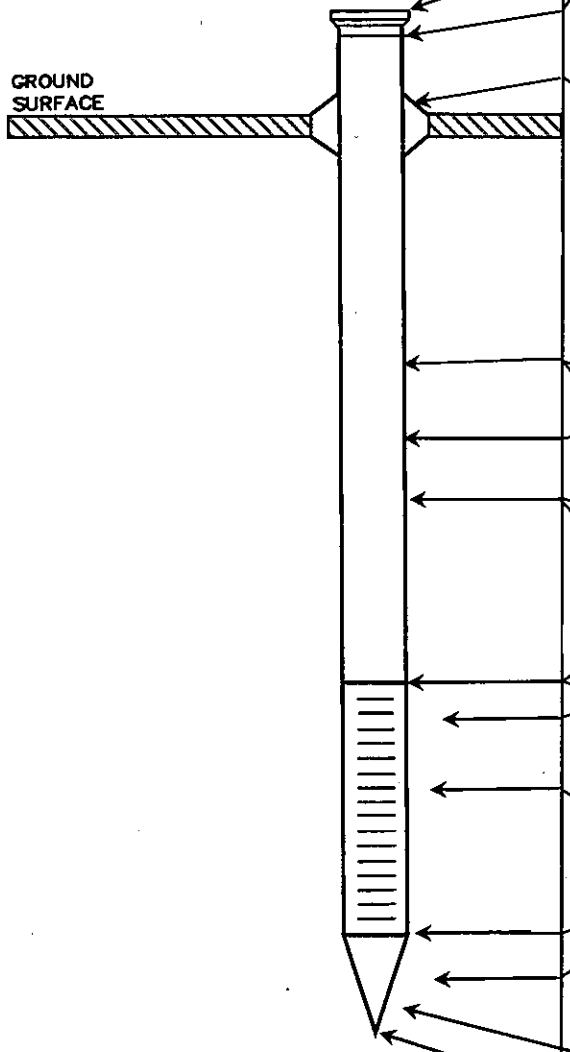
Elevation of Top of DP Wellpoint	11.7000
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.7
Elevation of Top of Riser Pipe (Ft)	11.2300
Height of Protective Outer Casing Above Ground Surface (Ft)	4.17
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	1
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	7
Elevation of Top of Screen	0.5300
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	12
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	12
Elevation of Bottom of Filter Pack	-4.4700
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	12
Elevation of Hole	-4.4700

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-2D**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-2D
BORING NUMBER:	MW-2D	DATE COMPLETED:	02/04/08
ELEVATION (FT):	8.2300	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255112.75500
DRILLER:	Zebra	Y COORDINATE:	219348.84200
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.12
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



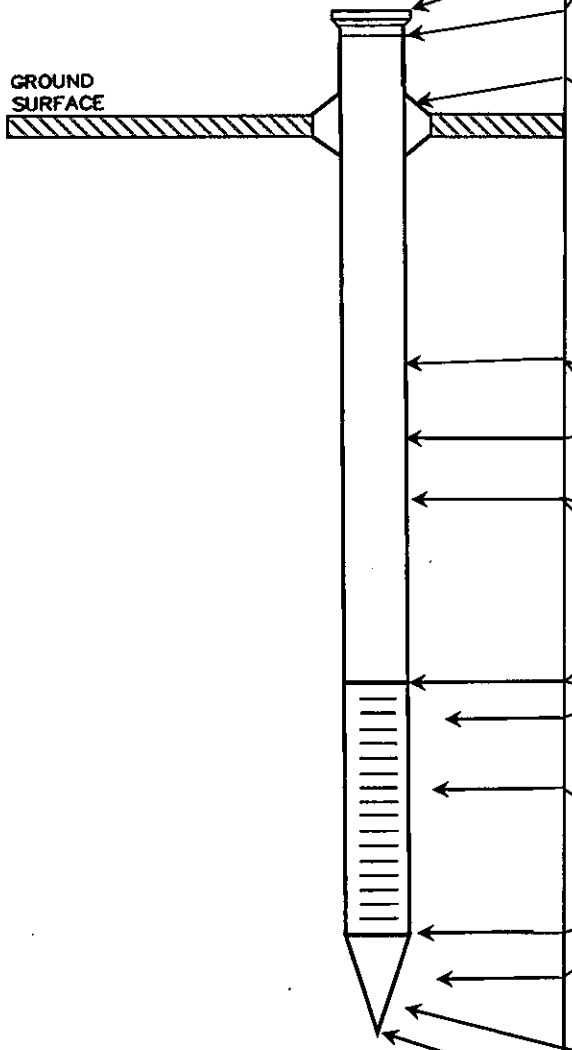
Elevation of Top of DP Wellpoint	8.9800
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.11
Elevation of Top of Riser Pipe (Ft)	8.2300
Height of Protective Outer Casing Above Ground Surface (Ft)	3.86
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	1
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	20
Elevation of Top of Screen	-14.8800
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	25
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	25
Elevation of Bottom of Filter Pack	-19.8800
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	25
Elevation of Hole	-19.8800

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-2S**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-2S
BORING NUMBER:	MW-2S	DATE COMPLETED:	01/28/08
ELEVATION (FT):	8.9700	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255107.89000
DRILLER:	Zebra	Y COORDINATE:	219370.35100
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.33
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



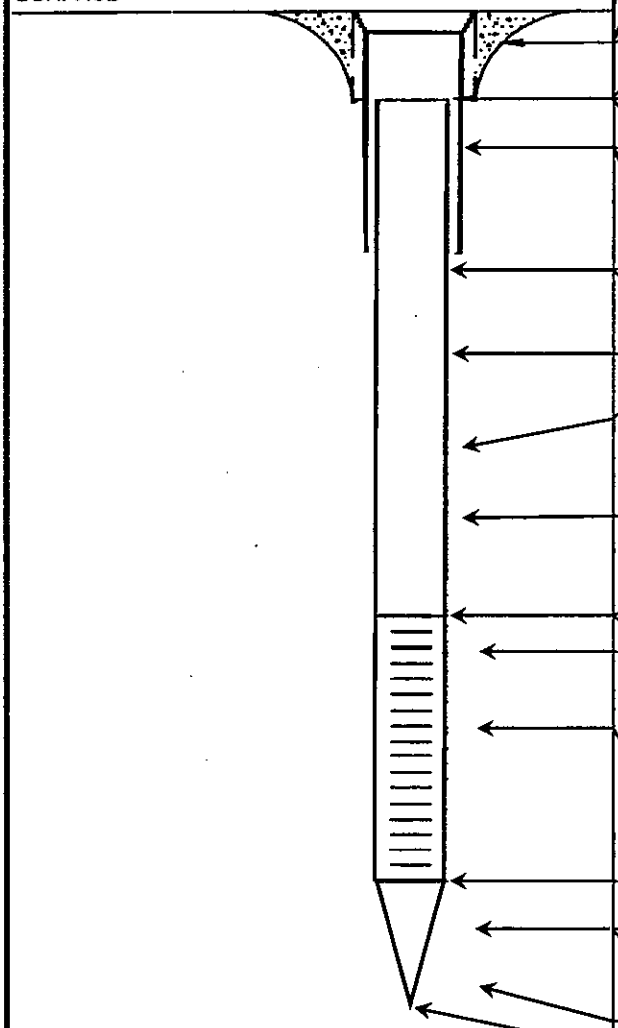
Elevation of Top of DP Wellpoint	9.0800
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.64
Elevation of Top of Riser Pipe (Ft)	8.9700
Height of Protective Outer Casing Above Ground Surface (Ft)	3.75
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	natural formation
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	5
Elevation of Top of Screen	0.3300
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	natural formation
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	10
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	10
Elevation of Bottom of Filter Pack	-4.6700
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	10
Elevation of Hole	-4.6700

TETRA TECH EC, INC.

NOT TO SCALE

UNCONSOLIDATED MONITORING WELL CONSTRUCTION DIAGRAM (FLUSH MOUNT)

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-3**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-3
BORING NUMBER:	MW-3	DATE COMPLETED:	01/28/08
ELEVATION (FT):	5.3900	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255328.74200
DRILLER:	Zebra	Y COORDINATE:	219200.31200
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.42
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT): 0	METHOD TO MEASURE WELL DEPTH:	Casing/screen used



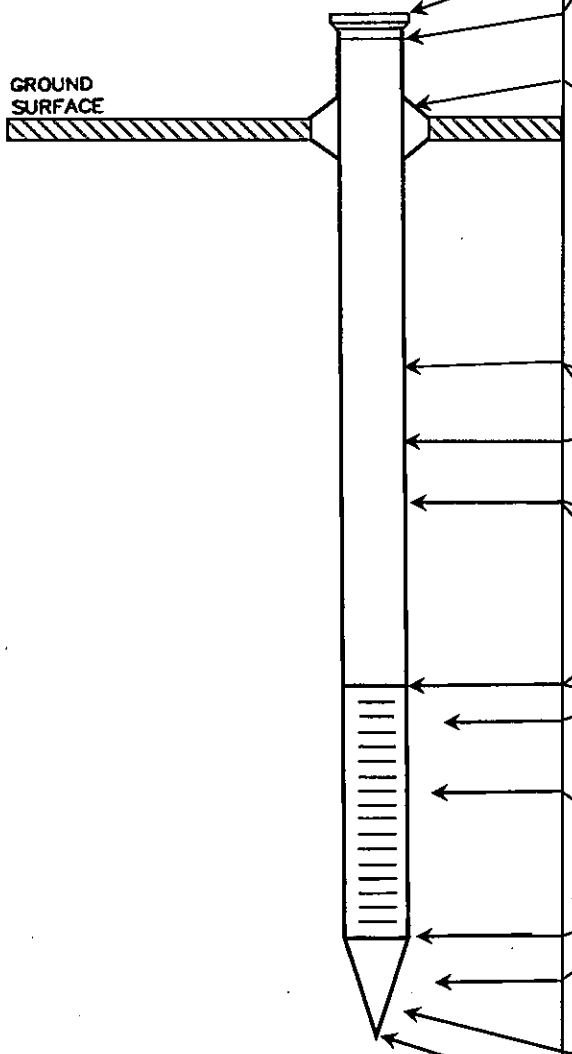
Elevation of Top of DP Wellpoint	5.5400
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	0.1
Diameter of Surface Plug (Ft)	2
DP Riser Pipe	
Elevation of Top of DP Riser Pipe	5.3900
Depth of Top of Riser Pipe (bgs in feet)	0.1500
I.D. of Surface Casing (Inches)	2
Type of Surface Casing	steel
Depth of Surface Casing (Ft)	1
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen (Ft)	5
Elevation of Top of Screen	0.4200
Type of Screen:	PVC sch 40
I.D. of Screen (Inches)	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen (Ft)	10
Depth of Bottom of Filter Pack (Ft)	10
Elevation of Bottom of Filter Pack	-4.5800
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint(Ft)	10
Elevation of Hole	-4.5800

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-4D**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-4D
BORING NUMBER:	MW-4D	DATE COMPLETED:	01/28/08
ELEVATION (FT):	7.5700	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255291.58300
DRILLER:	Zebra	Y COORDINATE:	219134.53100
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	4.36
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



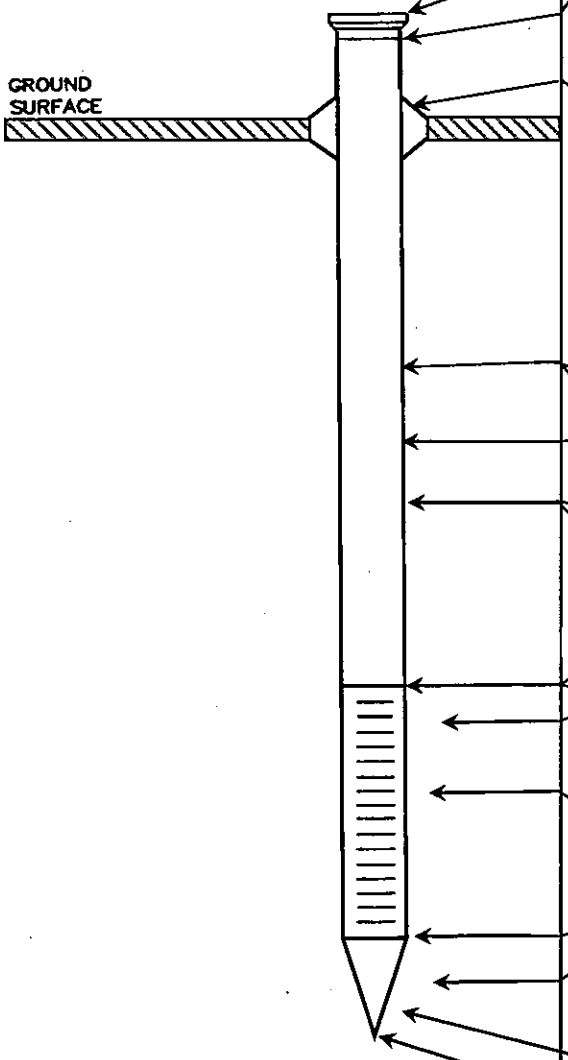
Elevation of Top of DP Wellpoint	8.0600
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.21
Elevation of Top of Riser Pipe (Ft)	7.5700
Height of Protective Outer Casing Above Ground Surface (Ft)	3.7
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	1
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	20
Elevation of Top of Screen	-15.6400
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	25
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	25
Elevation of Bottom of Filter Pack	-20.6400
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	25
Elevation of Hole	-20.6400

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-4S**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-4S
BORING NUMBER:	MW-4S	DATE COMPLETED:	01/28/08
ELEVATION (FT):	7.7400	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255290.45900
DRILLER:	Zebra	Y COORDINATE:	219131.47500
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	4.23
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



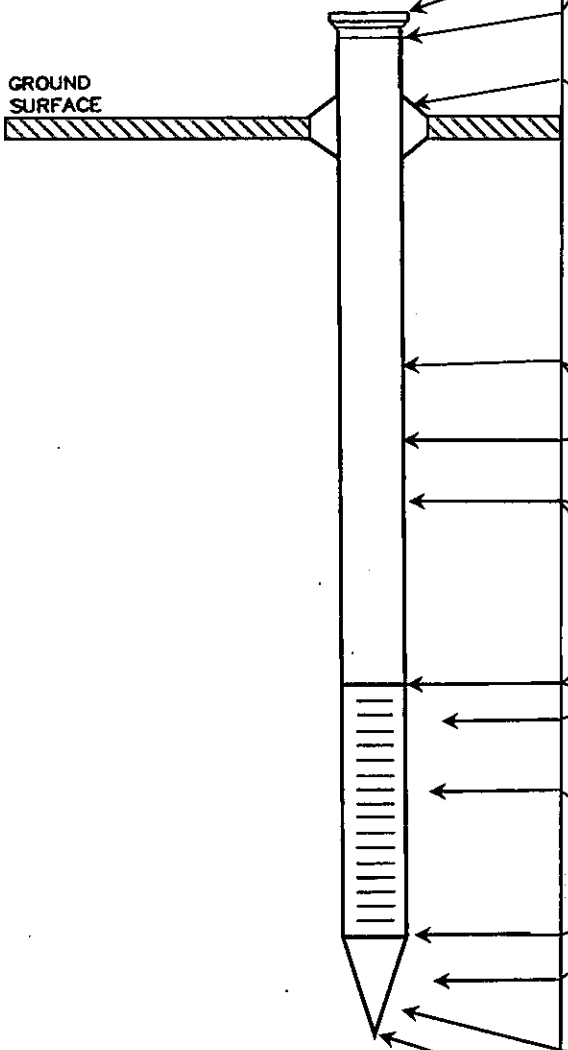
Elevation of Top of DP Wellpoint	8.0300
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.51
Elevation of Top of Riser Pipe (Ft)	7.7400
Height of Protective Outer Casing Above Ground Surface (Ft)	3.8
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	1
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	5
Elevation of Top of Screen	-0.7700
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	natural formation
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	10
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	10
Elevation of Bottom of Filter Pack	-5.7700
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	10
Elevation of Hole	-5.7700

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-5**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-5
BORING NUMBER:	MW-5	DATE COMPLETED:	02/04/08
ELEVATION (FT):	7.9300	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255217.39200
DRILLER:	Zebra	Y COORDINATE:	219284.88500
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	4.84
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



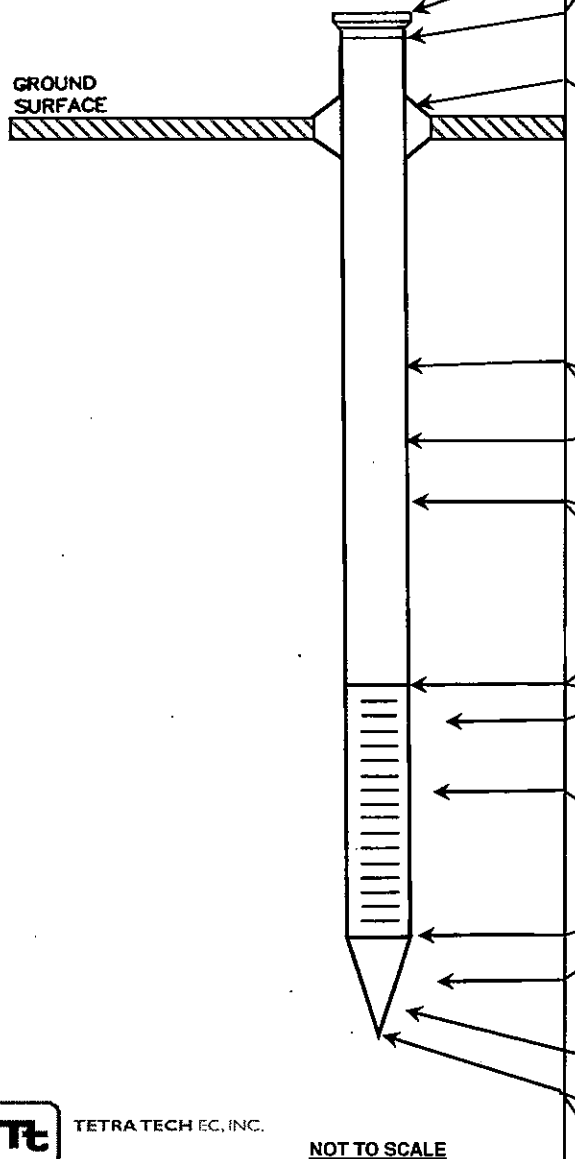
Elevation of Top of DP Wellpoint	8.3100
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.09
Elevation of Top of Riser Pipe (Ft)	7.9300
Height of Protective Outer Casing Above Ground Surface (Ft)	3.47
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	5
Elevation of Top of Screen	-0.1600
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	10
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	15
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	15
Elevation of Bottom of Filter Pack	-10.1600
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	15
Elevation of Hole	-10.1600

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-6**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-6
BORING NUMBER:	MW-6	DATE COMPLETED:	02/05/08
ELEVATION (FT):	8.0800	SURVEY DATE:	
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255188.62500
DRILLER:	Zebra	Y COORDINATE:	219365.02500
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	4.86
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



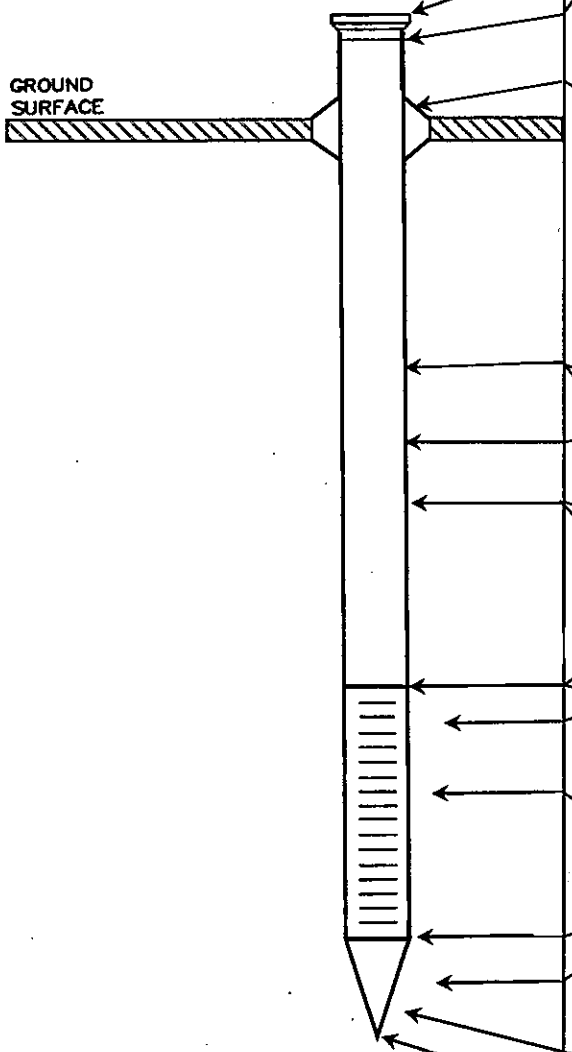
Elevation of Top of DP Wellpoint	8.3400
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	3.22
Elevation of Top of Riser Pipe (Ft)	8.0800
Height of Protective Outer Casing Above Ground Surface (Ft)	3.48
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	5
Elevation of Top of Screen	-0.1400
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	15
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	20
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	20
Elevation of Bottom of Filter Pack	-15.1400
Type of Backfill Below Filter Pack	sand pack
Depth of Hole to Tip of Wellpoint (Ft)	20
Elevation of Hole	-15.1400

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-7D**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-7D
BORING NUMBER:	MW-7D	DATE COMPLETED:	07/10/08
ELEVATION (FT):	8.0900	SURVEY DATE:	07/15/08
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255151.94300
DRILLER:	Zebra	Y COORDINATE:	219210.17890
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.2
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



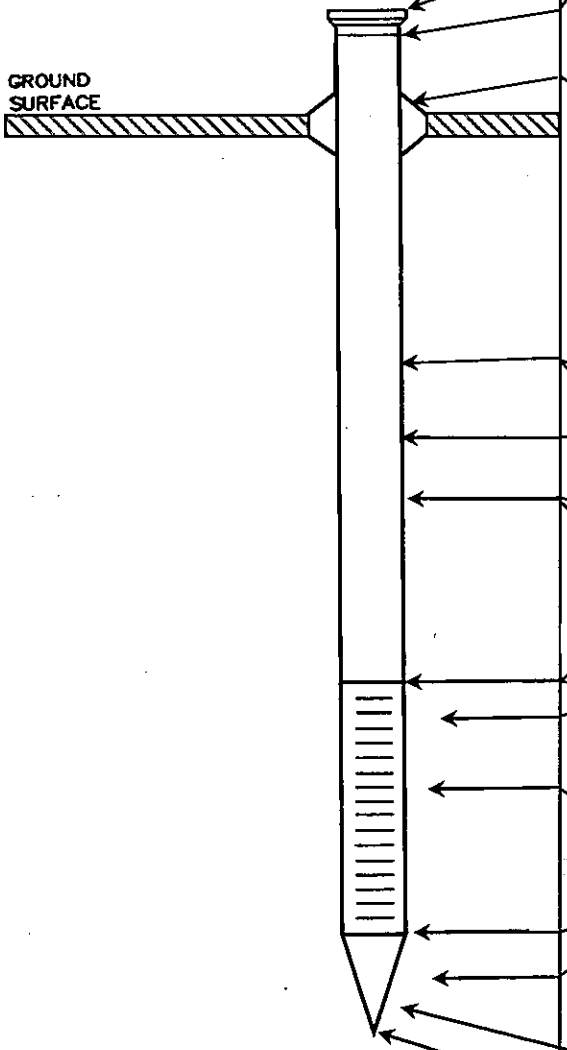
Elevation of Top of DP Wellpoint	8.5200
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	2.89
Elevation of Top of Riser Pipe (Ft)	8.0900
Height of Protective Outer Casing Above Ground Surface (Ft)	3.32
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	1
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	20
Elevation of Top of Screen	-14.8000
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	25
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	25
Elevation of Bottom of Filter Pack	-19.8000
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	25
Elevation of Hole	-19.8000

TETRA TECH EC, INC.

NOT TO SCALE

DIRECT PUSH WELLPOINT CONSTRUCTION DIAGRAM

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-7S**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-7S
BORING NUMBER:	MW-7S	DATE COMPLETED:	07/10/08
ELEVATION (FT):	8.2100	SURVEY DATE:	07/15/08
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255153.29900
DRILLER:	Zebra	Y COORDINATE:	219212.04600
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.37
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT):	METHOD TO MEASURE DEPTH OF WELL:	Casing/screen used



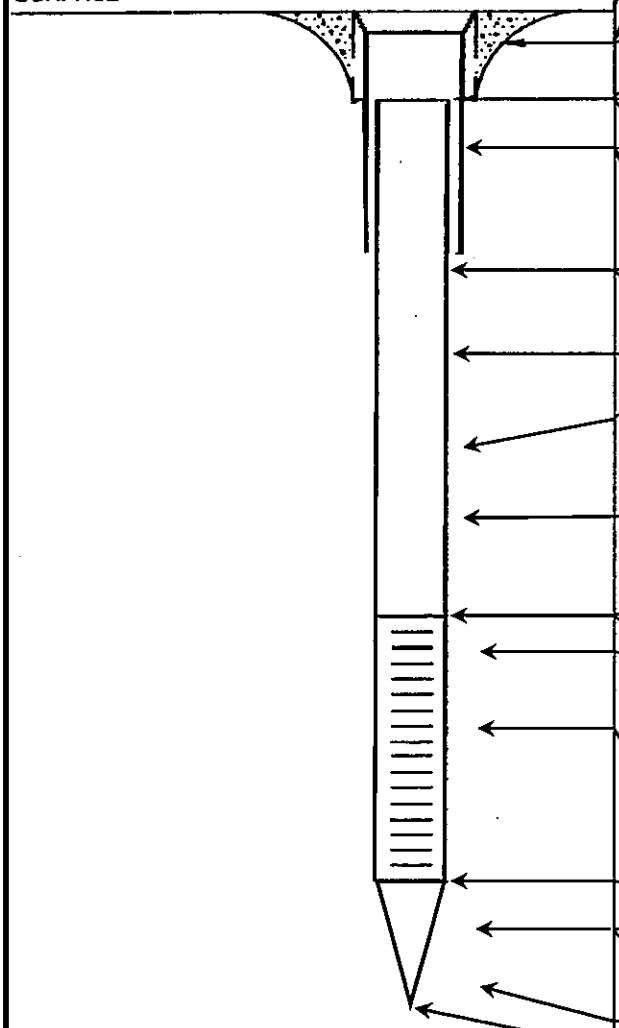
Elevation of Top of DP Wellpoint	8.5600
Stick-up DP Riser Pipe	
Height of DP Riser Pipe (Ft)	2.84
Elevation of Top of Riser Pipe (Ft)	8.2100
Height of Protective Outer Casing Above Ground Surface (Ft)	3.19
Surface Plug:	
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	1
Diameter of Surface Plug (Ft)	2.0
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen	4
Elevation of Top of Screen	1.3700
Type of Screen:	PVC sch 40
I.D. of Screen	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen	9
Filter Pack:	
Depth of Bottom of Filter Pack (Ft)	9
Elevation of Bottom of Filter Pack	-3.6300
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint (Ft)	9
Elevation of Hole	-3.6300

TETRA TECH EC, INC.

NOT TO SCALE

UNCONSOLIDATED MONITORING WELL CONSTRUCTION DIAGRAM (FLUSH MOUNT)

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-8D**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-8D
BORING NUMBER:	MW-8D	DATE COMPLETED:	07/10/08
ELEVATION (FT):	4.7700	SURVEY DATE:	07/15/08
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255314.26700
DRILLER:	Zebra	Y COORDINATE:	219376.87200
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.04
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT): 0	METHOD TO MEASURE WELL DEPTH:	Casing/screen used



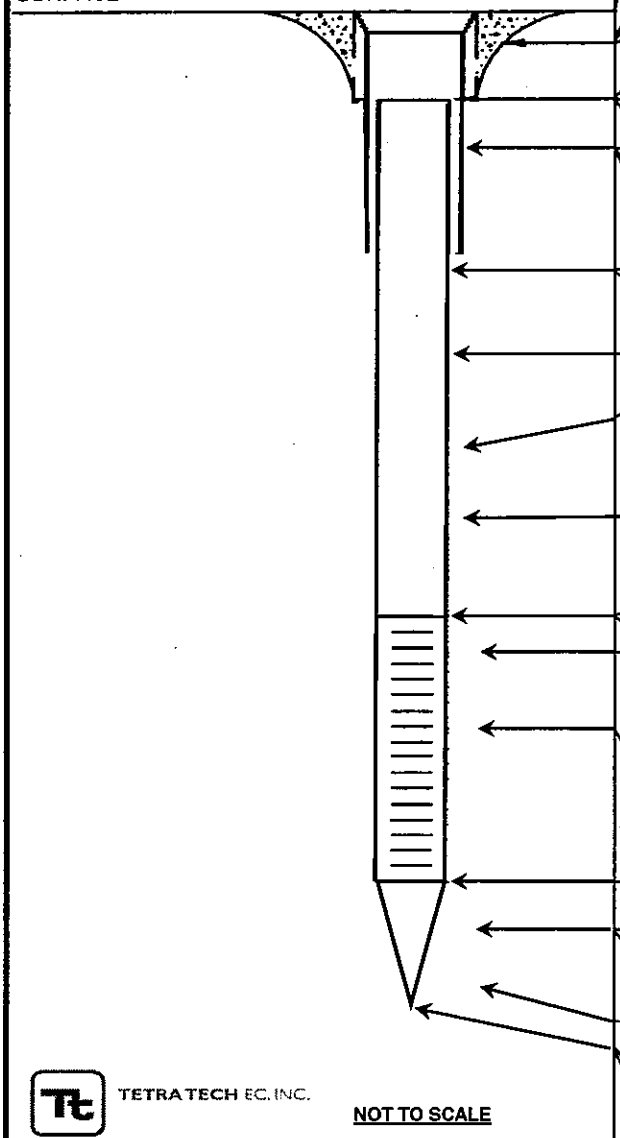
Elevation of Top of DP Wellpoint	5.0400
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2.2
Diameter of Surface Plug (Ft)	2
DP Riser Pipe	
Elevation of Top of DP Riser Pipe	4.7700
Depth of Top of Riser Pipe (bgs in feet)	0.27
I.D. of Surface Casing (Inches)	4
Type of Surface Casing	steel
Depth of Surface Casing (Ft)	1
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen (Ft)	20
Elevation of Top of Screen	-14.9600
Type of Screen:	PVC sch 40
I.D. of Screen (Inches)	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen (Ft)	25
Depth of Bottom of Filter Pack (Ft)	25
Elevation of Bottom of Filter Pack	-19.9600
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint(Ft)	25
Elevation of Hole	-19.9600

TETRA TECH EC, INC.

NOT TO SCALE

UNCONSOLIDATED MONITORING WELL CONSTRUCTION DIAGRAM (FLUSH MOUNT)

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-8S**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-8S
BORING NUMBER:	MW-8S	DATE COMPLETED:	07/10/08
ELEVATION (FT):	4.8600	SURVEY DATE:	07/15/08
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255313.69000
DRILLER:	Zebra	Y COORDINATE:	219375.89900
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	5.05
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT): 0	METHOD TO MEASURE WELL DEPTH:	Casing/screen used



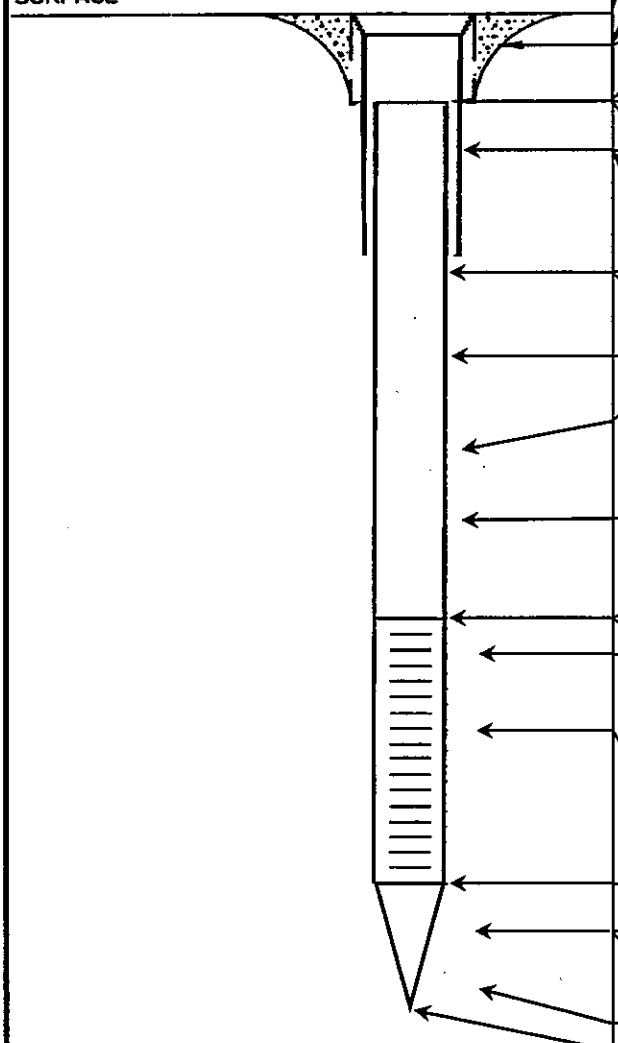
Elevation of Top of DP Wellpoint	5.0500
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2.2
Diameter of Surface Plug (Ft)	2
DP Riser Pipe	
Elevation of Top of DP Riser Pipe	4.8600
Depth of Top of Riser Pipe (bgs in feet)	0.19
I.D. of Surface Casing (Inches)	4
Type of Surface Casing	steel
Depth of Surface Casing (Ft)	1
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen (Ft)	4
Elevation of Top of Screen	1.0500
Type of Screen:	PVC sch 40
I.D. of Screen (Inches)	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen (Ft)	9
Depth of Bottom of Filter Pack (Ft)	9
Elevation of Bottom of Filter Pack	-3.9500
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint(Ft)	9
Elevation of Hole	-3.9500

TETRA TECH EC, INC.

NOT TO SCALE

UNCONSOLIDATED MONITORING WELL CONSTRUCTION DIAGRAM (FLUSH MOUNT)

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-9D**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-9D
BORING NUMBER:	MW-9D	DATE COMPLETED:	07/10/08
ELEVATION (FT):	4.6600	SURVEY DATE:	07/15/08
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255361.55200
DRILLER:	Zebra	Y COORDINATE:	219233.32860
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	4.69
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT): 0	METHOD TO MEASURE WELL DEPTH:	Casing/screen used



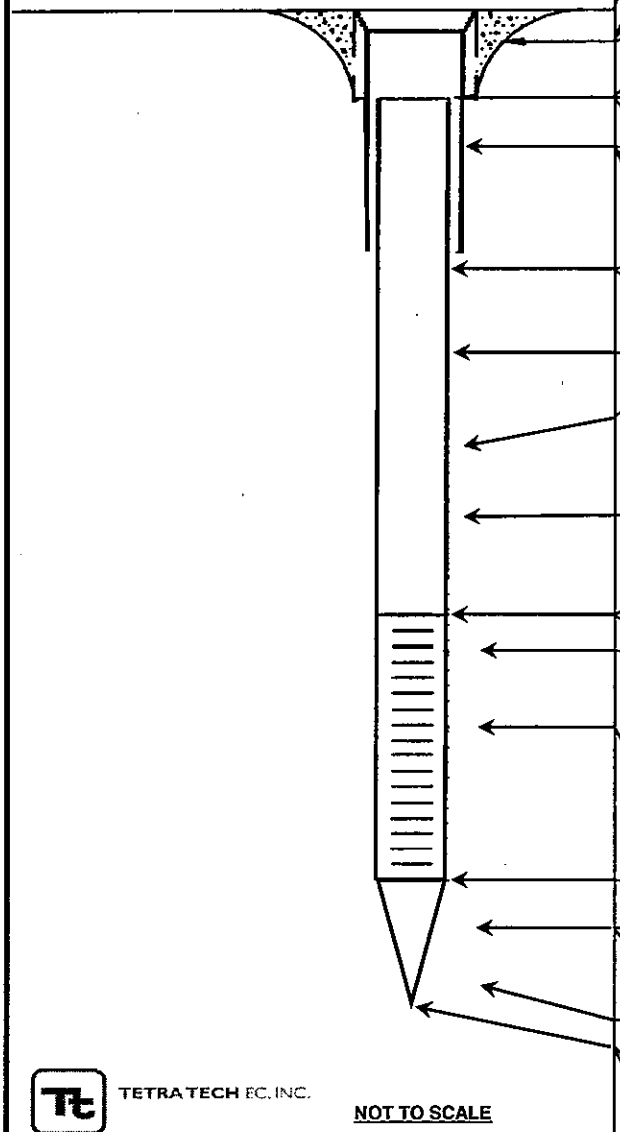
Elevation of Top of DP Wellpoint	4.7800
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2.2
Diameter of Surface Plug (Ft)	2
DP Riser Pipe	
Elevation of Top of DP Riser Pipe	4.6600
Depth of Top of Riser Pipe (bgs in feet)	0.12
I.D. of Surface Casing (Inches)	4
Type of Surface Casing	steel
Depth of Surface Casing (Ft)	1
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen (Ft)	20
Elevation of Top of Screen	-15.3100
Type of Screen:	PVC sch 40
I.D. of Screen (Inches)	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen (Ft)	25
Depth of Bottom of Filter Pack (Ft)	25
Elevation of Bottom of Filter Pack	-20.3100
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint(Ft)	25
Elevation of Hole	-20.3100

TETRA TECH EC, INC.

NOT TO SCALE

UNCONSOLIDATED MONITORING WELL CONSTRUCTION DIAGRAM (FLUSH MOUNT)

PROJECT:	Patchogue Former MGP	**WELL NUMBER:**	**MW-9S**
PROJECT NO.:	106-3599.0001.0030.00000	WELL LOCATION (STATION) ID:	MW-9S
BORING NUMBER:	MW-9S	DATE COMPLETED:	07/10/08
ELEVATION (FT):	4.4700	SURVEY DATE:	07/15/08
FIELD GEOLOGIST:	Tom Fowler	X COORDINATE:	1255360.27000
DRILLER:	Zebra	Y COORDINATE:	219232.12220
DRILLING METHOD:	Direct Push	DATUM:	NAVD88
DEVELOPMENT METHOD:	Submersible Pump	START DEPTH (FT):	4.70
SUMP INSTALLED?(Y/N):	N SUMP LENGTH (FT): 0	METHOD TO MEASURE WELL DEPTH:	Casing/screen used



Elevation of Top of DP Wellpoint	4.7400
Type of Surface Plug	concrete
Depth of Surface Plug (bgs in feet)	2.2
Diameter of Surface Plug (Ft)	2
DP Riser Pipe	
Elevation of Top of DP Riser Pipe	4.4700
Depth of Top of Riser Pipe (bgs in feet)	0.27
I.D. of Surface Casing (Inches)	4
Type of Surface Casing	steel
Depth of Surface Casing (Ft)	1
I.D. of Riser (Inches)	2
Type of Riser	PVC sch 40
Borehole Diameter (Inches)	3.4
Type of Backfill	bentonite slurry
Backfill - Tremied (Y or N)	N
Type of Seal:	bentonite slurry
Seal - Tremied (Y or N)	N
Depth of Top of Screen (Ft)	4
Elevation of Top of Screen	0.7000
Type of Screen:	PVC sch 40
I.D. of Screen (Inches)	2
Slot Size of Screen (Inches)	0.02
Length of Screen (Ft)	5
Type of Filter Pack:	sand pack
Filter Pack - Tremied (Y or N)	N
Well Construction Remarks:	
Depth of Bottom of Screen (Ft)	9
Depth of Bottom of Filter Pack (Ft)	9
Elevation of Bottom of Filter Pack	-4.3000
Type of Backfill Below Filter Pack	natural formation
Depth of Hole to Tip of Wellpoint(Ft)	9
Elevation of Hole	-4.3000

TETRA TECH EC, INC.

NOT TO SCALE

WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-1A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	8.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/21/12 - 3/21/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255177.4 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219314.6 ft.
			Ground Surface Elev: 6.3 ft.	TOC Elev: 8.1 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well (Stick Up)	ppm Readings (ppm)	Remarks
		SM	**FILL**	2-5-15-12			75.0	
	5	SC	Brown mf SAND, some Organics, little Silt. Pulverized concrete.					0.9-2' BGS: Moderate to strong odor.
		SW	Black mf SAND and mf GRAVEL (cinders & slag). Saturated w/ water @ 2.7'.	8-9-7-4			0.4	*0-1.5' BGS: Cement-bentonite grout*
		SM	Black mf SAND, trace Silt.					*1.5-2' BGS: Bentonite Plug*
		SM MH	Black mf SAND, some Silt.	6-5-6-6				*2-7.5' BGS: Filter pack (#1 Filpro Sand)*
5			No Recovery.					*2.5-7.5' BGS: PVC Screen (0.020" Slot)*
	0	SP	Dark brown mfc SAND, trace Gravel (rounded granite and granite flakes).	7-9-11-15			0.0	

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-1B** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/21/12 - 3/21/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255178.7 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219305.9 ft.
			Ground Surface Elev: 5.9 ft.	TOC Elev: 8.9 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well (Stick Up)	ppm Readings (ppm)	Remarks
	5	SW	**FILL**	19-10-10-5			0.0	
		SP	Brown-black mfc SAND, some Organics (roots, grass).					
		SM	Pulverized red-brown concrete.	2-4-3-7			0.0	
		SP	Reddish-black mf SAND, trace (-) Gravel. Pieces of red brick present. Mosit @ 1.7'.					
		GP	Black mf SAND, little Silt, trace Organics.	14-8-3-4				
5		SP	Saturated w/ water @ 3'.					
	0		Black c SAND and f Gravel (cinders and brick present).					*0-10' BGS: Cement-bentonite grout*
		SW		1-1-5-7			0.0	
		GP	Black mf SAND trace Gravel, trace (-) Silt. No recovery.					
		SW	**OUTWASH DEPOSITS**	17-12-8-11			0.0	
		GW	Brown mfc SAND, little (-) mf Gravel. Tan mfc SAND, little (+) Gravel (rounded qtz).					
10		SW		10-5-3-3			0.0	
	-5	GW	Brown mfc SAND, some Gravel (rounded qtz).					*10-12' BGS: Bentonite Plug*
		SP	Tan-orange mf SAND, trace (-) Gravel.	1-2-4-4			0.0	
		SP	Tan-grey mf SAND, trace (-) Gravel.					
				2-2-2-3			0.0	
15								*12-19' BGS: Filter pack (#1 Filpro Sand)*
	-10							
		SP	Tan-grey-beige mf SAND, trace Gravel. @ 17.1' BGS shell present w/ iron staining.	3-4-6-7			0.0	*14-19' BGS: PVC Screen (0.020" Slot)*
		SP	Tan-grey-beige mf SAND, little Gravel.	3-2-4-5			0.0	
		GP						
20								

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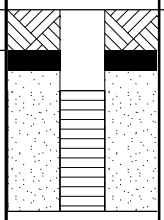
WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-2A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	5.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: No Sampling	Development Method:
3/22/12 - 3/22/12	ADT	**Hammer Type:** 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:		
Shawn Miller	HSA	CME 1500	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 5.8 ft.	**Easting:** 1255197.8 ft. **Northing:** 219330.2 ft. **TOC Elev:** 8.8 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Well	ppm Readings (ppm)	Remarks
5	5		Refer to PZ-2B boring log for description of soil.								*0-1' BGS: Cement-bentonite grout.* *1-1.5' BGS: Bentonite seal.* *1.5-5' BGS: Filter pack.* *2-5' BGS: PVC Screen (0.020" Slot)*

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-2B** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	18.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/22/12 - 3/22/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255209.7 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219332.1 ft.
			Ground Surface Elev: 5.3 ft.	TOC Elev: 8.3 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well	ppm Readings (ppm)	Remarks
		SP	**FILL** Brown mf SAND, little Organics (roots, grass), trace (-) Gravel. Specs of red brick present.	16-16-9-10			0.0	
		SP GP						
		SW	Pulverized concrete.	4-6-4-5			0.1	*0-6' BGS: Cement bentonite grout.*
		SM	Black mf SAND, some Gravel (cinders). Moist.					2.9-3.4' BGS: Slight tar-like odor.
		SP		2-3-2-1			72.1	4-4.3' BGS: Slight tar-like odor.
5	0	OH	Grey-beige mfc SAND, trace (-) Gravel (rounded qtz). Saturated w/ water @ 2.0'.					4.6-6' BGS: Black staining on some grains. Tar-like odor. Oily sheen on water.
		SW	**ALLUVIAL DEPOSITS**	1-1-3-3			7.0	*6-8' BGS: Bentonite seal.*
		SP	Grey-beige mfc SAND, little Silt, trace Organics, trace (-) Gravel (rounded qtz).					7' BGS: NAPL on surface of wood.
		SM	Color change to beige-tan @ 3.4'.	1-5-4-6			67.0	8-8.5' BGS: Black staining. Oily sheen on water.
		SP	Brown-biege mf SAND, trace Gravel.					8.5-10' BGS: Black staining. Moderate odor. NAPL coating on large grains.
		SW GP	Brown ORGANICS, little mf SAND.					*8-15' BGS: Filter pack.*
10	-5		Brown-beige mfc SAND.	3-3-3-5			7.0	*10-15' BGS: PVC Screen (0.020" Slot)*
		SP	Brown-beige mf SAND, trace (-) Organics (1" thick pcs of wood).					12-12.9' BGS: Oily sheen on grains and water. Tar-like odor.
			OUTWASH DEPOSITS	8-7-5-5			27.1	14-16' BGS: Slight odor. Slight staining.
			Black mf SAND, little Silt.					16-18' BGS: Black NAPL flecs w/ tacky, tar-like texture. Leaves residue on gloves. No odor.
		SW	Brown-beige mf SAND.					
		GP	Brown mfc SAND, some (-) Gravel.	7-3-3-4			13.0	
		SP	Brown-beige mf SAND. Mica flecs present.					
15	-10	GW	Brown-tan mfc SAND, some (-) Gravel.					
		SW	Brown-tan mc SAND and mfc GRAVEL (rounded qtz).	5-9-6-7			1.1	
			Tan-orange mfc SAND.					

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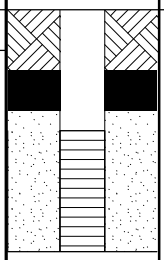
WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-3A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	6.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: No Sampling	Development Method:
3/23/12 - 3/23/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:		
Shawn Miller	HSA	CME 1500	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 5.0 ft.	**Easting:** 1255240.1 ft. **Northing:** 219241.1 ft. **TOC Elev:** 8.8 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Well	ppm Readings (ppm)	Remarks
5	0		Refer to PZ-3B boring log for description of soil.								*0-1.5' BGS: Cement bentonite grout.* *1.5-2.5' BGS: Bentonite seal.* *2.5-6' BGS: Filter pack.* *3-6' BGS: PVC Screen (0.020" Slot)*

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-3B** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/22/12 - 3/22/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255252.2 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219240.4 ft.
			Ground Surface Elev: 5.0 ft.	TOC Elev: 8.9 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well	ppm Readings (ppm)	Remarks
		SP GP SP	**FILL** Dark brown mf SAND, little Gravel, little Organics, little (-) Silt.	16-8-5-7			0.0	
		GP	Crushed/pulverized concrete.	7-5-5-4			0.0	*0-9' BGS: Cement bentonite grout.*
		SP GP	Black fm SAND, some Gravel (red brick), little (-) Silt. Moist.					
		SP	Grey-beige mc SAND, some m Gravel (angular).	2-2-2-2			0.0	4-6' BGS: Slight tar-like odor.
5	0	GP SP	Black fmc SAND, little (+) m Gravel. Wet.					
		GP SW	Wood. Grey-black mc SAND, little m Gravel (cinders). Wet to saturated. Saturated w/ water @ 4.0'.	1-2-4-8			35.0	6-6.8' BGS: Black staining on grains. Sheen on spoon. Black/reddish-brown NAPL blebs (sand sized).
		SP		3-5-5-4			19.5	6.8' BGS: 1/2" NAPL lens across core.
		SW	**OUTWASH DEPOSITS** Brown-beige mfc SAND.					8-8.6' BGS: Strong odor. Heavy, oily sheen on water in spoon.
10	-5	GW SW	Grey-beige mf SAND, trace (-) mf Gravel (rounded qtz).	3-6-4-3			2.6	8.6-10' BGS: Heavy NAPL staining on largest grains. Strong odor.
		GP SW	Grey-beige mfc SAND and mfc GRAVEL.					*9-11' BGS: Bentonite seal.*
		GP	Grey-brown mfc SAND, some f Gravel. Tan-brown mfc SAND, some f Gravel (rounded qtz)	5-5-5-4			4.5	10-10.1' BGS: Sheen on grains.
				13-5-6-4			3.0	10.1' BGS: 1/2" Tacky/thick NAPL lens across core.
15	-10	SW	Tan-orange mfc SAND.					10.7-12' BGS: Strong tar-like odor.
		SW	Tan-orange mfc SAND, trace (-) Gravel (rounded).	10-5-7-6			4.7	*11-18' BGS: Filter pack.*
		SW	Tan-orange mfc SAND.	4-5-6-4			9.1	14.8' BGS: Thin NAPL lens across core.
20	-15							*13-18' BGS: PVC Screen (0.020" Slot)* 18-20' BGS: Slight tar-like odor.

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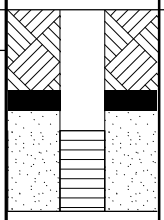
WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-4A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	5.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: No Sampling	Development Method:
5/23/12 - 5/23/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255365.3 ft.
Chris Miglione	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219236.5 ft.
			Ground Surface Elev: 5.0 ft.	TOC Elev: 4.8 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Well (Traffic Rated Vault Box)	ppm Readings (ppm)	Remarks
5	0		Refer to PASB-45 / MW-4D boring log soil description.								*0-2' BGS: Concrete well vault (flush mount).* *2-2.5' BGS: Bentonite seal.* *2.5-5' BGS: Filter pack.* *3-5' BGS: PVC Screen (0.020" Slot)*

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-101 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255243.5 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219389.2 ft.
			Ground Surface Elev: 4.9 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1		0.4	*Borehole backfilled with bentonite chips.*
		SP	Brown mf SAND, trace Silt, trace Organics.					
		GP	Brown cmf SAND, little Gravel (Misc.					1.2-1.8' BGS: Black staining and slight tar-like odor.
		SP	Fill-brick, coal).					
		GP	Gray/Lt. Gray mfc SAND, little fc Gravel.					
		PT	**ALLUVIAL DEPOSITS**					
			ORGANICS (root material). Wet @ 3.3'					
	0							
5		SP	Gray/Brown mfc SAND, trace f Gravel.		2		0.4	
		GP						
		OL	Dk. Brown SILT & CLAY.					
		SP	**OUTWASH DEPOSITS**					
		GP	Brown/Tan cmf SAND, little fmc Gravel (rounded). Wet to saturated @ 8.0'.					
	-5							
10		SP	Tan/Lt. Brown mfc SAND, trace (+) fmc		3		0.4	
		GP	Gravel (rounded). Saturated.					
	-10							
15		SP	Tan/Lt. Brown mfc SAND, trace (-) fm		4		0.2	
		GP	Gravel (rounded), trace Silt. Saturated.					
	-15							
20								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-102 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 1255259.4 ft. Northing: 219304.1 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1					50.9	*Borehole backfilled with bentonite chips.*
		SP GP	Dk. Brown fm SAND, little (+) Silt, trace Organics (topsoil).								
		SP GP	Gray/Brown fm SAND, some (-) Gravel (angular).								
		SP GP	Brown/Black/Tan cmf SAND, some (-) Gravel (Misc. Fill-coal, cinders). Moist.								2.2-2.5' BGS: Black staining, moderate to strong tar-like odor.
	0		Gray/Brown mf SAND, trace (-) fm Gravel. Wet at 2.0'								2.5-3.0' BGS: Slight to faint tar-like odor.
5		SP GP	Lt. Brown/Black cmf SAND, little Gravel (Misc. Fill-brick, coal).		2					10.3	
		SP GP	**OUTWASH DEPOSITS**								5.8' BGS: Slight tar-like odor.
		SP	Brown/Gray cmf SAND, trace Gravel, trace Organics.								6.2-6.5' BGS: Rainbow sheen on soil grains, slight NAPL coating on grains. Moderate to strong tar-like odor.
		SP	Lt. Gray cmf SAND. Wet to saturated.								
	-5	SP GP	Gray/Black cmf SAND.								
10		SP GP	Brown/Orange/Multi-colored cmf SAND and cmf GRAVEL.		3					0.7	7.0-7.7' BGS: Black staining, moderate tar-like odor.
			Lt. Brown/Orange cmf SAND, trace (-) f Gravel, trace Silt. Saturated.								
	-10										
15		SP GP	Orange mfc SAND, trace (-) Gravel, trace Silt. Saturated.		4					0.7	
	-15										
20											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-103 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 1255261.3 ft. Northing: 219274.5 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1		36.2	*Borehole backfilled with bentonite chips.*
		SM	Brown/Dk. Brown fm SAND, little Silt, little Organics.					
		SP						
		GP	Gray mfc SAND, little (+) Gravel. Moist					2.1' BGS: Slight to moderate tar-like odor.
		SP	Dk. Brown fmc SAND, little Silt, trace Gravel.					
		SM						
		SP	Lt. Gray fmc SAND, wet.					3.7' BGS: Brown NAPL coating soil grains, rainbow sheen. Moderate to strong tar-like odor.
	0	SP	Gray c SAND.		2		131	5.0-5.9' BGS: Black staining, slight tar-like odor.
5		SP	Wood.					5.9-6.5' BGS: Black stained, NAPL coating on soil grains. Brown NAPL on coarser material.
		SP	Lt. Gray fmc SAND, moist.					
		GP	Black/Dk. Brown cmf SAND, some (+) mf Gravel (Misc. Fill-coal, brick).					6.6-7.2' BGS: Black stained, slight NAPL coating on soil grains, moderate tar-like odor.
		SP						
		OL	Lt. Gray/Black cmf SAND.					7.6-7.7' BGS: Black staining, sheen and tar-like odor.
		SP	**ALLUVIAL DEPOSITS**					7.8-9.0' BGS: Spots of sheen on coarser material.
	-5	SP	Brown Silty CLAY and ORGANICS (peat).					
10		GP	**OUTWASH DEPOSITS**		3		6.3	
		SP	Black fmc SAND.					
		GP	Lt. Brown/Orange cmf SAND, little (+) Gravel (rounded).					
		SP						
		SM	Orange/Brown cmf SAND, little (+) fmc Gravel (rounded). Saturated.					
			Lt. Brown/Orange fmc SAND, trace Silt, trace (-) Gravel.					
	-10							
15		SP	Lt. Brown/Orange fmc SAND, trace Silt,		4		3.1	
		SM	trace (-) Gravel.					
	-15							
20								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-104 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 1255180.3 ft. Northing: 219252.1 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP SM	**FILL** Brown fm SAND, little Silt, little Organics.		1					0.5	*Borehole backfilled with bentonite chips.*
		SP GP	Dk. Brown/Red fmc SAND, little (+) Gravel, trace Silt (Misc. Fill- brick, wood, coal).								1.6' BGS: Slight tar-like odor.
		SP	Black/Gray cmf SAND. Moist.								
5	0	SP	Dk. Brown fm SAND, little Silt, trace Organics. Fire brick @ 3.0'		2					0.2	
		SP SM	**ALLUVIAL DEPOSITS** Dk. Brown fm SAND, little Silt, trace Organics.								
		SP GP	Gray/Brown/Black fmc SAND, little (-) Silt, little Organics (layered).								7.1' BGS: Sporadic black staining, slight tar-like odor.
			OUTWASH DEPOSITS Tan/Orange cmf SAND, little (+) Gravel (rounded). Saturated.								
10	-5	SP GP	Tan/Orange cmf SAND, little (-) fmc Gravel, trace Silt. Saturated.		3					0.2	
15	-10	SP GP	Tan/Orange fmc SAND, trace (-) Gravel, trace Silt. Saturated.		4					0.0	
20	-15										

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Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-105 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255136.0 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219248.2 ft.
			Ground Surface Elev: 5.3 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP SM SP GP SP SM	**FILL** Dk. Brown fm SAND, little Silt, trace Organics (topsoil). Gray/Black/Red cmf SAND, little (+) Gravel (Misc. Fill-brick). **OUTWASH DEPOSITS** Brown/Tan fmc SAND, little (-) Silt, trace Gravel, Moist.		1		0.3	*Borehole backfilled with bentonite chips.* 1.5-3.0' BGS: Sporadic black staining, faint tar-like odor.
5	0	SP SM	Brown/Gray mfc SAND, trace Silt, Saturated.		2		0.4	
		SP SM	Lt. Tan/Beige fmc SAND, trace Silt. Saturated.					
10	-5	SP SM	Lt. Tan/Beige fmc SAND, trace Silt. Saturated.		3		0	
15	-10	SP SM	Lt. Tan/Beige fmc SAND, trace Silt. Saturated, Iron staining.		4		0	
20								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-106 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.7 ft.	Easting: 1255124.4 ft. Northing: 219284.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
0	0	SP SM SP GP OL SP SM SP SM	**FILL** Dk. Brown fm SAND, little (+) Silt, trace Organics, Moist. Dk. Brown/Brown cmf SAND, little Gravel (Misc. Fill-brick), little Silt. Dk. Brown SILT & CLAY, litle (+) Organics (peat). Dk. Brown/Tan mfc SAND, little Silt, trace (+) Gravel (Misc. Fill-coal), Moist.		1		0.6	*Borehole backfilled with bentonite chips.* 0.2-1.1' BGS: Minor black staining, faint tar-like odor.
5		SP GP	**OUTWASH DEPOSITS** Beige/Tan mfc SAND, trace Silt, Wet. Beige/Tan/Multi-colored cmf SAND, little (-) fm Gravel (rounded), trace Silt. Iron staining. Wet to saturated.		2		0.3	
-5	10	SP GP	Beige/Tan/Multi-colored cmf SAND, little (-) fm Gravel (rounded), trace Silt. Iron staining. Wet to saturated.		3		0.3	
-10	15	SP GP	Beige/Tan/Multi-colored cmf SAND, little (-) fm Gravel (rounded), trace Silt. Iron staining. Wet to saturated.		4		0.2	
-15	20							

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-107 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.8 ft.	Easting: 1255122.4 ft. Northing: 219320.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP SM SP GP SP SM SP SM	**FILL** Dk. Brown mf SAND, little Silt, little Organics. Dk. Brown/Brown cmf SAND, little Gravel, Moist. Brown/Dk. Brown fmc SAND, little Silt, trace f Gravel.		1		2.1	*Borehole backfilled with bentonite chips.* 0.2-0.9' BGS: Faint tar-like odor
5	0	SP SM	**OUTWASH DEPOSITS** Tan/Beige mfc SAND, trace Silt, Wet. Tan/Beige/Orange fmc SAND, little (-) Silt, trace mf Gravel. Wet to saturated. Iron staining.		2		0.3	
10	-5	SP SM	Beige mfc SAND, little Silt, trace (-) f Gravel. Wet to saturated.		3		0.2	
15	-10	SP SM	Beige mfc SAND, little Silt, trace mf Gravel. Wet to saturated.		4		0.2	
20	-15							

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-108 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	6.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255108.6 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219358.8 ft.
			Ground Surface Elev: 5.4 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1		4.3	*Borehole backfilled with / bentonite chips.*
		GP/SP	Brown fmc SAND, little (+) Gravel, trace Silt, Moist.					
		GP/SP	White/Beige fmc SAND, little (+) Gravel (pulverized).					2.5-2.6' BGS: Minor black staining, slight tar-like odor.
		SM/SP	Brown mfc SAND, little Silt, trace Gravel, Wood chips.					
5	0	GP/SP	Brown fmc SAND, little Silt, little Gravel, trace Organics. Moist to wet.		2		0.4	
		GP/GP/SP	Brown fmc SAND, little Silt, little Gravel, trace Organics. Moist to wet. Lt. Gray/White mf GRAVEL (pulverized concrete), little (+) Sand. Wet.					Geoprobe refusal @ 6.0' BGS. Move over to location SB-108A.

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-108A **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	5.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255108.6 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219364.2 ft.
			Ground Surface Elev: 5.3 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
5		SP SP GP SP GP GP SP	**FILL** Brown fmc SAND, little Organics. Brown/Dk. Brown cmf SAND, little (+) Gravel, trace Silt, trace Organics. Brown/Lt. Brown cmf SAND, little (-) Gravel, trace Silt. Moist to wet. Lt. Gray/White mf GRAVEL (pulverized concrete), little (+) Silt.		1					27.3	*Borehole backfilled with bentonite chips.* 1.75-1.9' BGS: Black hardened tar, moderate tar-like odor. 2.5-2.6' BGS: NAPL coating soil grains, sheen and NAPL blebs on liner. Moderate to strong tar-like odor. Geoprobe refusal @ 5.0' BGS.

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-109 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 1255322.4 ft. Northing: 219280.0 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	Asphalt		1		1.2	*Borehole backfilled with bentonite chips.*
		GP	**FILL** Dk. Brown/Black fm SAND, little (-) Gravel (Misc. Fill-cinders, brick).					
		SP						
		SM	Brown/Tan fm SAND, little (-) Silt, trace Gravel.					
		SP						
		GP	Red/Brown/Purple fmc SAND, little Gravel (Misc. Fill) little Silt. Moist.					
5	0	SP						1.7-2.5' BGS: Faint petroleum-like odor.
		GP	**ALLUVIAL DEPOSITS**		2		0.3	
		SP	Red/Purple/Brown fmc SAND, little (+) f Gravel (shells). Moist.					3.6-3.8' BGS: Minor black staining, hardened tar, moderate tar-like odor.
		GP						
		PT	Red/Purple/Brown fmc SAND, little (+) f Gravel (shells). Moist.					
		SP						
		SM	Dk. Brown/Brown SILT & CLAY and ORGANICS (peat) . Moist to wet.					
		SP						
10	-5	SM	**OUTWASH DEPOSITS**		3		1.0	
		SP	Tan/Beige fmc SAND, little (-) Silt.					
		GP						
		SP	Dk. Brown fmc SAND, little (+) Silt, trace (+) Organics.					
		GP						
			Tan/Beige cmf SAND, little (+) fmc Gravel. Wet to saturated.					
			Tan/Beige cmf SAND, little (+) fmc Gravel, trace Silt. Saturated.					
15	-10	SP			4		0.2	
		GP	Tan/Beige cmf SAND, trace Gravel, trace Silt. Saturated. Iron staining.					
20								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-110 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255337.0 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219225.5 ft.
			Ground Surface Elev: 5.2 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP	Asphalt **ALLUVIAL DEPOSITS** Dk. Brown cmf SAND, little (+) mf Gravel (rounded), Moist.		1		0.4	*Borehole backfilled with bentonite chips.*
		SP	Lt. Brown cmf SAND.					
		SP	Brown fm SAND, little Silt, little Organics.					
5	0	SM	Shells @ 3.65-3.7'.		2		0.5	
		SP	Beige mfc SAND.					
		SP	Beige mfc SAND.					
		PT	Dk. Brown f SAND, little Silt & Clay, little Organics (peat).					
		SP SM	**OUTWASH DEPOSITS**					
		SP GP	Lt. Brown/Tan mfc SAND, little (-) Silt, trace (-) Gravel (rounded), Wet.					
10	-5	SP GP	Tan cmf SAND, little (+) fmc Gravel (rounded) trace Silt, wet.		3		0.1	
			Tan/Orange cmf SAND, little (-) fm Gravel (rounded), trace Silt. Saturated. Iron staining.					
15	-10	SP GP	Tan/Lt. Brown cmf SAND, trace f Gravel, trace Silt, Saturated.		4		0.0	
20								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-111 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/4/10 - 10/4/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.5 ft.	Easting: 1255112.6 ft. Northing: 1255112.0 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
	5	SP GP SP GP SP GP	**FILL** Lt. Gray fmc SAND, little Gravel (pulverized concrete/rock). Lt. brown fmc SAND, trace (+) fm Gravel. Wet. Beige fmc SAND, litte (-) fmc Gravel. Wet.		1		1.6	*Borehole backfilled with bentonite chips.* 0.5-1.7' BGS: Sporadic spots of black staining.
5	0	SP GP	Beige/tan mfc SAND, little (-) fm Gravel. Wet to saturated.		2		23.4	Sample SB-111-7-9 collected and submitted for laboratory analysis. 7.1-7.3' BGS: Band of NAPL saturated soils (tacky), moderate tar-like odor. 7.3-8.2' BGS: Sheen extending from saturated soils and within soil core when broken apart.
10	-5	SP GP	Beige mfc SAND, trace (-) fm Gravel.		3		0.2	
15	-10	SP GP	Beige mfc SAND, trace (-) fm Gravel.		4		0.0	Sample SB-111-15-17 collected and submitted for laboratory analysis.
20	-15	SP GP	Beige mcf SAND, trace (+) fm Gravel. Iron staining throughout.		5		0.0	
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-112 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/4/10 - 10/4/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.4 ft.	Easting: 1255112.0 ft. Northing: 219353.8 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
	5	SP GP SP GP SP GP	**FILL** Brown fmc SAND, some (-) fmc Gravel, trace Organics. Wet. Brown mfc SAND, trace (+) fm Gravel. Wet. Beige mfc SAND, trace (+) fm Gravel. Wet.		1					0.9	*Borehole backfilled with bentonite chips.* 1.4-1.5' BGS: Black staining, faint tar-like odor. Sample SB-112-1-3 collected and submitted for laboratory analysis.
5	0	SP GP	Beige/tan mfc SAND, trace (+) f Gravel. Wet/saturated. Iron staining.		2					0.7	
10	-5	SP GP	Beige mfc SAND, trace (-) f Gravel. Wet/saturated. Iron staining.		3					0.7	Sample SB-112-10-12 collected and submitted for laboratory analysis.
15	-10	SP GP	Beige mfc SAND, trace (-) f Gravel. Wet/saturated. Iron staining.		4					0.4	
20	-15	SP GP	Beige mfc SAND, trace (-) f Gravel. Wet/saturated. Iron staining.		5					0.0	
25											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-113 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 1255160.0 ft. Northing: 219341.6 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1		0.0	*Borehole backfilled with bentonite chips.*
		SP GP	Brown fmc SAND, trace Gravel, trace Organics.					
		SP	Gray fmc SAND, some Gravel (angular).					Sample SB-113-1-3 collected and submitted for laboratory analysis.
		GP	Black/brown fmc SAND, trace (+) fm Gravel.					1-2.4' BGS: Black staining, faint tar-like odor
		SP						
		GP	Brown fmc SAND, trace (+) fm Gravel.					
5	0	SP	Orange cmf SAND, trace f Gravel. Iron staining.		2		0.0	3.1-3.3' BGS: Black staining, faint tar-like odor
		SP GP	**OUTWASH DEPOSITS** Tan/orange cmf SAND, little (+) fm Gravel. Wet.					
10	-5	SP GP	Tan/beige fmc SAND, little (-) fm Gravel. Wet.		3		0.0	
15	-10	SP GP	Lt/ brown/tan mfc SAND, trace (+) fm Gravel. Wet.		4		0.0	
20	-15	SP GP	Lt/ brown/tan mfc SAND, trace (+) fm Gravel. Wet.		5		0.0	Sample SB-113-20-22 collected and submitted for laboratory analysis.
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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-114 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255172.0 ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT	Vert Datum: NAVD88	Northing: 219327.9 ft.
			Ground Surface Elev: 5.7 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
	5	SP	**FILL**	--	1		1.6	*Borehole backfilled with bentonite chips.*
		SP GP	Brown fmc SAND, trace Gravel, trace Organics.					0.9-2.2' BGS: Black staining, faint tar-like odor.
		SP	Gray/Brown fmc SAND, some fmc Gravel.					Sample SB-114-1-3 collected and submitted for laboratory analysis.
5		GP	Brown fmc SAND, little (-) fm Gravel. Moist to wet.					
	0	SP GP	**OUTWASH DEPOSITS** Tan/Orange mfc SAND, little (+) fm Gravel. Wet. Iron staining throughout.	--	2		0.6	
10	-5	SP	Beige/Tan fmc SAND, trace (-) f Gravel. Iron staining.	--	3		1.8	
15	-10			--	4		0.4	
20	-15	SP	Beige/Tan fmc SAND. Wet. Iron staining.	--	5		0.0	Sample SB-114-20-22 collected and submitted for laboratory analysis.
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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-115 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255181.0 ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT	Vert Datum: NAVD88	Northing: 219315.3 ft.
			Ground Surface Elev: 5.6 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
	5	SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (-) Gravel, trace Organics. Gray fmc SAND, some (+) mf Gravel. Brown/Gray/Black fmc SAND, little (-) Gravel. Moist.	--	1		0.5	*Borehole backfilled with bentonite chips.* 1.3' BGS: Black staining, slight/moderate tar-like odor. 2-2.5' BGS: Soils slightly coated with NAPL.
5	0	SP SP	Dk. Brown/Gray fmc SAND, trace mf Gravel. Wet. Brown/Tan mfc SAND, trace (+) fmc Gravel. Wet. Piece of wood.	--	2		0.2	5-5.7' BGS: Faint tar-like odor. Sample SB-115-10-12 collected and submitted for laboratory analysis.
10	-5	SP GP	**OUTWASH DEPOSITS** Tan/Orange mfc SAND, little fm Gravel. Wet.	--	3		13.5	10.85 and 11.45' BGS: Band of soil coated with tacky NAPL, sheen, faint tar-like odor.
15	-10	SP	Tan mfc SAND, trace Gravel. Dk. Red Iron staining.	--	4		0.4	15-20' BGS sample interval: Sheen observed at bottom of acetate liner.
20	-15	SP	Tan mfc SAND, trace Gravel.	--	5		0.0	20' BGS: Few small specks of NAPL.
25	-20	SP	Beige/Tan fmc SAND, trace (-) f Gravel.	--	6		0.0	Sample SB-115-25-27 collected and submitted for laboratory analysis.
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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-116 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.7 ft.	Easting: 1255185.6 ft. Northing: 219299.3 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
	5	SP GP	**FILL** Brown fmc SAND, little (-) fm Gravel, trace Organics.	--	1					1.0	*Borehole backfilled with bentonite chips.*
5	0	NR	No recovery.	--	2					3.2	5-10' BGS: Minimal sample recovery, sheen and black staining observed on acetate liner.
10	-5	SP GP	**OUTWASH DEPOSITS** Brown/Tan fmc SAND, little (+) fm Gravel. Wet to saturated.	--	3					9.7	Sample SB-116-11-13 collected and submitted for laboratory analysis. 11' BGS: Black staining. 11.6-11.7' BGS: Black staining. 11.9' BGS: Band of soils coated with NAPL, sheen. 12-12.2' BGS: Black staining.
15	-10	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet.	--	4					1.4	12.2' BGS: Band of soils coated with NAPL, sheen, faint/moderate tar-like odor.
20	-15			--	5					0.0	20.5' BGS: Very few specks of tacky NAPL. Sample SB-116-21-23 collected and submitted for laboratory analysis.
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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-117 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 1255181.2 ft. Northing: 219263.2 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	Topsoil.	--	1		5.2	*Borehole backfilled with bentonite chips.*
		SM	**FILL**					
		SP	Black/Gray/Red cmf SAND, some (-) fmc Gravel (Misc. Fill - brick, cinders). Wet.					1.9-2.9' BGS: Black staining, faint tar-like odor.
		GP						
		ML	Dk. Brown SILT and CLAY, little Organics.					2.6-2.7' BGS: Soils coated with NAPL.
		CL	Brown/Black fmc SAND, little (-) Gravel (Misc. Fill).					Sample SB-117-2-3 collected and submitted for laboratory analysis.
		SP						
	0	GP						
5			**OUTWASH DEPOSITS**					
		SP	Gray cmf SAND, little (+) Gravel (rounded).	--	2		0.4	
		GP						
		SP	Gray/Dk. Gray mfc SAND, trace Gravel, trace Organics.					
		SP						
		GP	Tan/Gray cmf SAND, some (+) fmc Gravel. Wet.					
	-5							
10		SP	Tan/Orange mfc SAND, trace (+) fm Gravel. Wet. Iron staining.	--	3		0.3	
	-10							
15				--	4		0.4	
	-15							
20		SP	Tan fmc SAND, trace (-) f Gravel. Wet.	--	5		0.0	Sample SB-117-20-22 collected and submitted for laboratory analysis.
	-20							
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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-118 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 1255191.0 ft. Northing: 219349.2 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP SP GP	**FILL** Brown fmc SAND, little Gravel, trace Silt, trace Organics. Gray fm SAND, little (+) mf Gravel (angular). Brown fm SAND, little (-) Gravel (Misc. Fill - brick, cinders).	--	1		202	*Borehole backfilled with bentonite chips.* 2.3-3.2' BGS: Black stained and NAPL coated soils, moderate tar odor. 3.2' BGS: Blue-green stained material, sulfur-like odor.
5	0	SP GP	Green/Blue tinge mf SAND, little Gravel (pieces of pulverized quartz). **ALLUVIAL DEPOSITS** Black fmc SAND, little (-) fmc Gravel. Moist to wet.	--	2		62.7	5-10' BGS: NAPL coated sand grains, moderate/strong tar-like odor.
10	-5	SP SP	Black fm SAND. **OUTWASH DEPOSITS** Tan/Brown fm SAND. Wet.	--	3		9.9	10-10.4' BGS: Black stained soils, moderate tar-like odor. 11.3' BGS: Lens of NAPL coated soils. 11.6' BGS: Lens of NAPL coated soils (more viscous than observed at 11.3').
15	-10	SP	Tan fmc SAND. Wet to saturated.	--	4		9.7	15-15.5' BGS: Thin band of black viscous NAPL coated soils, moderate tar-like odor. 15.5-16' BGS: Sheen extending from saturated soil grains. Sample SB-118-15-17 collected and submitted for laboratory analysis.
20	-15			--	5		0.0	Sample SB-118-22-24 collected and submitted for laboratory analysis.
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-119 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 219364.5 ft. Northing: 1255201.5 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP GP SP SP GP SP	**FILL** Brown/Gray fmc SAND, little (-) fmc Gravel (Misc. Fill - brick, cinders). Black f SAND and SILT. Black fm SAND, trace f Gravel. Green/White cmf GRAVEL (pulverized rock - quartz), little (-) Sand.	--	1					89.2	*Borehole backfilled with bentonite chips.* 1.1-1.3' BGS: NAPL coated soils 1.3-3' BGS: NAPL coating/NAPL saturated, moderate tar-like odor.
5	0	SP SM ML SP GP SP	**ALLUVIAL DEPOSITS** Brown mf SAND, trace Organics. Dk. Brown SILT and f SAND, little Organics. Gray/Dk. Gray fmc SAND. **OUTWASH DEPOSITS** Tan/Beige SAND and GRAVEL. Wet @ 7.4'.	--	2					19.6	5-5.9' BGS: Black stained/NAPL coated soils. 6.8' BGS: Sheen extending from saturated soils, sporadic specks/blebs of NAPL. 7.4' BGS: Band/lens of NAPL.
10	-5	SP	Tan/Orange fm SAND, trace fm Gravel. Wet.	--	3					9.0	10.7' BGS: Black staining, sheen and NAPL coating on gravel. 10.8' BGS: Band/lens of tacky NAPL within coarser grained material, moderate tar-like odor.
15	-10	SP	Tan fmc SAND, trace f Gravel. Wet. Iron staining.	--	4					0.0	Sample SB-119-11-13 collected and submitted for laboratory analysis.
20	-15	SP	Tan/Orange fmc SAND, trace (-) f Gravel. Wet. Iron staining.	--	5					0.0	20-25' BGS: Spots of sheen on water within acetate liner, but not within soil core when broken apart. Sample SB-119-22-24 collected and submitted for laboratory analysis.
25	-20										

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-120 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219356.2 ft. Northing: 1255219.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP GP	**FILL** Brown/Gray fmc SAND, little Gravel.	--	1					139	*Borehole backfilled with bentonite chips.* 1.7-3' BGS: Black staining, moderate tar-like odor.
		GP SP	Red SAND, little Gravel (Misc. Fill - pulverized brick/fire brick).								3'-3.1 BGS: NAPL coating, blebs/sheen extending from saturated soil grains.
		SP	Brown/Gray fm SAND.								3.1-3.7' BGS: moderate tar-like odor.
		SP GP	Lt. Gray fm SAND, little (+) fmc GRAVEL, trace Silt. Compact.								5-6.7' BGS: NAPL coating/saturated, moderate tar-like odor.
5	0										6.7-8.3' BGS: Black stained soils, sheen throughout, moderate tar-like odor.
		SP GP	Gray/Brown fmc SAND, little f Gravel (Misc. Fill - brick). Saturated.	--	2					136	8.3-9.5' BGS: Sheen extending from saturated soils, moderate tar-like odor.
		SP	**ALLUVIAL DEPOSITS** Gray/Black fm SAND, trace Organics.								10-10.7' BGS: Bands of black staining/NAPL coated soils, sheen, moderate tar-like odor.
		GP SP	**OUTWASH DEPOSITS** Brown/Tan cmf SAND and fmc GRAVEL.								10.7-11.3; BGS: Sheen extending from saturated soils.
10	-5	SP	Tan fmc SAND. Saturated.	--	3					31.9	11.3-11.4' BGS: Black staining, NAPL (tacky to touch).
											12.2-12.3' BGS: Lens of NAPL (tacky to touch).
15	-10	SP	Tan/Orange fmc SAND.	--	4					17.9	15.9-16.1' BGS: NAPL saturated (tacky to touch), moderate to strong tar-like odor.
											16.1-16.8' BGS: Sheen extending from saturated soils, moderate tar-like odor.
20	-15			--	5					0.0	16.5' BGS: Lens of tacky NAPL. Sample SB-120-15-17 collected and submitted for laboratory analysis.
											Sample SB-120-22-24 collected and submitted for laboratory analysis.
25	-20										

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-121 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 219340.4 ft. Northing: 1255204.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (+) Gravel, trace Organics. Brown/Gray/Black cmf SAND, little Gravel (Misc. Fill - brick). Dk. Brown/Black fm SAND, little (-) f Gravel.	--	1		85.2	*Borehole backfilled with bentonite chips.* Sample SB-121-2-4 collected and submitted for laboratory analysis. 2.4-2.9' BGS: NAPL coating soil, moderate tar-like odor.
5	0	SP ML CL GP SP	**ALLUVIAL DEPOSITS** Brown fmc SAND. Dk. Brown SILT and CLAY. **OUTWASH DEPOSITS** Brown/Tan fmc SAND and GRAVEL. Moist to wet.	--	2		10.5	2.4, 2.7' BGS: Sand with blue tinge, faint sulfur-like odor. 5-5.4' BGS: NAPL coating on soil grains, moderate tar-like odor. 5.8-7' BGS: Slight tar-like odor.
10	-5	SP GP	Tan/Beige mfc SAND, little (+) fm Gravel. Wet. Iron staining.	--	3		2.4	7-7.4' BGS: Sheen extending from saturated soil grains, slight tar-like odor 11.5-11.7' BGS: Globules of viscous NAPL (tacky to touch). 11.7' BGS: Lens of NAPL.
15	-10	SP	Tan/Orange mcf SAND, trace (-) f Gravel. Iron staining. Wet to saturated.	--	4		6.7	Sample SB-121-15-17 collected and submitted for laboratory analysis. 15.2-17' BGS: Lenses of tacky NAPL concentrated around coarser grained material, sheen throughout, moderate tar-like odor.
20	-15	SP	Orange/Tan mf SAND, trace (-) f Gravel. Wet to saturated.	--	5		0.0	Sample SB-121-22-24 collected and submitted for laboratory analysis.
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-122 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	28.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 219354.3 ft. Northing: 1255200.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**	--	1		210	*Borehole backfilled with bentonite chips.*
		SP	Brown mf SAND, trace Gravel, trace Organics.					
		GP						
		CL	Gray/Brown fmc SAND, little (+) Gravel (Misc. Fill - brick).					2.2-3.9' BGS: NAPL coating soil grains, moderate/strong tar-like odor.
		SP						
		GP	Red CLAY.					
		SP	Brown/White fmc SAND, little (+) Gravel (pulverized rock).					
5	0	GP						
		SP	Brown mf SAND, trace f Gravel. Moist.	--	2		386	5-5.7' BGS: NAPL saturated, strong tar-like odor.
		GP	Green/White GRAVEL (pulverized quartz).					5.7-6.9' BGS: NAPL coating on soil grains, sheen throughout.
		SP	Brown/Black fmc SAND, trace Gravel.					5.9-6, 6.2-6.4, 6.6-6.7' BGS: NAPL saturated.
		SP	Tan/Beige SAND and GRAVEL.					6.9-7.4': Sheen extending from saturated soil grains.
			ALLUVIAL DEPOSITS Black fm SAND. Wet to saturated.					
10	-5	SP	**OUTWASH DEPOSITS**	--	3		52.4	
		GP	Tan/Beige mfc SAND, little (+) f Gravel. Wet to saturated.					10.8-10.9' BGS: Tacky NAPL coating on soils, sheen.
								11.2-11-5' BGS: NAPL saturated (tacky).
								11.7, 11.8' BGS: Lenses of tacky NAPL.
15	-10	SP	Tan/Orange mfc SAND. Wet to saturated.	--	4		7.0	11.8 to 12.3': Sheen extending from saturated soil grains.
								15.9' BGS: Black stained soils.
								16.05-16.1' BGS: Lenses of tacky NAPL, moderate tar-like odor.
20	-15	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet to saturated.	--	5		10.1	Sample SB-122-20-22 collected and submitted for laboratory analysis.
								20.65-20.75' BGS: Lenses/bands of NAPL coated soils, moderate tar-like odor.
25	-20	SP	Tan/Beige mcf SAND. Wet.	--	6		0.0	Sample SB-122-25-27 collected and submitted for laboratory analysis.

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-123 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 219315.0 ft. Northing: 1255222.3 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP SP	**FILL** Brown cmf SAND, little (-) Gravel, trace Organics. Gray fmc SAND, little (+) Gravel. Brown/Black fmc SAND, little (-) Gravel (Misc. Fill - brick), trace Organics. Gray/Brown fm SAND, trace (-) Gravel.	--	1		236	*Borehole backfilled with bentonite chips.* 1.1-1.9' BGS: Black stained soils, moderate tar-like odor. 1.9-3.2' BGS: NAPL coating on soil grains. 1.9-2.2' BGS: NAPL saturated, moderate tar-like odor.
5	0	SP	Gray/Brown fm SAND, trace (-) Gravel., trace Organics.	--	2		36.7	5-6.1' BGS: NAPL coating on soil grains, moderate tar-like odor. 6.1- 8.1' BGS: Sporadic blebs of NAPL and sheen concentrated around gravel.
		GP SP	**OUTWASH DEPOSITS** Tan cmf SAND and fmc GRAVEL. Wet.					
10	-5	SP	Tan/Orange fmc SAND, trace (+) fmc Gravel. Wet.	--	3		4.7	Sample SB-123-15-17 collected and submitted for laboratory analysis. 11.2' BGS: Few NAPL blebs on coarse grained material. 11.9-12, 12.6' BGS: Bands of black staining, slight NAPL coating, sheen, moderate tar-like odor.
15	-10	SP	Orange/Tan fm SAND, trace Gravel.	--	4		24.9	15-15.6' BGS: Sheen, sporadic black staining. 15.6-16' BGS: NAPL coating, sheen, moderate tar-like odor. 16-16.5' BGS: NAPL saturated.
20	-15	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet.	--	5		0.0	16.5-16.9' BGS: Sheen. 16.9-17.2' BGS: NAPL saturated. Sample SB-123-20-22 collected and submitted for laboratory analysis.
25	-20			--	6		0.0	
30								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-124 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.7 ft.	Easting: 219314.8 ft. Northing: 1255246.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP GP	**FILL** Gray/Brown cmf SAND, some Gravel.	--	1					11.9	0.7-1.7' BGS: Slight tar-like odor. *Borehole backfilled with bentonite chips.* 2.1-2.2' BGS, 3.3'-3.9' BGS: Black staining, moderate to strong tar-like odor. Sample SB-124-2-4 collected and submitted for laboratory analysis.
		SP GP	Black cmf SAND, little (+) fm Gravel (Misc. Fill - cinders). Moist.								
		SP GP	Brown/Tan mfc SAND, trace f Gravel. Moist to wet.								
	0										
5		SP GP	**OUTWASH DEPOSITS** Lt. Gray fm SAND, little fm Gravel.	--	2					4.2	6-7' BGS: Sporadic black staining. Moderate/faint tar-like odor.
		GP	Lt. Gray/Tan cmf SAND and GRAVEL.								
		SP SP GP	Lt. Tan/Beige cm SAND, little (-) fm Gravel. Wet.								
	-5										
10		SP GP	Orange/Tan mcf SAND, little (-) f Gravel. Wet to saturated.	--	3					0.2	
											12.9' BGS: Few NAPL blebs and sheen on soil grains. Moderate tar-like odor.
	-10										
15		SP	Orange/Tan fmc SAND. Wet to saturated.	--	4					0.0	
	-15										
20				--	5					0.0	
											Sample SB-124-22-24 collected and submitted for laboratory analysis.
	-20										
25											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-125 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219279.0 ft. Northing: 1255206.5 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (-) Gravel, trace Organics. Gray fmc SAND, some (+) Gravel. Dk. Brown/Black cmf SAND, little (+) Gravel (Misc. Fill - brick, cinders).	--	1					1.3	*Borehole backfilled with bentonite chips.* 0-5' BGS: Faint tar-like odor.
5	0	SP	Brown mfc SAND, trace (+) mf Gravel. Wet.	--	2					0.1	5-6' BGS: Sheen on soil grains and on water, faint tar-like odor.
10	-5	SP	**OUTWASH DEPOSITS** Tan/Orange mfc SAND, trace (+) fm Gravel. Wet. Iron staining.	--	3					0.3	12-12.4' BGS: Faint tar-like odor.
15	-10	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet.	--	4					0.3	15.4-15.8' BGS: Very few spots of NAPL coated soils (tacky), faint tar-like odor.
20	-15	SP	Tan/Brown fmc SAND, trace (-) f Gravel.	--	5					9.5	20.7-20.8' BGS: Band of soils coated with tacky NAPL. 20.8-21.2' BGS: Sheen extending from saturated soils, but not within soil core when broken apart.
25	-20	SP	Tan/Orange mfc SAND, trace (+) f Gravel. Wet. Fe staining.	--	6					0.0	Sample SB-125-20-22 collected and submitted for laboratory analysis. Sample SB-125-25-27 collected and submitted for laboratory analysis.
30	-25										

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-126 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.5 ft.	Easting: 219284.2 ft. Northing: 1255240.4 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP	**FILL** Gray/Brown cmf SAND, some Gravel, trace Organics. Dk. Brown/Black fmc SAND, little (+) fmc Gravel (Misc. Fill - brick, cinders, wood). Moist.	--	1		152	*Borehole backfilled with bentonite chips.* 1.9-2.4' BGS: Sheen, moderate tar-like odor. 1.9-2.4' BGS: Sheen on grains, moderate tar-like odor.
	0							
5		SP GP	Brown mfc SAND, little (+) f Gravel.	--	2		324	2.9-3' BGS: NAPL coating sand and gravel, tacky to touch, moderate to strong tar-like odor. 5-6.8' BGS: NAPL coated/saturated, moderate tar-like odor. 8.1' BGS: NAPL saturated. 8.1-8.3' BGS: Black stained soils.
	-5	GP SP	**OUTWASH DEPOSITS** Tan/Brown SAND and GRAVEL. Moist to wet.					
10		SP GP	Tan/Brown cmf SAND, little (+) fmc Gravel. Wet.	--	3		18.5	8.3' BGS: Sporadic sheen and black staining throughout, moderate tar-like odor. 11.7, 11.9-12.1, 12.2-12.4' BGS: Spots of sheen and black staining, moderate tar-like odor.
	-10							
15		SP	Orange/Tan fmc SAND. Wet.	--	4		0.0	15-20' BGS: Spots of sheen on sides of core, but not inside core when broken apart. Sample SB-126-5-7 collected and submitted for laboratory analysis.
	-15							
20		SP	Tan/Beige fmc SAND, trace f Gravel. Wet to saturated.	--	5		0.0	Sample SB-126-22-24 collected and submitted for laboratory analysis.
	-20							
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-127 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.8 ft.	Easting: 219268.1 ft. Northing: 1255247.6 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP	**FILL** Lt. Brown/Gray fmc SAND, little (+) cmf Gravel, trace Organics. Brown/Dk. Brown fmc SAND, little Gravel (Misc. Fill - brick, cinders, glass).	--	1		28.3	*Borehole backfilled with bentonite chips.* 1.8-3.1' BGS: Faint to moderate tar-like odor. 2.8-3.1' BGS: Sheen (especially surrounding coarser grained material).
	0							
5		SP	Dk. Brown/Gray cmf SAND, trace (+) Gravel (Misc. Fill - cinders, brick).	--	2		76.1	5-5.7' BGS: Sheen, moderate tar-like odor. 5.7'-6 BGS: NAPL saturated, moderate tar-like odor. 6-6.6' BGS: Sporadic sheen, black stained soils. 6.8' BGS: Sheen on outside of soil core, but not inside core when broken apart.
		SP SP SM GP SP	**ALLUVIAL DEPOSITS** Beige fmc SAND. Wet. Brown fm SAND, little Silt. **OUTWASH DEPOSITS** Beige/Tan SAND and GRAVEL.					
	-5							
10		SP	Tan fm SAND. Wet to saturated.	--	3		2.3	10-15' BGS: Sporadic spots of sheen extending from saturated soils Sample SB-127-5-7 collected and submitted for laboratory analysis.
	-10							
15		SP	Tan/Orange fmc SAND. Saturated.	--	4		0.0	15-20' BGS: Spots of sheen on outside of soil core, but not inside core when broken apart.
	-15							
20				--	5		0.0	Sample SB-127-22-24 collected and submitted for laboratory analysis.
	-20							
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-128 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219245.1 ft. Northing: 1255247.0 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP	**FILL** Gray/Brown fmc SAND, little (+) Gravel, trace Organics. Black/Gray fmc SAND, little (+) Gravel (Misc. Fill - brick, cinders). Moist to wet. Tan/Brown fm SAND, trace (+) fm Gravel. Wet.	--	1					6.9	*Borehole backfilled with bentonite chips.* 2-3' BGS: Minor black staining, faint tar-like odor.
5	0	SP GP	Black/Gray fmc GRAVEL (pulverized rock), little (-) Sand. Wet. Gray/Black cmf SAND, little (-) Gravel.	--	2					60.3	5-6' BGS: Black stained soils, slight tar-like odor. 6.9' BGS: Soils heavily coated with NAPL. 7.9' BGS: Sheen extending from saturated soils, faint tar-like odor.
		ML CL SP GP GP	**ALLUVIAL DEPOSITS** Dk. Brown SILT and CLAY, little Organics. Lt. Gray fmc SAND, little (+) Gravel (rounded). Spots of tidal marsh @ 7.0 and 7.1'.								
10	-5	SP SP	**OUTWASH DEPOSITS** Gray SAND and GRAVEL. Wet. Tan/Lt. Brown mfc SAND, trace (-) f Gravel.	--	3					17.5	10-10.4' BGS: Sheen. 11.1-11.2' BGS: Minor black staining, faint tar-like odor.
15	-10	SP	Tan/Lt. Brown mfc SAND, trace (-) fm Gravel. Wet to saturated.	--	4					19	15-15.4' BGS: Black stained soils, moderate tar-like odor. 15.8-16' BGS: Black stained soils. 15.9-16' BGS: Bands of soil heavily coated with NAPL. 16-17.5' BGS: Sheen extending from saturated soils.
20	-15	SP	Tan/Orange mfc SAND, trace (+) fm Gravel. Wet.	--	5					10.9	20.2' BGS: Bands of soils coated with tacky NAPL, sheen, faint tar-like odor. Sample SB-128-20-22 collected and submitted for laboratory analysis.
25	-20	SP	Tan/Orange mfc SAND. Wet. Iron staining.	--	6					0.0	Sample SB-128-25-27 collected and submitted for laboratory analysis.
30	-25										

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-129 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 219243.2 ft. Northing: 1255226.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP SP GP	**FILL** Brown fm SAND, little Gravel, trace Organics. Gray fm SAND, little Gravel. Gray/Black fmc SAND, little (+) Gravel (Misc. Fill - brick, cinders). Gray/Tan mfc SAND, little Gravel.	--	1		282	*Borehole backfilled with bentonite chips.* 3.6' BGS: Sheen, slight tar-like odor.
5	0	SP GP	Black cmf SAND, little (+) mf Gravel (Misc. Fill - cinders). Wet.	--	2		40.2	5-5.3' BGS: Sheen, slight tar-like odor. 6' BGS: NAPL coated soils. 6.2-6.4' BGS: NAPL saturated soils. 6.4-7.5' BGS: Sheen and NAPL blebs throughout. 6.8' BGS: Soils heavily coated with NAPL.
			ALLUVIAL DEPOSITS					
		SP SM	Brown f SAND and SILT, trace Organics. Brown fm SAND, trace f Gravel. Wet.					
		SP	**OUTWASH DEPOSITS**					
		GP SP	Tan/Beige cmf SAND and GRAVEL.					
10	-5	SP GP	Tan/Orange mfc SAND, little (-) fm Gravel. Wet to saturated.	--	3		45.6	
15	-10	SP GP	Tan fmc SAND, little (+) fm Gravel. Wet.	--	4		132	15.7-16' BGS: Bands and spots of NAPL coated soils (tacky), moderate tar-like odor. 16-17.3' BGS: Sheen extending from saturated soils.
20	-15	SP	Tan/range fmc SAND. Wet. Iron staining.	--	5		65.8	22.05' BGS: Thin band of stringy NAPL with sheen surrounding it, faint tar-like odor.
25	-20			--	6		0.0	Sample SB-129-22-24 collected and submitted for laboratory analysis. Sample SB-129-26-28 collected and submitted for laboratory analysis.
30								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-130 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.4 ft.	Easting: 219256.9 ft. Northing: 1255207.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**	--	1		3	*Borehole backfilled with bentonite chips.*
		GP	Brown fmc SAND, little Gravel, trace Organics.					
		SP						
		GP	Gray cmf SAND, some fmc Gravel. Moist.					
		SP	Black/Red/Gray fmc SAND, little (+) Gravel (Misc. Fill - brick, cinders, pulverized rock). Moist.					2.3-2.6' BGS: Minor black staining, faint tar-like odor.
		GP						
		SP						
5	0		Gray/Brown mf SAND, trace f Gravel.	--	2		73.1	5-5.6' BGS: Minor black staining, faint tar-like odor.
		GP	Black/Gray fm GRAVEL, little (-) Sand.					5.6-6' BGS: Soils heavily coated with NAPL.
		SP	**ALLUVIAL DEPOSITS**					6.2-7.9' BGS: Sheen and spots of black staining, slight to moderate tar-like odor.
		ML	Dk. Brown SILT and CLAY, little Organics.					
		CL	**OUTWASH DEPOSITS**					
		SP	Tan/Gray mfc SAND, trace fm Gravel.					
		SP	Tan/Lt. Brown cmf SAND, some (+) fmc Gravel. Wet.					
10	-5	GP						
		SP	Tan/Orange mfc SAND, trace (+) fm Gravel. Wet.	--	3		6.7	10-15' BGS: Faint tar-like odor.
15	-10	SP	Tan/Orange fmc SAND, trace (-) f Gravel.	--	4		6.7	15.9' BGS: Lens/band of black stained soil, slightly coated with NAPL. Sample SB-130-16-18 collected and submitted for laboratory analysis.
20	-15	SP	Tan/Orange mfc SAND. Wet.	--	5		0.0	17.2' BGS: Thin band of tacky NAPL. 17.2-17.8' BGS: Sheen extending from saturated soils. Sample SB-130-20-22 collected and submitted for laboratory analysis.
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-131 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 219265.3 ft. Northing: 1255226.0 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP	**FILL** Brown/Gray fmc SAND, little (+) fm Gravel, trace Organics. Gray/Dk. Gray cmf SAND, little (+) cmf Gravel (Misc. Fill - brick, cinders). Moist to wet. Gray/Brown fm SAND, little (-) f Gravel.	--	1		59.7	*Borehole backfilled with bentonite chips.* 1.2-2' BGS: Slight NAPL coating on soil grains, slight tar-like odor. 2-5.4' BGS: Heavy NAPL coating on soils, moderate tar-like odor.
5	0	ML CL SP ML CL	**ALLUVIAL DEPOSITS** Brown SILT & CLAY, little (+) Organics. Tan/Beige mfc SAND. Wet. Brown SILT & CLAY, little (+) Organics. **OUTWASH DEPOSITS**	--	2		3.8	5.6-6.4' BGS: Sheen. 5.6-8.1' BGS: Slight sheen, faint tar-like odor.
10	-5	SP GP SP GP	Tan/Beige cmf SAND, some (+) fmc Gravel. Wet to saturated, Tan/Orange cmf SAND, some (+) fmc Gravel. Tan/Orange mfc SAND, little (+) fmc Gravel. Wet.	--	3		60.4	10.95' BGS: Band of tacky NAPL. 11.3, 11.6, 11.65 and 11.8' BGS: Spots of NAPL coated soils and sheen.
15	-10	SP	Tan/Orange mfc SAND, trace f Gravel. Wet to saturated.	--	4		14.7	15.6-15.75' BGS: Band of NAPL coated soils, slight tar-like odor. 5.75-16.3' BGS: Sheen. 16.3-16.4' BGS: Band of NAPL saturated soils. 16.4-17.3' BGS: Sheen.
20	-15	SP	Tan/Beige mfc SAND. Wet to saturated.	--	5		11.9	20.95-21' BGS: Bands of soils heavily coated with NAPL. Sample SB-131-21-23 collected and submitted for laboratory analysis.
25	-20	SP	Tan/Orange mfc SAND. Wet.	--	6		0.0	21.55-21.7' BGS: NAPL saturated soils. 21.85' BGS: Band of soil heavily coated with NAPL. 22' BGS: Spots of NAPL coated soils. 22.2-22.3' BGS: Spots of NAPL coated soils, sheen.
30	-25							Sample SB-131-25-27 collected and submitted for laboratory analysis.

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-132 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219258.0 ft. Northing: 1255223.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
		SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (+) Gravel, trace Organics. Gray/Black cmf SAND, little (+) Gravel (Misc. Fill - brick, cinders). Moist. Brown mf SAND. Black fmc GRAVEL, little Sand.	--	1					11.9	*Borehole backfilled with bentonite chips.* 1.9-2.4' BGS: Sporadic black staining, faint tar-like odor. 2.4-2.6' BGS: Soils slightly coated with NAPL.
5	0	GP SP ML CL SP GP	Black fmc GRAVEL, little Sand, trace Organics. Tan/Beige mfc SAND, trace f Gravel. **ALLUVIAL DEPOSITS** Brown SILT & CLAY, little Organics. **OUTWASH DEPOSITS** Tan/Orange cmf SAND, little (+) fmc Gravel. Wet.	--	2					104	5-5.4' BGS: NAPL saturated soils. 5.4-6.1' BGS: Sheen throughout, few bands of soils coated with NAPL. 6.3-7.9' BGS: Sheen, few spots of black staining.
10	-5	SP GP	Tan/Orange mfc SAND, little (+) fmc Gravel. Wet.	--	3					1.3	
15	-10	SP	Tan fmc SAND, trace (+) f Gravel. Wet.	--	4					13.1	15.7' BGS: Band of soils coated with NAPL, sheen, moderate tar-like odor. 15.7-17.5' BGS: Sheen. 17.5' BGS: Slight tar-like odor.
20	-15	SP SP	Tan/Orange fmc SAND, trace (+) fmc Gravel. Orange/Tan cmf SAND, trace fmc Gravel. Wet.	--	5					17.5	21.6-21.7' BGS: NAPL saturated soils (slightly tacky). 21.7-22.4' BGS: Sheen extending from saturated soils, several NAPL blebs extending from soils.
25	-20	SP	Tan/Orange mf SAND. Wet.	--	6					0.0	Sample SB-132-21-23 collected and submitted for laboratory analysis. Sample SB-132-25-27 collected and submitted for laboratory analysis.
30	-25										

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-133 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.3 ft.	Easting: 219380.1 ft. Northing: 1255207.8 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**	--	1		2.8	*Borehole backfilled with bentonite chips.*
		GP	Brown cmf SAND, little Gravel (Misc. Fill - brick, cinders), trace Organics.					0.9-2.8' BGS: Faint tar-like odor.
		GP						
		SP	Gray fm GRAVEL, little c Sand.					
		SP	Brown/Tan cmf SAND, trace Gravel, trace Silt, trace Organics.					
	0							
5		SP	Brown/Lt. Brown mfc SAND, little (-) fm Gravel. Wet.	--	2		0.7	
		GP						6.1-6.65' BGS: Spots of sheen on grains, faint tar-like odor.
		SP	**OUTWASH DEPOSITS**					
		GP	Brown/Lt. Brown mfc SAND, some (-) fm Gravel. Wet.					
		SP						
	-5	GP	Brown/Lt. Brown mfc SAND, little (-) fm Gravel. Wet.					
10		SP	Beige/Tan mfc SAND, trace (-) fmc Gravel. Wet.	--	3		0.0	
	-10							
15		SP	Tan/Orange fmc SAND, trace f Gravel. Wet.	--	4		0.9	15' BGS: Small spots of sheen.
								16-3.16.8' BGS: Slight sheen on saturated soils.
								Sample SB-133-15-17 collected and submitted for laboratory analysis.
	-15							
20		SP	Tan/Beige mfc SAND, trace f Gravel. Wet.	--	5		0.0	
								Sample SB-133-22-24 collected and submitted for laboratory analysis.
	-20							
25								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-134 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/6/10 - 10/6/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 219342.7 ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT	Vert Datum: NAVD88	Northing: 1255114.4 ft.
			Ground Surface Elev: 5.1 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL** Dk. Brown fmc SAND, little (+) Gravel, trace Organics. Wet.		1		0.0	*Borehole backfilled with bentonite chips.*
		SP	Brown mfc SAND, little (-) fm Gravel. Moist to wet.					
			Beige mfc SAND, little (-) fm Gravel. Moist to wet. Iron staining.					
5	0	SP	Beige mfc SAND, trace fm Gravel. Wet to saturated.		2		0.0	Sample SB-134-5-7 collected and submitted for laboratory analysis.
10								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-135 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/6/10 - 10/6/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 219363.5 ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT	Vert Datum: NAVD88	Northing: 1255105.7 ft.
			Ground Surface Elev: 5.4 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	ppm Readings (ppm)	Remarks
	5	SP	**FILL**		1					0.0	*Borehole backfilled with bentonite chips.*
		SP	Dk. Brown fm SAND, little Organics.								
		GP	Brown/tan mfc SAND, trace (+) fm Gravel.								
		SP									
		GP	Beige mfc SAND, little (+) fm Gravel. Wet.								
5	0	SP	Beige/tan mfc SAND, little (-) fm Gravel. Wet.		2					0.0	Sample SB-135-5-7 collected and submitted for laboratory analysis.
		GP									
10											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-136 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/6/10 - 10/6/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 219374.5 ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT	Vert Datum: NAVD88	Northing: 1255120.6 ft.
			Ground Surface Elev: 5.6 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	ppm Readings (ppm)	Remarks
	5	SP	**FILL** Dk. Brown fm SAND, trace Gravel, tace Organics.		1		0.0	*Borehole backfilled with bentonite chips.*
		SP	Brown fmc SAND, trace fm Gravel, trae (-) Organics. Wet.					
		SP	Beige fmc SAND, trace fm Gravel, trae (-) Organics. Wet.					
5	0	SP GP	Tan/beige mfc SAND, little (-) fm Gravel. Wet.		2		0.0	Sample SB-136-5-7 collected and submitted for laboratory analysis.
10								

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-1A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	8.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/21/12 - 3/21/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255177.4 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219314.6 ft.
			Ground Surface Elev: 6.3 ft.	TOC Elev: 8.1 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well (Stick Up)	ppm Readings (ppm)	Remarks
		SM	**FILL**	2-5-15-12			75.0	
	5	SC	Brown mf SAND, some Organics, little Silt. Pulverized concrete.					0.9-2' BGS: Moderate to strong odor.
		SW	Black mf SAND and mf GRAVEL (cinders & slag). Saturated w/ water @ 2.7'.	8-9-7-4			0.4	*0-1.5' BGS: Cement-bentonite grout*
		SM	Black mf SAND, trace Silt.					*1.5-2' BGS: Bentonite Plug*
		SM MH	Black mf SAND, some Silt.	6-5-6-6				*2-7.5' BGS: Filter pack (#1 Filpro Sand)*
5			No Recovery.					*2.5-7.5' BGS: PVC Screen (0.020" Slot)*
	0	SP	Dark brown mfc SAND, trace Gravel (rounded granite and granite flakes).	7-9-11-15			0.0	

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-1B** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/21/12 - 3/21/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255178.7 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219305.9 ft.
			Ground Surface Elev: 5.9 ft.	TOC Elev: 8.9 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well (Stick Up)	ppm Readings (ppm)	Remarks
	5	SW	**FILL**	19-10-10-5			0.0	
		SP	Brown-black mfc SAND, some Organics (roots, grass).					
		SM	Pulverized red-brown concrete.	2-4-3-7			0.0	
		SP	Reddish-black mf SAND, trace (-) Gravel. Pieces of red brick present. Mosit @ 1.7'.					
		GP	Black mf SAND, little Silt, trace Organics.	14-8-3-4				
5		SP	Saturated w/ water @ 3'.					
	0		Black c SAND and f Gravel (cinders and brick present).					*0-10' BGS: Cement-bentonite grout*
		SW		1-1-5-7			0.0	
		GP	Black mf SAND trace Gravel, trace (-) Silt. No recovery.					
		SW	**OUTWASH DEPOSITS**	17-12-8-11			0.0	
		GW	Brown mfc SAND, little (-) mf Gravel. Tan mfc SAND, little (+) Gravel (rounded qtz).					
10		SW		10-5-3-3			0.0	
	-5	GW	Brown mfc SAND, some Gravel (rounded qtz).					*10-12' BGS: Bentonite Plug*
		SP	Tan-orange mf SAND, trace (-) Gravel.	1-2-4-4			0.0	
		SP	Tan-grey mf SAND, trace (-) Gravel.					
				2-2-2-3			0.0	
15								*12-19' BGS: Filter pack (#1 Filpro Sand)*
	-10							
		SP	Tan-grey-beige mf SAND, trace Gravel. @ 17.1' BGS shell present w/ iron staining.	3-4-6-7			0.0	*14-19' BGS: PVC Screen (0.020" Slot)*
		SP	Tan-grey-beige mf SAND, little Gravel.	3-2-4-5			0.0	
		GP						
20								

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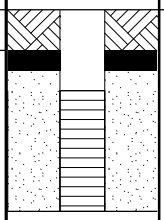
WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-2A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	5.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: No Sampling	Development Method:
3/22/12 - 3/22/12	ADT	**Hammer Type:** 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:		
Shawn Miller	HSA	CME 1500	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 5.8 ft.	**Easting:** 1255197.8 ft. **Northing:** 219330.2 ft. **TOC Elev:** 8.8 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Well	ppm Readings (ppm)	Remarks
5	5		Refer to PZ-2B boring log for description of soil.								*0-1' BGS: Cement-bentonite grout.* *1-1.5' BGS: Bentonite seal.* *1.5-5' BGS: Filter pack.* *2-5' BGS: PVC Screen (0.020" Slot)*

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-2B** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	18.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/22/12 - 3/22/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255209.7 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219332.1 ft.
			Ground Surface Elev: 5.3 ft.	TOC Elev: 8.3 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well	ppm Readings (ppm)	Remarks
		SP	**FILL** Brown mf SAND, little Organics (roots, grass), trace (-) Gravel. Specs of red brick present.	16-16-9-10			0.0	
		SP GP						
		SW	Pulverized concrete.	4-6-4-5			0.1	*0-6' BGS: Cement bentonite grout.*
		SM	Black mf SAND, some Gravel (cinders). Moist.					2.9-3.4' BGS: Slight tar-like odor.
		SP		2-3-2-1			72.1	4-4.3' BGS: Slight tar-like odor.
5	0	OH	Grey-beige mfc SAND, trace (-) Gravel (rounded qtz). Saturated w/ water @ 2.0'.					4.6-6' BGS: Black staining on some grains. Tar-like odor. Oily sheen on water.
		SW	**ALLUVIAL DEPOSITS**	1-1-3-3			7.0	*6-8' BGS: Bentonite seal.*
		SP	Grey-beige mfc SAND, little Silt, trace Organics, trace (-) Gravel (rounded qtz).					7' BGS: NAPL on surface of wood.
		SM	Color change to beige-tan @ 3.4'.	1-5-4-6			67.0	8-8.5' BGS: Black staining. Oily sheen on water.
		SP	Brown-biege mf SAND, trace Gravel.					8.5-10' BGS: Black staining. Moderate odor. NAPL coating on large grains.
		SW GP	Brown ORGANICS, little mf SAND.					*8-15' BGS: Filter pack.*
10	-5		Brown-beige mfc SAND.	3-3-3-5			7.0	*10-15' BGS: PVC Screen (0.020" Slot)*
		SP	Brown-beige mf SAND, trace (-) Organics (1" thick pcs of wood).					12-12.9' BGS: Oily sheen on grains and water. Tar-like odor.
			OUTWASH DEPOSITS	8-7-5-5			27.1	14-16' BGS: Slight odor. Slight staining.
			Black mf SAND, little Silt.					16-18' BGS: Black NAPL flecs w/ tacky, tar-like texture. Leaves residue on gloves. No odor.
		SW	Brown-beige mf SAND.					
		GP	Brown mfc SAND, some (-) Gravel.	7-3-3-4			13.0	
		SP	Brown-beige mf SAND. Mica flecs present.					
15	-10	GW	Brown-tan mfc SAND, some (-) Gravel.					
		SW	Brown-tan mc SAND and mfc GRAVEL (rounded qtz).	5-9-6-7			1.1	
			Tan-orange mfc SAND.					

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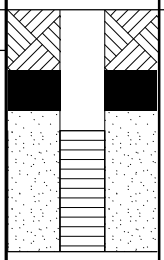
WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-3A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	6.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: No Sampling	Development Method:
3/23/12 - 3/23/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:		
Shawn Miller	HSA	CME 1500	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 5.0 ft.	**Easting:** 1255240.1 ft. **Northing:** 219241.1 ft. **TOC Elev:** 8.8 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Well	ppm Readings (ppm)	Remarks
5	0		Refer to PZ-3B boring log for description of soil.								*0-1.5' BGS: Cement bentonite grout.* *1.5-2.5' BGS: Bentonite seal.* *2.5-6' BGS: Filter pack.* *3-6' BGS: PVC Screen (0.020" Slot)*

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WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-3B** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
3/22/12 - 3/22/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255252.2 ft.
Shawn Miller	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219240.4 ft.
			Ground Surface Elev: 5.0 ft.	TOC Elev: 8.9 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Well	ppm Readings (ppm)	Remarks
		SP GP SP	**FILL** Dark brown mf SAND, little Gravel, little Organics, little (-) Silt.	16-8-5-7			0.0	
		GP	Crushed/pulverized concrete.	7-5-5-4			0.0	*0-9' BGS: Cement bentonite grout.*
		SP GP	Black fm SAND, some Gravel (red brick), little (-) Silt. Moist.					
		SP	Grey-beige mc SAND, some m Gravel (angular).	2-2-2-2			0.0	4-6' BGS: Slight tar-like odor.
5	0	GP SP	Black fmc SAND, little (+) m Gravel. Wet.					
		GP SW	Wood. Grey-black mc SAND, little m Gravel (cinders). Wet to saturated. Saturated w/ water @ 4.0'.	1-2-4-8			35.0	6-6.8' BGS: Black staining on grains. Sheen on spoon. Black/reddish-brown NAPL blebs (sand sized).
		SP		3-5-5-4			19.5	6.8' BGS: 1/2" NAPL lens across core.
		SW	**OUTWASH DEPOSITS** Brown-beige mfc SAND.					8-8.6' BGS: Strong odor. Heavy, oily sheen on water in spoon.
10	-5	GW SW	Grey-beige mf SAND, trace (-) mf Gravel (rounded qtz).	3-6-4-3			2.6	8.6-10' BGS: Heavy NAPL staining on largest grains. Strong odor.
		GP SW	Grey-beige mfc SAND and mfc GRAVEL.					*9-11' BGS: Bentonite seal.*
		GP	Grey-brown mfc SAND, some f Gravel. Tan-brown mfc SAND, some f Gravel (rounded qtz)	5-5-5-4			4.5	10-10.1' BGS: Sheen on grains.
				13-5-6-4			3.0	10.1' BGS: 1/2" Tacky/thick NAPL lens across core.
15	-10	SW	Tan-orange mfc SAND.					10.7-12' BGS: Strong tar-like odor.
		SW	Tan-orange mfc SAND, trace (-) Gravel (rounded).	10-5-7-6			4.7	*11-18' BGS: Filter pack.*
		SW	Tan-orange mfc SAND.	4-5-6-4			9.1	14.8' BGS: Thin NAPL lens across core.
20	-15							*13-18' BGS: PVC Screen (0.020" Slot)* 18-20' BGS: Slight tar-like odor.

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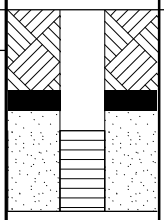
WELL LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:**	**Well No.** **PZ-4A** **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
N. Batarags/Allendale, NJ	RLO	8"	2" PVC	0.020"	5.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: No Sampling	Development Method:
5/23/12 - 5/23/12	ADT	Hammer Type: 140lb Auto	Surge and Pump

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255365.3 ft.
Chris Miglione	HSA	CME 1500	Vert Datum: NAVD88	Northing: 219236.5 ft.
			Ground Surface Elev: 5.0 ft.	TOC Elev: 4.8 ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Well (Traffic Rated Vault Box)	ppm Readings (ppm)	Remarks
5	0		Refer to PASB-45 / MW-4D boring log soil description.								*0-2' BGS: Concrete well vault (flush mount).* *2-2.5' BGS: Bentonite seal.* *2.5-5' BGS: Filter pack.* *3-5' BGS: PVC Screen (0.020" Slot)*

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-201 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	3"	NA	NA"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/8/14 - 5/8/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255313.3 ft.
C. Migliore	Direct-Push	Geoprobe® 7720DT	Vert Datum: NAVD 88	Northing: 219241.8 ft.
			Ground Surface Elev: 5.0 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
0		SW	Asphalt	N/A						2.3	*Boring backfilled with bentonite.*
		SP	**FILL** Discolored black cmf SAND, some (-) mf Gravel (including coal/coke material). Dry.								
			ALLUVIAL DEPOSITS								
		SW	Discolored black/dark brown mf SAND, some Silt, some (-) Organic (wood debris). Moist.	N/A						7.2	1.8-3.5' BGS: Slight to moderate organic-like odor. 3.5-4.5' BGS: Slight organic-like odor. 4.5-4.8' BGS: Black stringy, tacky viscous, tar-like material. Moderate naphthalene-like odor. Slight sheen on acetate liner. 4.8-5.8' BGS: Slight organic-like odor.
5		SW									
		SP	Discolored black cmf SAND, some Silt, some (+) Organics (wood debris). Moist to Saturated at 3.5' BGS.								
		SP	Discolored black cmf SAND, some Silt, some (+) Organics (wood debris). Saturated.								
		SW	Brown mf SAND, little (-) Silt. Saturated.								
		GP	Discolored black ORGANICS (wood debris). Saturated.								
10			Light brown/grey mf SAND, trace Silt. Saturated.								
			OUTWASH DEPOSITS Brown/red brown cmf SAND and mf GRAVEL, trace (-) Silt. Saturated.								
15											
20											
25											
30											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-202 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	3"	NA	NA"	17.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/8/14 - 5/8/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255290.1 ft.
C. Migliore	Direct-Push	Geoprobe® 7720DT	Vert Datum: NAVD 88	Northing: 219242.9 ft.
			Ground Surface Elev: 4.9 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
		SW	Asphalt	NA						1.6	*Boring backfilled with bentonite.*
		SP	**FILL** Discolored black cmf SAND, some (+) mf Gravel (includes coal/coke material). Dry.								1.8-3.0' BGS: Slight organic-like odor.
		SP	**ALLUVIAL DEPOSITS** Discolored black mf SAND, little (+) mf Gravel, little (-) Organics (wood debris). Moist.	NA						18.9	4.0-5.1' BGS: Slight naphthalene-like odor.
5	0	SW	Discolored black mf SAND, some (-) Organics (wood debris (soft material)), little (-) mf Gravel. Moist to Saturated @ 3.5' BGS.								5.3-5.5' BGS: Black viscous, tacky, stringy tar-like material partially coating sand grains. Moderate naphthalene-like odor.
			Same as above.								5.8-6.1' BGS: Black viscous, tacky, stringy tar-like material partially coating sand grains. Moderate naphthalene-like odor.
			Discolored black Organics (wood debris), little mf SAND, trace f Gravel. Saturated.								
10	-5	SW/GW	Brown cmf SAND, little mf Gravel, trace Silt. Saturated.	NA						2.8	9.0-9.3' BGS: Sporadic sheen visible on sand grains within soil core and on acetate liner.
			Same as above.								
			OUTWASH DEPOSITS								
		SP	Brown cmf SAND and cmf GRAVEL. Saturated.	NA						1.3	
			Brown/red brown mf SAND, trace (-) f Gravel. Saturated.								
15	-10										
20											
25											
30											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-203 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	3"	NA	NA"	13.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/8/14 - 5/8/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255335.8 ft.
C. Migliore	Direct-Push	Geoprobe® 7720DT	Vert Datum: NAVD 88	Northing: 219243.6 ft.
			Ground Surface Elev: 5.2 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	Readings (ppm)	Remarks
		SW	Asphalt	NA			1.7	*Boring backfilled with bentonite.*
			FILL Discolored black cmf SAND, some (+) mf Gravel (includes coke/coal material), trace Silt. Dry.					
		SP	**ALLUVIAL DEPOSITS**	NA			7.2	
		SP	Slightly discolored brown/black mf SAND,					
		SP	little (+) mf Gravel. Moist to Saturated @					3.8-4.0' BGS: Strong naphthalene-like odor. Slight sheen visible on gravel surfaces.
5	0	SP	3.0' BGS.					4.0-4.3' BGS: Slight naphthalene-like odor.
		SW	Slightly discolored brown/black mf SAND, little (+) mf Gravel. Saturated.					
			Discolored black mf SAND, some (+) mf Gravel. Saturated.					
		SW/GP	Brown mf SAND, little f Gravel. Saturated.	NA			1.2	
			Brown cmf SAND, little (+) f Gravel.					
10	-5		Saturated.					
			OUTWASH DEPOSITS					
			Brown cmf SAND and mf GRAVEL, trace (-) Silt. Saturated.					
		SP	Brown mf SAND, trace (-) Gravel. Saturated.					
15								
20								
25								
30								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-204 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	3"	NA	NA"	9.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/8/14 - 5/8/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255343.1 ft.
C. Migliore	Direct-Push	Geoprobe® 7720DT	Vert Datum: NAVD 88	Northing: 219260.3 ft.
			Ground Surface Elev: 5.1 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
0		SP	Asphalt	NA						1.3	*Boring backfilled with bentonite.* No visible observations or odor indicative of MGP-related materials. 3.0-4.9' BGS: Slight organic-like odor.
		SP	**FILL** Discolored black mf SAND, some (+) cmf Gravel (includes coke/coal, brick, glass). Dry.								
		SP	Discolored black f SAND, some (-) Silt, little Organics (wood debris), trace f Gravel. Lime-like material @ 3.2' BGS. Moist to Saturated @ 3.8' BGS.	NA						1.6	
5	0	SP	**ALLUVIAL DEPOSITS** Discolored black ORGANICS (wood debris), little (+) mf SAND. Soft material. Saturated.								
		GW/SW	Brown/grey mf SAND, trace f Gravel. Saturated.								
10			**OUTWASH DEPOSITS** Grey/brown cmf GRAVEL and cmf SAND. Saturated.								
15											
20											
25											
30											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-205 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	3"	NA	NA"	8.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/8/14 - 5/8/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255346.7 ft.
C. Migliore	Direct-Push	Geoprobe® 7720DT	Vert Datum: NAVD 88	Northing: 219273.2 ft.
			Ground Surface Elev: 5.5 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
	5		Asphalt.	NA						0.4	*Boring backfilled with bentonite.* No visible observations or odor indicative of MGP-related materials.
		SW	**FILL** Discolored black cmf SAND, some (-) mf Gravel (included coal/coke, brick). Moist to Saturated @3.0' BGS.								
		SW	Discolored black cmf SAND, some (-) mf Gravel (included coal/coke, brick). Saturated @3.0' BGS.	NA						0.5	3.8-4.4' BGS: Slight decomposing organic-like odor.
5	0	SW	**ALLUVIAL DEPOSITS** Discolored black ORGANICS (root matter). Saturated.								
			Brown cmf SAND, little (-) f Gravel. Saturated.								
			Brown cmf SAND, some (+) mf Gravel. Saturated.								
10											
15											
20											
25											
30											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-206 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	3"	NA	NA"	12.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/8/14 - 5/8/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255337.8 ft.
C. Migliore	Direct-Push	Geoprobe® 7720DT	Vert Datum: NAVD 88	Northing: 219236.1 ft.
			Ground Surface Elev: 5.6 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
	5		Asphalt	NA						0.4	*Boring backfilled with bentonite.*
		SP	**FILL** Brown/discolored black mf SAND, some (+) mf Gravel (includes brick). Dry.	NA						11.7	
		SP	Brick (refusal) Discolored black mf SAND, little (+) f Gravel, trace Silt. Moist to Saturated @ 2.9' BGS.								3.5-4.0' BGS: Black tacky, viscous, stringy tar-like material partially coating wood and sand grains. Moderate naphthalene-like odor. Moderate sheen.
5	0		**ALLUVIAL DEPOSITS** Discolored black ORGANICS (wood debris), some mf SAND. Saturated.								
		SP	Brown mf SAND, little (-) Organics (wood debris). Saturated.	NA						1.4	4.0-4.9' BGS: Slight naphthalene-like odor.
		SW/GP	Brown mf SAND. Saturated.								
			OUTWASH DEPOSITS Brown cmf SAND and mf GRAVEL. Saturated.								
10	-5										
15											
20											
25											
30											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-207 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	8"	NA	NA"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
5/9/14 - 5/9/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255317.1 ft.
C. Migliore	Hollow Stem Auger	CME 85	Vert Datum: NAVD 88	Northing: 219233.6 ft.
			Ground Surface Elev: 4.8 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
0	4.8	SP	Asphalt	NA						0.0	*Boring backfilled with bentonite.*
			FILL Discolored black mf SAND, some (+) cmf Gravel (includes brick, coak/coal, glass). Dry to Moist.								
		SP	Brown/ discolored black mf SAND, little (+) f Gravel. Moist to Saturated @ 3.8' BGS.	1-H-1-H						1.2	4.4-5.0' BGS: Slight naphthalene-like odor. Slight sheen visible on sand grains.
5	0	SW									
		SW	**ALLUVIAL DEPOSITS** Black discolored cmf SAND, some (-) Organics (wood debris). Saturated.	2-4-6-4						0.0	5.0-5.2' BGS: Slight naphthalene-like odor.
		SP									
		SP/GP	Black discolored cmf SAND, some (-) Organic (wood debris). Saturated.	7-6-4-6						0.0	
		SP	Brown mf SAND, little (-) f Gravel. Saturated.								
	-5	SW/GP	Same as above.								
10			**OUTWASH DEPOSITS** Brown mf SAND and mf GRAVEL. Saturated. Brown/grey mf SAND, little (-) f Gravel. Saturated. Brown/red brown cmf SAND and mf Gravel. Saturated.								
15											
20											
25											
30											

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-208 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	8"	NA	NA"	11.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon Hammer Type: NA	Development Method:
5/9/14 - 5/9/14	ADT, Inc.		NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD 88 Ground Surface Elev: 4.9 ft.	Easting: 1255290.9 ft. Northing: 219234.1 ft. TOC Elev: NA ft.
C. Migliore	Hollow Stem Auger	CME 85		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int / Recovery / Lithology / Backfill	Readings (ppm)	Remarks
		SP	Asphalt	NA			0.2	*Boring backfilled with bentonite.*
		SP	**FILL** Discolored black mf SAND, some (+) mf Gravel (includes coal/coke material). Dry to Saturated @ 3.0' BGS.					
		SP	**ALLUVIAL DEPOSITS**	1-2-1-4			1.2	3.0-3.7' BGS: Slight organic-like odor.
		SP	Discolored black mf SAND, some (+) Organics (wood debris). Saturated.					4.0-4.1' BGS: Strong organic-like odor.
5	0	SP	Brown mf SAND, little (-) Organic (wood debris). Saturated.	2-4-2-1			9.3	5.0-5.6' BGS: Slight organic-like odor.
		SP	Piece of wood.					5.6-5.8' BGS: Black stringy, tacky tar-like material partially coating sand grains and wood. Strong naphthalene-like odor.
		SW/GW	Brown mf SAND, little (-) Organics (wood debris). Saturated.	6-4-3-4			0.4	
		SW	Discolored black mf SAND and ORGANICS (wood debris). Saturated.	7-4-6-5			0.0	
10	-5		**OUTWASH DEPOSITS** Brown cmf SAND and cmf GRAVEL. Saturated. Brown cmf SAND, some (-) mf Gravel. Saturated.					
15								
20								
25								
30								

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-209 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	8"	NA	NA"	11.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
5/9/14 - 5/9/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255286.4 ft.
C. Migliore	Hollow Stem Auger	CME 85	Vert Datum: NAVD 88	Northing: 219327.3 ft.
			Ground Surface Elev: 5.2 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
		SP	Asphalt	NA						0.0	*Boring backfilled with bentonite.*
		SP	**FILL** Brown mf SAND, some (-) cmf Gravel (brick). Dry.								1.1-2.6' BGS: Slight treated wood (wood polish-like) odor
		SP	Discolored black mf SAND, some (-) cmf Gravel (coal/coak, brick, glass), some Organics (treated wood- possible railroad tie). Dry to Moist.	4-4-2-2						1.2	2.9' BGS: Specs of sheen on surface of water in borehole.
5	0	SP	Discolored black mf GRAVEL, some (-) mf Sand. Moist to Saturated @ 2.9' BGS.	2-4-2-2						0.4	3.0-3.3' BGS: Moderate naphthalene-like odor, moderate sheen on sand grains.
		SP	Discolored black mf GRAVEL, some (-) mf Sand. Saturated.	4-4-4-3						0.3	3.3-3.8' BGS: Slight naphthalene-like odor.
		SP	**ALLUVIAL DEPOSITS** Discolored black mf SAND, little (-) f Gravel. Saturated.	4-4-5-4						0.5	
10	-5	SP	Dark grey mf SAND. Saturated. Dark grey mf SAND. Saturated. Dark brown mf SAND, some (-) Organic (wood debris), little (+) f Gravel. Saturated. Same as above.								
			OUTWASH DEPOSITS Brown mf SAND, little f Gravel. saturated. Same as above.								
15											
20											
25											
30											

P:\National_Grid\Patchogue\OffSite_Inv\Boring_Logs

BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-210 **Page** 1 **of** 1

Inspector/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
BFT/Albany, NY	JLM	8"	NA	NA"	31.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Split Spoon	Development Method:
5/9/14 - 5/9/14	ADT, Inc.	Hammer Type: NA	NA

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255321.5 ft.
C. Migliore	Hollow Stem Auger	CME 85	Vert Datum: NAVD 88	Northing: 219257.4 ft.
			Ground Surface Elev: 5.2 ft.	TOC Elev: NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
			Split-spoon samples not collected. Refer to PASB-41 boring log for description of soils.								*Boring backfilled with cement/bentonite grout. Boring hand cleared to 3.5' BGS.*
5	0										
10	-5										15-31' BGS: Soils recovered from 15-31' BGS had a slight napthalene-like odor likely due to the potential transport of impacted groundwater during drilling process from shallower intervals of the borehole.
15	-10	SW	Brown/red brown cmf SAND, trace (-) f Gravel. Saturated.	2-3-2-2						0.0	
		SW	Same as above.	3-4-2-2						0.0	
		SW	Brown cmf SAND. Saturated.	4-4-2-4						0.3	
20	-15	SW	Brown cmf SAND. Saturated.	5-6-7-5						0.1	
		SW	Same as above.	7-8-6-7						0.0	
		SW	Dark brown cmf SAND. Saturated.								
25	-20	SW	Brown cmf SAND, little (-) f Gravel. Saturated.	4-4-2-4						0.0	
			No Recovery.	2-4-5-7						--	
			No. Recovery.	4-2-3-4						--	
30	-25										

P:\National_Grid\Patchogue\OffSite_Inv\Boring_Logs

BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 142128 **Project Location:** Patchogue, NY	**Permit Number:** NA	**Boring No.** SB-211 **Page** 1 **of** 1

Inspector/Office	**Checked By:**	**Borehole Diameter:**	**Screen Diameter and Type:**	**Slot Size:**	**Total Boring Depth (ft)**
BFT/Albany, NY	JLM	8"	NA	NA"	11.0 ft.

Start/Finish Date	**Drilling Contractor:**	**Sampling:** Split Spoon	**Development Method:**
5/9/14 - 5/9/14	ADT, Inc.	**Hammer Type:** NA	NA

Driller:	**Drilling Method:**	**Drilling Equipment:**		
C. Migliore	Hollow Stem Auger	CME 85	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD 88 **Ground Surface Elev:** 5.6 ft.	**Easting:** 1255292.4 ft. **Northing:** 219222.3 ft. **TOC Elev:** NA ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Graphic Log: Sample Int	Graphic Log: Recovery	Graphic Log: Lithology	Graphic Log: Backfill	Readings (ppm)	Remarks
	5	SP	Asphalt	NA						0.0	*Boring backfilled with bentonite.*
		SP	**FILL** Discolored black mf SAND, some (+) mf Gravel (includes coke/coal, glass, brick). Dry.								2.6-4.7' BGS: Slight naphthalene-like odor, slight organic-like odor.
5	0	SP	**ALLUVIAL DEPOSITS** Brown mf SAND, little (-) f Gravel, little (-) Organics (wood debris). Moist to Saturated @ 4.7' BGS.	2-4-2-3						0.0	5.0-8.6' BGS: Slight naphthalene-like odor.
		SP	Brown mf SAND, trace f Gravel, little Organics (wood debris). Saturated.								
		SW	Brown cmf SAND, little (-) f Gravel. Saturated.	4-5-7-6						1.4	
		SW	Discolored black cmf SAND. Saturated.								
		SW	Brown cmf SAND. Saturated.	6-6-7-6						0.2	
10	-5	SW	**OUTWASH DEPOSITS** Brown cmf SAND and mf GRAVEL. Saturated.								
15											
20											
25											
30											

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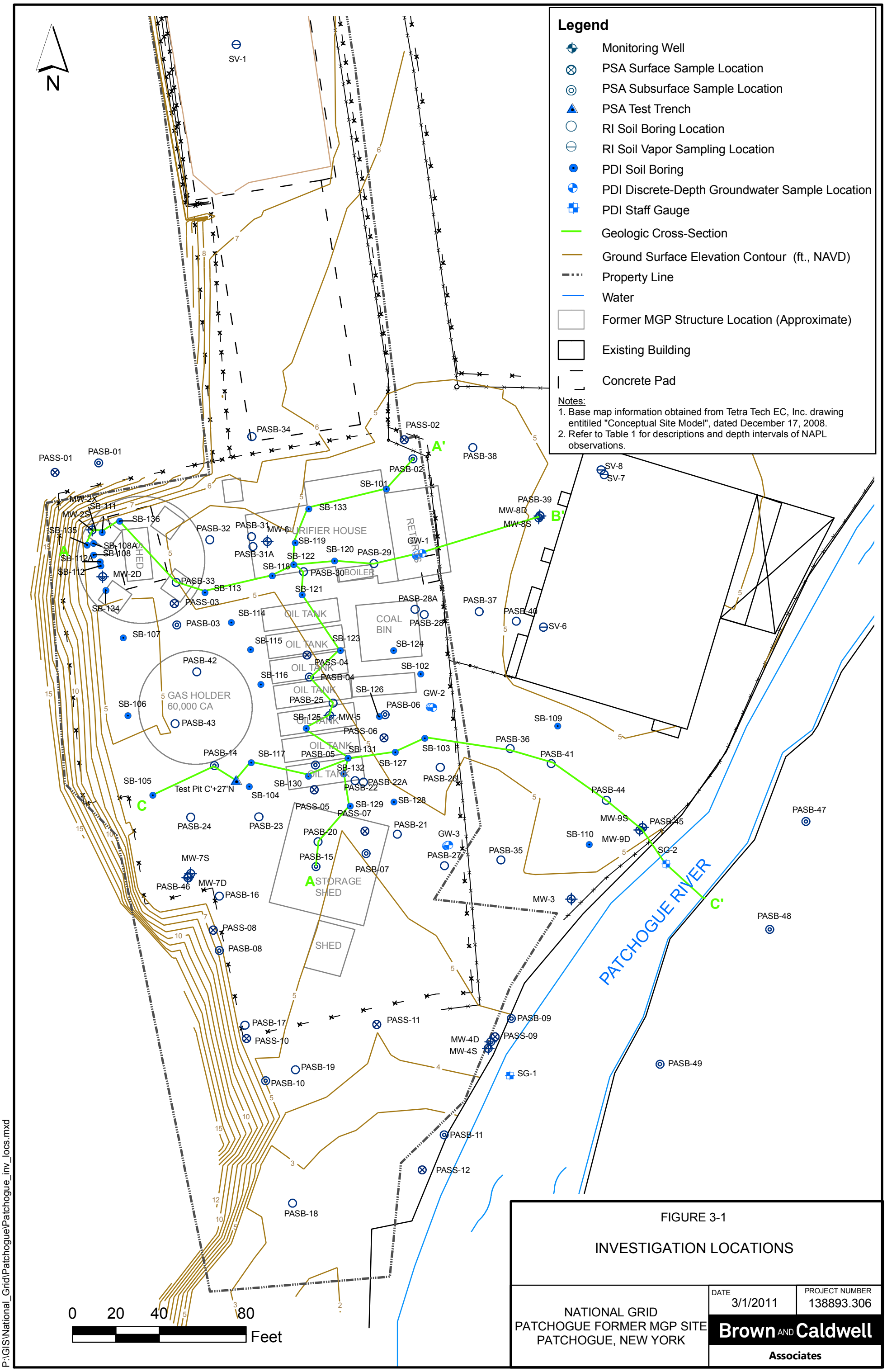
APPENDIX D

FOCUSED FEASIBILITY STUDY REFERENCE FIGURES


N
Legend
Monitoring Well
PSA Surface Sample Location
PSA Subsurface Sample Location
PSA Test Trench
RI Soil Boring Location
RI Soil Vapor Sampling Location
PDI Soil Boring
PDI Discrete-Depth Groundwater Sample Location
PDI Staff Gauge
Geologic Cross-Section
Ground Surface Elevation Contour (ft., NAVD)
Property Line
Water
Former MGP Structure Location (Approximate)
Existing Building
Concrete Pad
Notes:
1. Base map information obtained from Tetra Tech EC, Inc. drawing entitiled "Conceptual Site Model", dated December 17, 2008.
2. Refer to Table 1 for descriptions and depth intervals of NAPL observations.
SV-1
PASS-01
PASB-01
PASB-34
PASS-02
PASB-38
SV-8
SV-7
PASB-39
MW-8D
MW-8S
MW-2D
MW-2S
SB-111
SB-136
SB-135
SB-108A
SB-108
SB-112A
SB-112
SB-134
PASB-32
PASB-31
MW-6
PURIFIER HOUSE
SB-119
PASB-31A
SB-122
SB-120
PASB-29
GW-1
RETORT
SB-118
PASB-30
BOILER
SB-101
SB-133
PASB-33
SB-113
SB-121
PASS-03
PASB-28A
PASB-37
PASB-40
SV-6
SB-114
OIL TANK
COAL BIN
PASB-28
PASB-03
SB-107
SB-115
OIL TANK
SB-123
SB-124
PASB-42
PASS-04
SB-116
PASB-04
SB-102
OIL TANK
SB-126
GW-2
PASB-25
PASB-06
SB-106
GAS HOLDER 60,000 CA
PASB-43
SB-125
MW-5
OIL TANK
SB-109
PASS-06
PASB-36
PASB-14
SB-117
PASB-05
SB-131
SB-103
PASB-41
SB-127
SB-132
OIL TANK
PASB-26
SB-105
Test Pit C'+27'N
SB-130
PASB-22A
PASB-22
SB-104
PASB-44
PASS-05
SB-129
SB-128
PASS-07
PASB-47
PASB-24
PASB-23
PASB-21
MW-9S
PASB-45
PASB-20
GW-3
SB-110
MW-9D
MW-7S
PASB-15
PASB-27
PASB-35
SG-2
PASB-07
STORAGE SHED
PASB-46
MW-7D
PASB-16
MW-3
PASB-48
PASS-08
PASB-08
SHED
PASB-17
PASS-11
PASB-09
PASS-10
MW-4D
MW-4S
PASS-09
PASB-19
PASB-49
SG-1
PASB-10
PASB-11
PASS-12
PASB-18
A
A'
B
B'
C
C'
PATCHOGUE RIVER
0 20 40 80
Feet
FIGURE 3-1
INVESTIGATION LOCATIONS
NATIONAL GRID
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK
DATE
3/1/2011
PROJECT NUMBER
138893.306
Brown AND Caldwell
Associates
P:\GIS\National_Grid\Patchogue\Patchogue_inv_locs.mxd

N

Legend

- Monitoring Well
- PSA Surface Sample Location
- PSA Subsurface Sample Location
- PSA Test Trench
- RI Soil Boring Location
- RI Soil Vapor Sampling Location
- PDI Soil Boring
- PDI Discrete-Depth Groundwater Sample Location
- PDI Staff Gauge
- NAPL/Tar observed in soil
- Ground Surface Elevation Contour (ft., NAVD)
- Property Line
- Water
- Former MGP Structure Location (Approximate)
- Existing Building
- Concrete Pad
- (17.2) Deepest indicator of NAPL/Tar in soil (ft, BGS)

Notes:
1. Base map information obtained from Tetra Tech EC, Inc. drawing entitiled "Conceptual Site Model", dated December 17, 2008.
2. Refer to Table 1 for descriptions and depth intervals of NAPL observations.

SV-1 SV-2 SV-3 SV-4 SV-5 SV-6 SV-7 SV-8

PASS-01 PASS-02 PASS-03 PASS-04 PASS-05 PASS-06 PASS-07 PASS-08 PASS-09 PASS-10 PASS-11 PASS-12

PASB-01 PASB-02 PASB-03 PASB-04 PASB-05 PASB-06 PASB-07 PASB-08 PASB-09 PASB-10 PASB-11 PASB-14 PASB-15 PASB-16 PASB-17 PASB-18 PASB-19 PASB-20 PASB-21 PASB-22 PASB-23 PASB-24 PASB-25 PASB-26 PASB-27 PASB-28 PASB-28A PASB-29 PASB-30 PASB-31 PASB-31A PASB-32 PASB-33 PASB-34 PASB-35 PASB-36 PASB-37 PASB-38 PASB-39 PASB-40 PASB-41 PASB-42 PASB-43 PASB-44 PASB-45 PASB-46 PASB-47 PASB-48 PASB-49

SB-101 SB-102 SB-103 SB-104 SB-105 SB-106 SB-107 SB-108 SB-108A SB-109 SB-110 SB-111 SB-112 SB-112A SB-113 SB-114 SB-115 SB-116 SB-117 SB-118 SB-119 SB-120 SB-121 SB-122 SB-123 SB-124 SB-125 SB-126 SB-127 SB-128 SB-129 SB-130 SB-131 SB-132 SB-133 SB-134 SB-135 SB-136

MW-2D MW-2S MW-2X MW-3 MW-4D MW-4S MW-5 MW-6 MW-7D MW-7S MW-8D MW-8S MW-9D MW-9S

GW-1 GW-2 GW-3 SG-1 SG-2

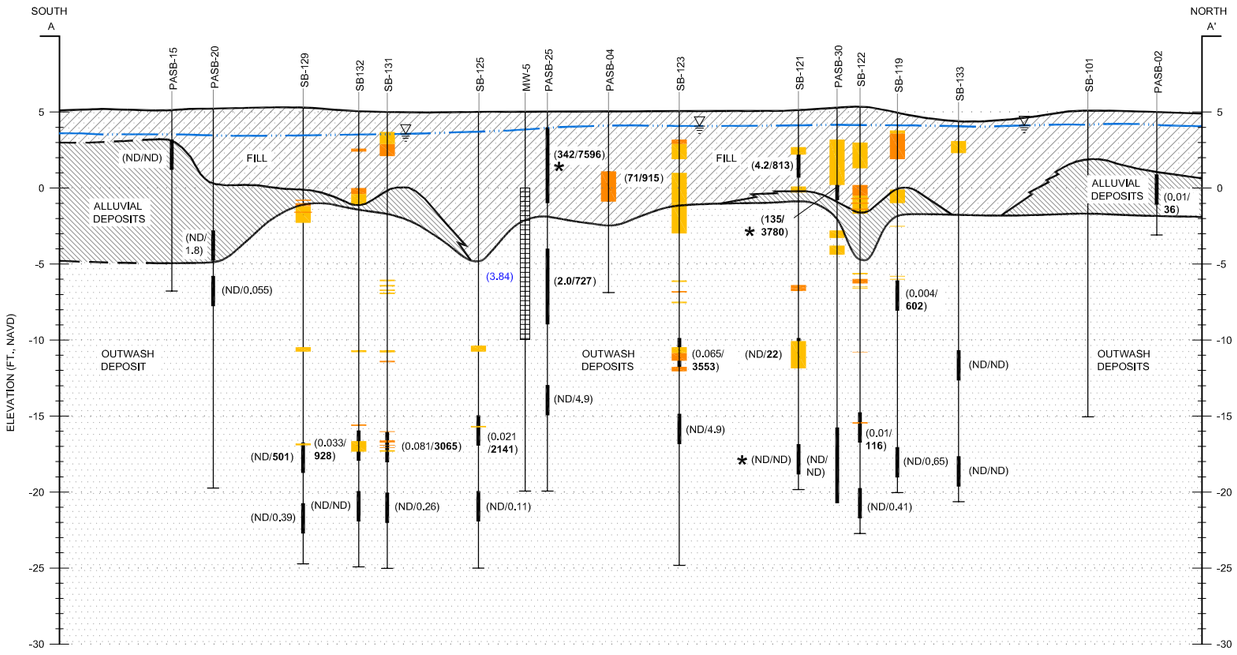
Test Pit C'+27'N

PURIFIER HOUSE
RETORT
BOILER
OIL TANK
OIL TANK
OIL TANK
OIL TANK
OIL TANK
COAL BIN
GAS HOLDER 60,000 CA
SHED
SHED
STORAGE SHED
PATCHOGUE RIVER

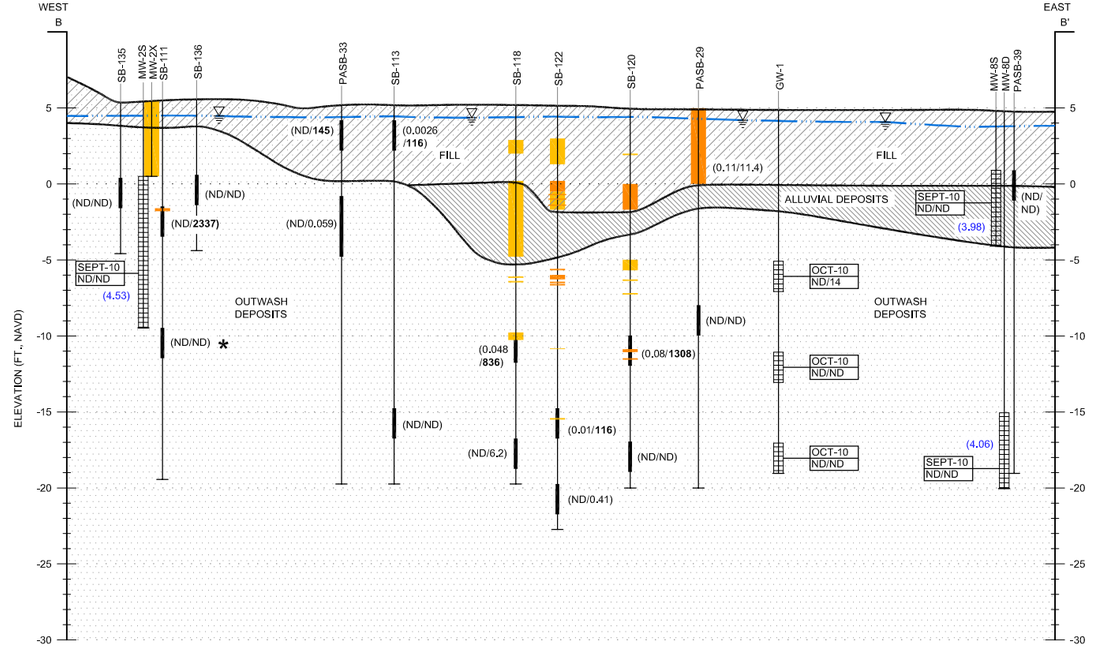
0 20 40 80 Feet

FIGURE 3-2	
NAPL/TAR OBSERVATIONS	
NATIONAL GRID PATCHOGUE FORMER MGP SITE PATCHOGUE, NEW YORK	DATE 01/03/11 PROJECT NUMBER 138893.305
	Brown AND Caldwell Associates

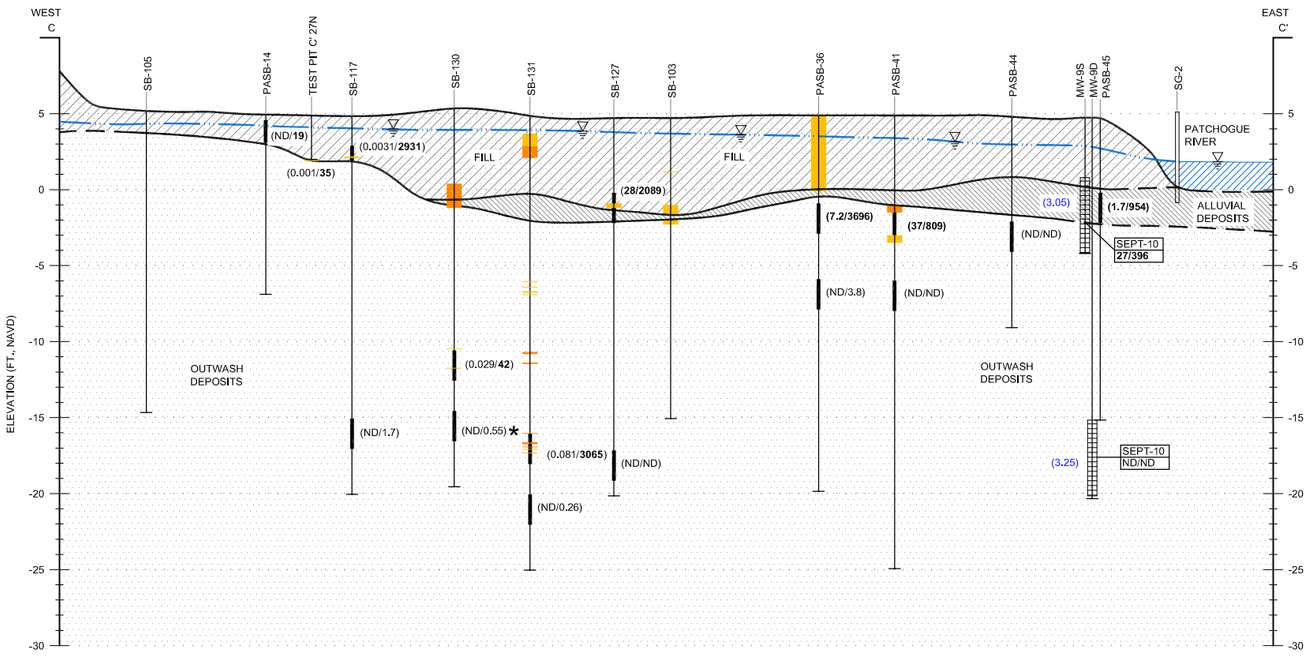
P:\GIS\National_Grid\Patchogue\Patchogue_NAPL_obs.mxd



CROSS SECTION A-A'



CROSS SECTION B-B'



CROSS SECTION C-C'

LEGEND:

MW-7S — MONITORING WELL / SOIL BORING IDENTIFICATION AND APPROXIMATE LOCATION

GENERALIZED GROUND SURFACE

WELL SCREEN INTERVAL

SEPT-10 ND/14 — TOTAL BTEX/TOTAL PAHS IN GROUNDWATER. VALUES REPORTED IN MICROGRAMS PER LITER (ug/L) BOLD VALUE INDICATES ONE OR MORE CONSTITUENT CONCENTRATIONS ABOVE CLASS GA CRITERIA.

INTERVAL/DISCRETE DEPTH WHERE NAPL/TAR OBSERVED IN SOIL. COLOR OF SYMBOL INDICATES DEGREE OF SATURATION. (DARK ORANGE -= HIGH, LIGHT ORANGE = LOW)

(ND/3,8) — TOTAL BTEX/TOTAL PAH (mg/kg) CONCENTRATION WITHIN SAMPLE INTERVAL. BOLD VALUE INDICATES ONE OR MORE CONSTITUENT CONCENTRATIONS ABOVE PART 375 UNRESTRICTED SOIL CLEANUP OBJECTIVES.

TOTAL DEPTH OF BOREHOLE

FILL

ALLUVIAL DEPOSITS

OUTWASH DEPOSITS

WATER TABLE (9/8/2010)

(3.05) — GROUNDWATER ELEVATION (FT., NAVD)

ABBREVIATIONS:

BTEX	BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE ISOMERS
PAH	POLYCYCLIC AROMATIC HYDROCARBONS
ND	NOT DETECTED
*	HIGHEST TOTAL BTEX OR TOTAL PAH VALUE LISTED FROM ORIGINAL AND DUPLICATE SAMPLE

0 5 10
SCALE IN FEET
VERTICAL

0 40 80
SCALE IN FEET
HORIZONTAL

FIGURE 3-3
GEOLOGICAL CROSS SECTIONS

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE: 5/11
PROJECT NUMBER: 138893.305

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\138893-PATCHOGUE\2-SHEETS\B-GEOTECHNICAL\FIG_3-3_GEOLOGICAL CROSS SECTIONS.DWG 05/06/2011 02:10:04PM By:rjames XREFS: Basemap Layout: Layout1

138893.305

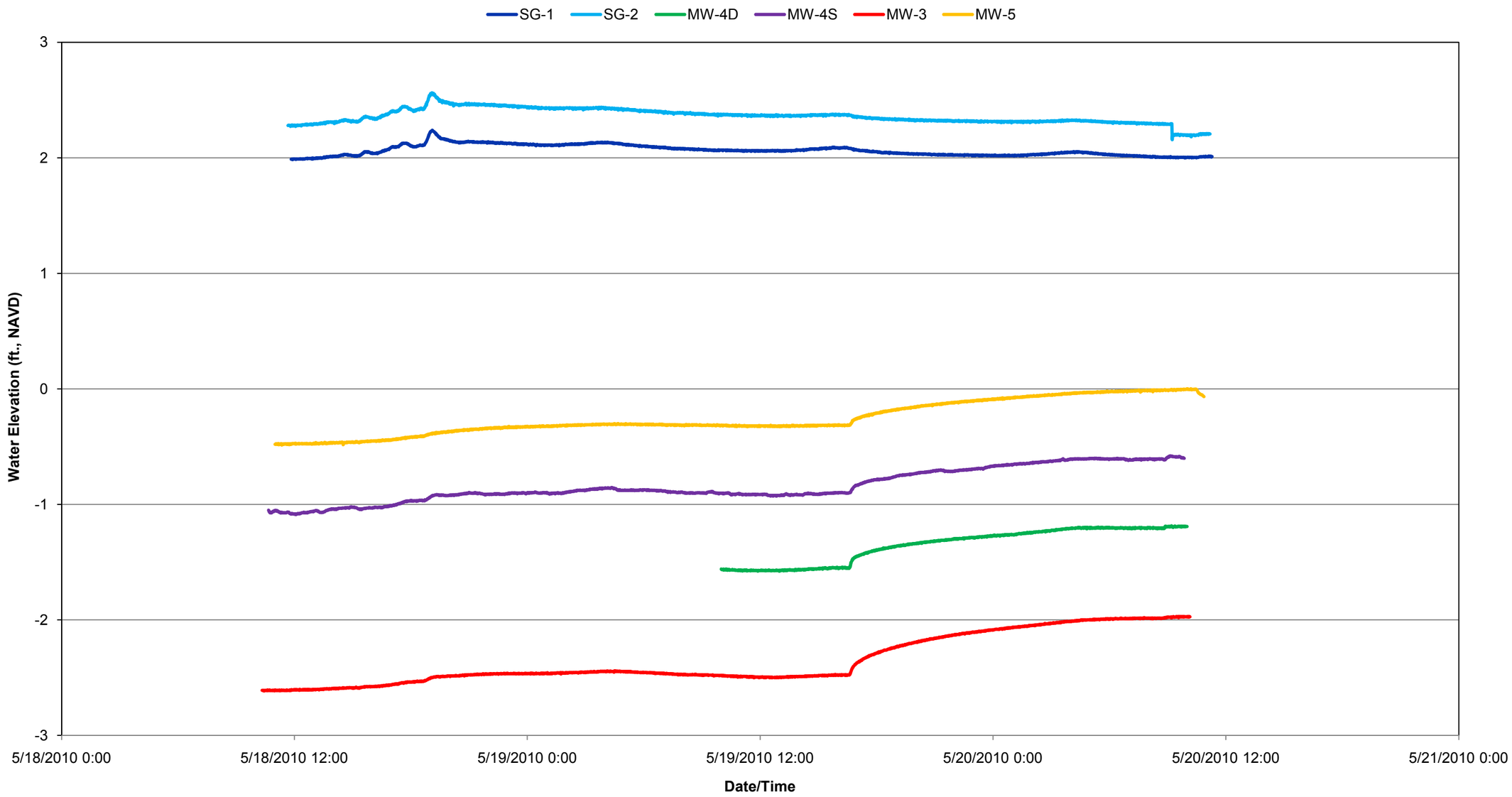


FIGURE 3-5

GROUNDWATER/ SURFACE WATER HYDROGRAPHS – CONTINUOUS MONITORING (MAY 18-20, 2010)

PATCHOGUE FORMER MGP SITE
PATCHOGUE NEW YORK

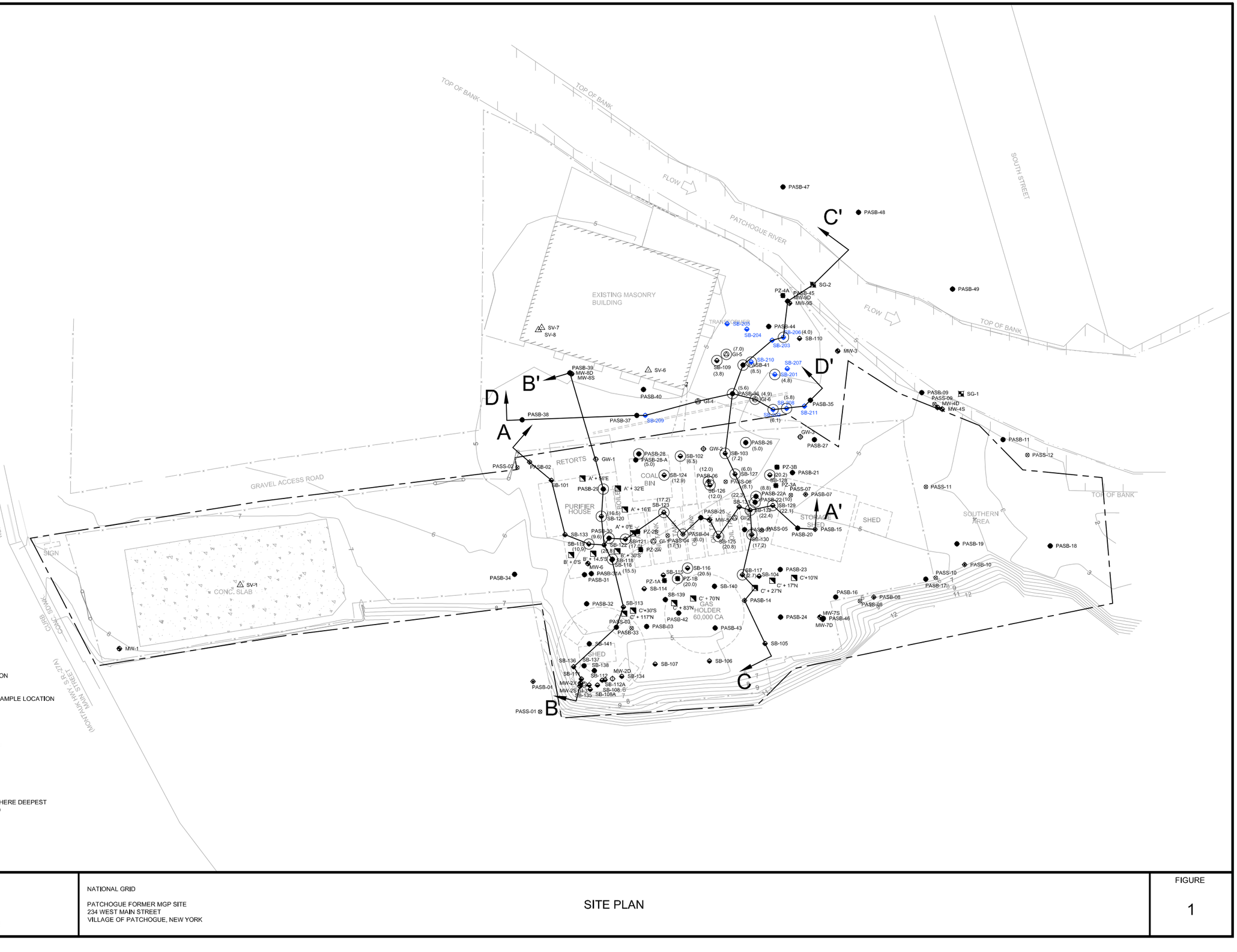
Brown AND Caldwell
Associates

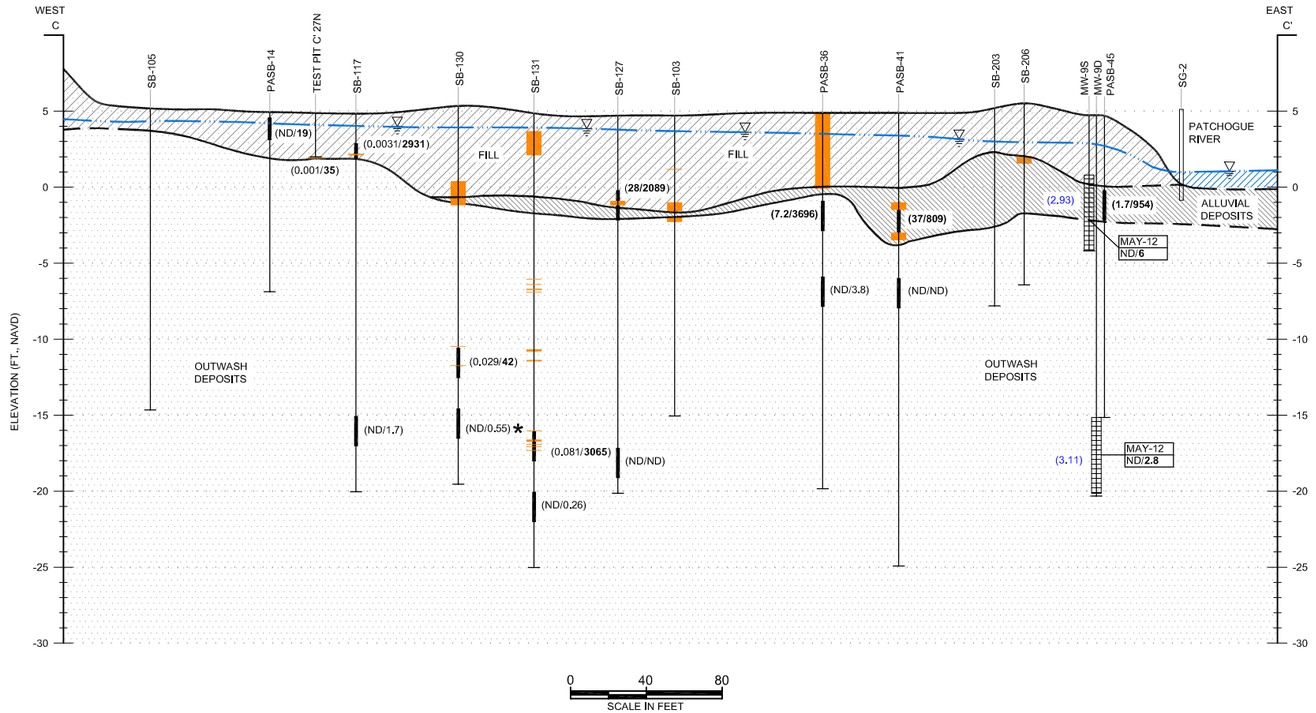
\\BCALL01\projects\National_Grid\Patchogue\GW_Monitoring\WL_Monitoring\GW_SW_interaction.ppt

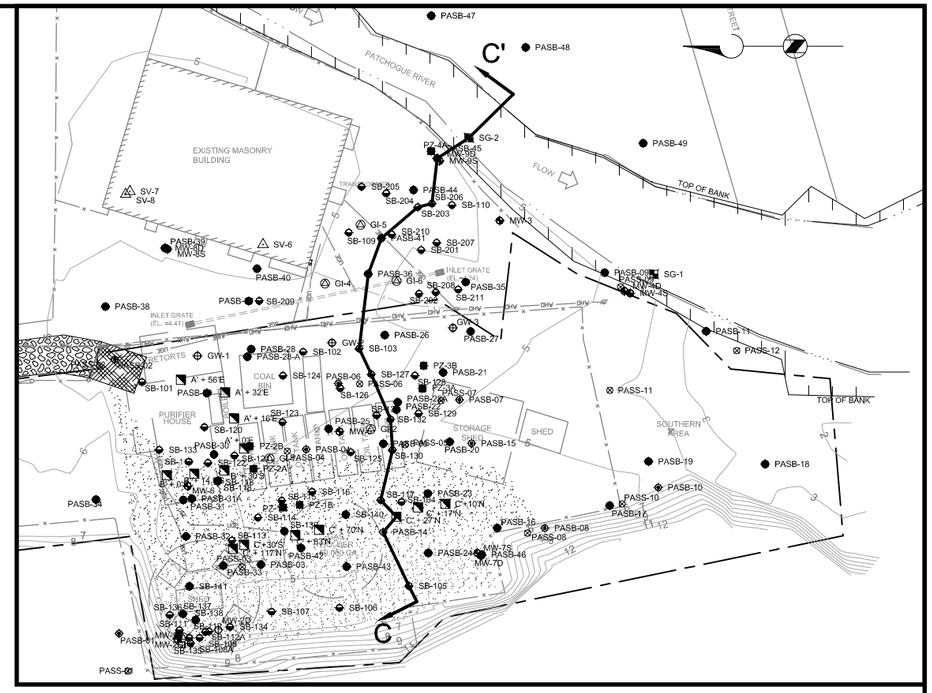
APPENDIX E

OFF-SITE INVESTIGATION REFERENCE FIGURES

0 30 60
SCALE IN FEET


TOP OF BANK
FLOW
PATCHOGUE RIVER
SOUTH STREET
EXISTING MASONRY BUILDING
TRANSFORMER
RETORTS
COAL BIN
PURIFIER HOUSE
GAS HOLDER 60,000 CA
STORAGE SHED
SHED
SOUTHERN AREA
GRAVEL ACCESS ROAD
WEST MAIN STREET
CONC. SLAB
CONC. SLAB
SIGN
(MONTAUK HWY. S.R. 27A) MAIN STREET
A
A'
B
B'
C
C'
D
D'
PASB-47
PASB-48
PASB-49
PASB-45
MW-9D
MW-9S
PZ-4A
SG-2
SB-208
SB-204
SB-206 (4.0)
SB-203
PASB-44
SB-110
MW-3
SB-210
SB-207
SB-201
(4.8)
PASB-39
MW-8D
MW-8S
SV-7
SV-8
SV-6
PASB-40
PASB-38
PASB-37
SB-209
PASB-35
SB-211
PASB-09
PASS-09
MW-4D
MW-4S
SG-1
PASB-11
PASS-12
PASS-11
PASB-26
(5.0)
PASB-27
GW-3
PASB-28
PASB-28-A
(5.0)
SB-102
(6.5)
SB-103
(7.2)
PZ-3B
PASB-21
PASS-07
PASB-07
PASB-22A
PASB-22
(10)
SB-123
(22.1)
SB-125
(20.8)
SB-130
(17.2)
PASB-15
PASB-20
PASB-19
PASB-18
PASB-10
PASS-10
PASB-17
PASB-16
PASB-08
PASB-23
SB-104
C'+10'N
C' + 17'N
C' + 27'N
PASB-14
PASB-24
MW-7S
MW-7D
PASB-46
SB-105
PASB-43
PASB-03
PASB-42
PASB-33
PASB-32
SB-113
C'+30'S
C' + 117'N
PASB-03A
SB-116
(20.5)
PZ-1B
(20.0)
PZ-1A
SB-114
SB-140
SB-139
C' + 70'N
C' + 83'N
SB-141
SB-136
SB-137
SB-138
SB-107
SB-106
MW-2D
SB-134
SB-112
SB-112A
SB-108
SB-108A
PASB-01
PASS-01
PASB-02
PASS-02
GW-1
A' + 16'E
A' + 32'E
A' + 0'E
B' + 14.5'S
B' + 30'S
B' + 0'S
PASB-28
PASB-28-A
(5.0)
SB-124
(12.9)
PASB-06
PASS-06
(6.1)
SB-126
(12.0)
SB-127
(20.2)
SB-128
(22.4)
PASB-22A
PASB-22
(10)
SB-123
(17.2)
PASB-25
MW-5
PASB-04
(6.0)
SB-121
(17.0)
PZ-2B
PZ-2A
GI-3
PASB-30
(9.6)
SB-133
(10.9)
SB-122
(17.0)
SB-120
(16.5)
SB-118
(15.5)
PASB-31
MW-6
PASB-34
SV-1
MW-1
PASB-01
PASS-01
SB-101
PASB-29
GI-1
(7.0)
SB-109
(3.8)
GI-5
(5.6)
PASB-36
(4.9)
GI-6
(5.8)
SB-208
SB-205
(6.1)
SB-41
(6.5)
GI-4
SB-202
SB-201
(4.8)
SB-203
SB-204
SB-206 (4.0)
SB-110
SB-207
SB-211
SB-210
SB-208
SB-205
SB-202
PZ-4A
PASB-45
MW-9D
MW-9S
SG-2
PASB-44
MW-3
PASB-35
PASB-09
PASS-09
MW-4D
MW-4S
SG-1
PASB-11
PASS-12
PASS-11
PASB-26
(5.0)
PASB-27
GW-3
GW-2




C'
C
PASB-47
PASB-48
PASB-49
PATCHOGUE RIVER
EXISTING MASONRY BUILDING
SG-2
SV-7
SV-8
SV-6
SB-205
SB-204
SB-203
SB-110
MW-3
GI-5
SB-109
SB-210
SB-207
SB-201
PASB-40
GI-4
SB-209
SB-208
SB-211
SB-212
SG-1
PASB-38
PASB-26
PASB-27
GW-1
SB-103
SB-102
PASB-28
PASB-28-A
PASB-21
SB-101
SB-124
PASB-06
SB-127
SB-129
SB-126
PASB-07
SB-128
SB-120
SB-123
SB-122
SB-121
SB-130
PASB-15
PASB-19
PASB-18
PASB-10
PASB-16
PASB-08
PASB-05
PASB-14
PASB-24
PASB-46
MW-7S
MW-7D
PASB-43
SB-105
SB-106
SB-107
SB-141
SB-137
SB-138
SB-134
SB-135
SB-136
SB-139
SB-140
SB-116
SB-117
SB-118
SB-119
SB-114
SB-115
SB-113
SB-112
SB-111
SB-142
SB-143
SB-144
SB-145
SB-146
SB-147
SB-148
SB-149
SB-150
SB-151
SB-152
SB-153
SB-154
SB-155
SB-156
SB-157
SB-158
SB-159
SB-160
SB-161
SB-162
SB-163
SB-164
SB-165
SB-166
SB-167
SB-168
SB-169
SB-170
SB-171
SB-172
SB-173
SB-174
SB-175
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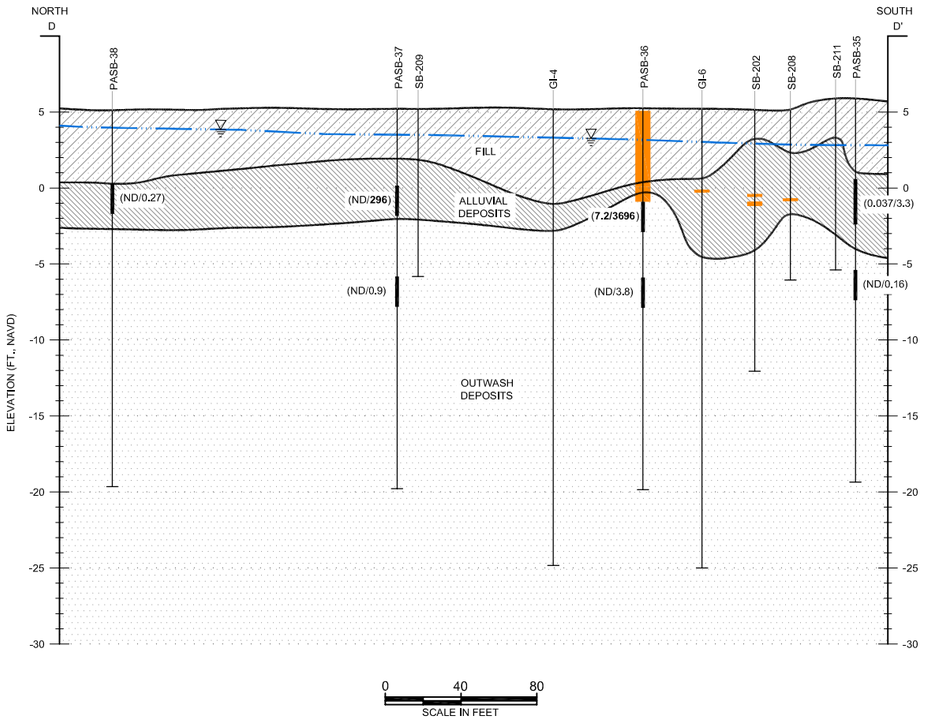

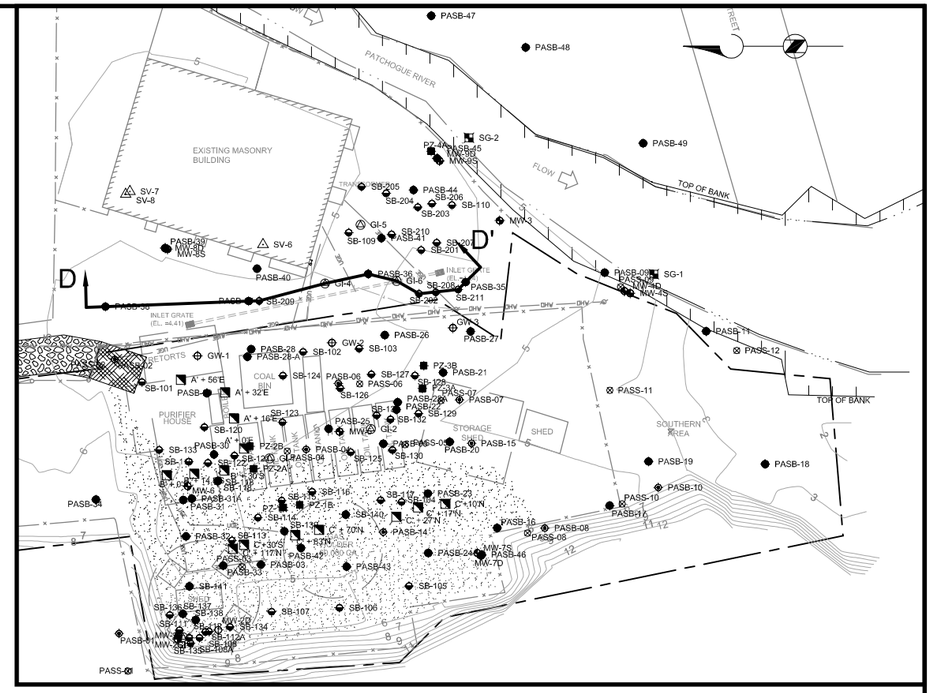
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APPENDIX F

EXCAVATION WORK PLAN

APPENDIX F – EXCAVATION WORK PLAN (EWP)

F-1 NOTIFICATION

At least 30 days prior to the start of any intrusive activity on the Site that is anticipated to encounter remaining MGP-related impacts, the Site owner or their representative will notify the NYSDEC. At least 30 days prior to the start of any intrusive activity to be conducted on the Off-Site Property, the Off-Site Property owner or their representative will notify National Grid. If an intrusive activity is to be conducted on the Site or the Off-Site Property that is not anticipated to encounter remaining MGP-related impacts (e.g., previously remediated area that has been restored with clean fill materials), notifications to NYSDEC are not required. Table 1 includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix B.

Table 1: Notifications*

Name	Contact Information
Elizabeth Lukowski, NYSDEC Project Manager	(518) 402-9564; eblukows@gw.dec.state.ny.us
Sarah Aldridge, National Grid Project Manager	(516) 545-2568 sarah.aldridge@national grid.com

* Note: Notifications are subject to change and will be updated as necessary.

National Grid will generate the notification to NYSDEC via Notice of Intrusion Letter. This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for intrusive activities to be conducted on the Site or the Off-Site Property, re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control;

- A detailed description of dewatering, proposed containment of dewatering liquids and planned disposal options for dewatering liquids, if applicable;
- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of intrusive work;
- A summary of the applicable components of this EWP;
- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120;
- A copy of the contractor's HASP, in electronic format, if it differs from the HASP provided in Appendix G of this ISMP;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with required chemical testing results.

F-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based (e.g. photoionization detector) soil screening will be performed by a Qualified Environmental Professional contracted by National Grid to oversee invasive activities on the Site and the Off-Site Property during all excavations into known or potentially contaminated material (remaining MGP-related impacts). Soil screening will be performed when invasive work is done and will include excavation and invasive work into known or potentially contaminated material performed during development, such as excavations for foundations and utility work.

Soils excavated within areas where remaining MGP-related impacts may be potentially encountered will be segregated based on previous environmental data and screening results into material that requires off-site disposal at an off-site disposal facility that is licensed and permitted to accept the type of waste, material that can be returned to the subsurface, and material that can be used as cover soil. Soil potentially suitable for reuse that is stockpiled shall be sampled and analyzed (as described in Section F-7 of this EWP) to evaluate whether material can be (a) reused on the Site or the Off-Site Property; or (b) must be transported to a permitted licensed and permitted off-site disposal facility

for treatment and/or disposal.

F-3 SOIL STAGING METHODS

At a minimum, soil stockpiles will be placed on top of polyethylene sheeting or equivalent and continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points. If required by the NYSDEC, the soil stockpiles will be placed within an engineered staging area. Stockpiles will be kept covered with appropriately anchored polyethylene sheeting or equivalent. Stockpiles will be routinely inspected by National Grid's QEP and damaged polyethylene sheeting will be promptly replaced. Stockpiles will be inspected by National Grid's QEP at a minimum once each week and after storm events. Results of inspections will be recorded by National Grid's QEP in a logbook and maintained at the Site and available for inspection by the NYSDEC.

F-4 MATERIALS EXCAVATION AND LOAD-OUT

A QEP contracted by National Grid or person under their supervision will oversee invasive work into known or potentially contaminated material and the excavation and load-out of excavated material generated at the Site and the Off-Site Property.

The owner of the property and the Remedial Party/Respondent solely responsible for safe execution of invasive and other work performed under this EWP.

The presence of utilities and easements will be investigated by the QEP. It will be determined whether a risk or impediment to the planned work under this ISMP is posed by utilities or easements on the Site or the Off-Site Property.

Loaded vehicles leaving the Site/Off-Site Property will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and other applicable transportation requirements). The QEP contracted by National Grid will perform checks for compliance with these requirements.

When necessary, a truck wash will be operated on-site. The QEP contracted to National Grid will be responsible for ensuring and documenting that outbound trucks are washed (as necessary) at the truck wash before leaving the Site/Off-Site Property until the

intrusive activities into known or potentially impacted materials performed under this section are complete. Truck wash waters will be collected and disposed of at a licensed and permitted off-site disposal facility in an appropriate manner.

Locations where vehicles enter or exit the Site/Off-Site Property shall be inspected daily by National Grid's QEP for evidence of off-site soil tracking. The QEP will document that egress points for truck and equipment transport from the Site/Off-Site Property are clean of dirt and other materials derived from the Site/Off-Site Property during intrusive excavation activities into known or potentially contaminated materials (MGP-related impacts). Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials. National Grid will maintain responsibility for these activities whether associated with the Site or the Off-Site Property.

F-5 MATERIALS TRANSPORT TO PERMITTED OFF-SITE DISPOSAL FACILITIES

Transport of MGP-related impacted material will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded. The QEP contracted by National Grid will maintain responsibility for this for activity whether conducted on the Site or the Off-Site Property.

Material transported by trucks exiting the Site/Off-Site Property will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used. The truck transport routes for trucks exiting the Site/Off-Site Property with material destined for off-site treatment and/or disposal are as follows:

- Proceed southwest on West Main Street toward River Avenue;
- Turn right onto Waverly Avenue;
- At the traffic circle, take the first exit and stay on Waverly Avenue;
- Continue onto Patchogue-Holbrook Road;
- Turn left onto Expressway Drive North/Long Island Expressway North Service Road to head towards I-495 West or turn right onto Expressway Drive

South/Long Island Expressway South Service Road to head towards I-495 East;

- Proceed to destination.

Trucks loaded with contaminated materials will exit the vicinity of the Site/Off-Site Property using only this approved truck route. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project Site/Off-Site Property. Queuing of trucks will be performed on the Site/Off-Site Property, as practical, in order to minimize off-site disturbance. Off-site queuing will be prohibited.

Egress points for truck and equipment transport from the Site/Off-Site Property will be kept clean of dirt and other materials during Site remediation and development.

F-6 MATERIALS DISPOSAL AT PERMITTED OFF-SITE DISPOSAL FACILITIES

Soil/fill/solid waste excavated and removed from known or potentially MGP-related impacted areas of the Site and the Off-Site Property will be treated as contaminated and regulated material and will be transported and disposed in accordance with local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from the Site/Off-Site Property is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from the Site and the Off-Site Property will not occur without formal NYSDEC or National Grid approval, respectively.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification made to the NYSDEC by National Grid's QEP. This will include estimated quantities and a breakdown by class of disposal facility if appropriate (i.e. waste disposal facility, treatment facility, construction/demolition recycling facility, etc.).

Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report (described in Section 7.7 of the ISMP) to be prepared and submitted by National Grid. This documentation will include: waste profiles, laboratory analytical test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off of the Site and the Off-Site Property will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

F-7 MATERIALS REUSE ON THE SITE AND THE OFF-SITE PROPERTY

Excavated materials outside potentially impacted areas on the Site and the Off-Site Property can be reused for fill on the respective properties, subject to NYSDEC requirements (currently DER-10, Table 5.4(e)4 Reuse of Soil). Excavated soil/fill from the Site/Off-Site Property that is free of visible stains and obvious odors shall be considered potentially suitable for reuse on the respective Site/Off-Site property. Material potentially suitable for reuse shall be placed on polyethylene sheeting. The stockpiled potentially reusable material shall be covered whenever soils are not actively being placed into or removed from the stockpile, during overnight/weekend hours, during periods of precipitation, or whenever dust action levels are exceeded. This material shall be covered using polyethylene sheeting to reduce potential infiltration of precipitation, migration of wind-blown dust, and direct contact exposures.

Stockpiled potentially reusable material from the Site/Off-Site Property shall be sampled and analyzed to evaluate if the material can be used as backfill on the property from which it was excavated or must be transported to a licensed and permitted off-site disposal. In accordance with DER-10 Table 5.4(e)10, a minimum of one (1) composite sample shall be collected for each 250 CY of potentially impacted soils and analyzed for TCL SVOCs, inorganics, PCBs and pesticides. In addition, four (4) discrete grab samples will be collected from the 250 CY stockpile and analyzed for VOCs. As indicated in the Generic QAPP included as Appendix H to the ISMP, one duplicate sample shall also be collected for every 20 samples, with a minimum of one duplicate per sample delivery group (SDG). Each composite sample shall be formed using individual grab samples

collected from five locations within each stockpile (i.e., five discrete grab samples per composite). The composite sample shall be formed by placing equal portions of soil from each of the five discrete grab sampling locations into a pre-cleaned, stainless steel bowl (or dedicated container). Per the Generic Field Sampling Plan (Generic FSP) included as Appendix J to the ISMP, the composite sample shall be thoroughly homogenized using a stainless steel scoop or trowel before being transferred into the sample containers provided by the laboratory. The filled sample containers shall be labeled and transported to the laboratory using a chain-of-custody form. Each sample (composite or grab) will be submitted for laboratory analysis for the constituents listed in Appendix 5 of DER-10. Material suitable for reuse on the Site/Off-Site Property must meet the restricted residential use SCOs in 6NYCRR Part 375-6.

National Grid's Qualified Environmental Professional will ensure that procedures defined for materials reuse in this ISMP are followed and that unacceptable material does not remain on the Site/Off-Site Property. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for reuse on the Site/Off-Site Property will be placed below the clean soil cap under the demarcation layer on the Site or beneath the impervious surface (asphalt) on the Off-Site Property, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Concrete crushing or processing on-site will not be performed without prior NYSDEC approval on the Site or the approval of National Grid on the Off-Site Property. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the Site/Off-Site Property will not be reused on-site.

F-8 FLUIDS MANAGEMENT

All impacted liquids to be removed from the Site/Off-Site Property, including but not limited to, excavation dewatering waters, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the Site/Off-Site Property, and will be managed off-site, unless prior approval is obtained by National Grid from the NYSDEC for fluids generated by activities performed on the Site and approval is granted by National Grid for activities performed on the Off-Site

Property.

Discharge of water generated during large-scale construction activities to surface waters (i.e., a local pond, stream or river) will be performed under a State Pollution Discharge Elimination System (SPDES) permit obtained by National Grid.

F-9 COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities on the Site or the Off-Site Property, the cover system will be restored by National Grid in a manner that complies with the ROD. The Site soil cover system to be installed as part of the remedy is comprised of a minimum of 24 inches of clean soil. The existing cover system on the Off-Site Property is comprised of the building's foundation system and the asphalt pavement. Demarcation layers will be installed as part of the Site cover system as part of implementation of the remedy. The demarcation layer will consist of orange geotextile or equivalent material and will be installed to provide a visual reference to the top of the remaining MGP-related impact zone, the zone that requires adherence to special conditions for disturbance of remaining MGP-related impacted soils defined in this ISMP. The cover system (asphalt) on the Off-Site Property, after disturbance during implementation of the remedy, will be restored using the orange geotextile or equivalent material. This material will be installed only in areas disturbed during remediation by the invasive activities. The property owner shall not change the type of cover system following excavation without prior written permission from National Grid. A figure, to be prepared by National Grid, showing the modified surface will be included in the subsequent Periodic Review Report and in an updated ISMP.

F-10 BACKFILL FROM OFF-SITE SOURCES

Materials proposed for import onto the Site/Off-Site Property will be approved by National Grid's Qualified Environmental Professional and will be in compliance with provisions in this ISMP prior to receipt at the Site/Off-Site Property.

Imported material shall be sampled in accordance with the frequency requirements presented in Table 5.4(e)10 of NYDEC DER-10. Imported material to be used on the Site/Off-Site Property shall meet the restricted residential use SCOs (6NYCRR Subpart 375-6).

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the Site/Off-Site Property. Imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for the Site/Off-Site Property, will not be imported onto the Site/Off-Site Property without prior approval by NYSDEC or materials being imported to the Site or by National Grid for materials being imported to the Off-Site Property. Solid waste will not be imported onto the Site/Off-Site Property.

Trucks entering the Site/Off-Site Property with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

F-11 STORMWATER POLLUTION PREVENTION

General stormwater pollution prevention activities will be conducted in support of Site excavation including the following:

- Barriers and hay bale checks will be installed around the entire perimeter of the construction area and will be inspected once a week and after every storm event by National Grid's QEP. Results of inspections will be recorded in a logbook and maintained at the Site by National Grid's QEP and available for inspection by the NYSDEC. Necessary repairs shall be made promptly.
- Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.
- Undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.
- Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.
- Erosion and sediment control measures identified in the ISMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

- Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

All maintenance, monitoring and repairs to the soil erosion and sediment control measures will be performed under the supervision of National Grid's QEP.

F-12 EXCAVATION CONTINGENCY PLAN

If underground tanks or other previously unidentified contaminant sources are found during the implementation of the remedy or post-remedial subsurface excavations or development related construction on the Site or the Off-Site Property, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Sampling will be performed on product, sediment and surrounding soils, etc. by National Grid's QEP as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs), unless the history of the Site or the Off-Site Property and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed by National Grid to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive work conducted on the Site or the Off-Site Property will be promptly communicated by phone to NYSDEC's Project Manager by National Grid. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline by National Grid. These findings will be also included in the PRR to be prepared by National Grid.

F-13 COMMUNITY AIR MONITORING PLAN

Community air monitoring for VOCs and particulates will be conducted for any soil disturbance activities at the Site/Off-Site Property when conducting activities in areas with known or potentially impacted soils, in accordance with the CAMP provided in Appendix G to the ISMP. The CAMP will be implemented by National Grid. The quantity and locations of community air monitoring stations will be determined by National Grid's QEP

in conjunction with the NYSDOH, based on the size and location of the proposed excavation; however, at a minimum there will be one upwind and one downwind monitoring location. CAMP monitoring data will be recorded by National Grid and included in the project report to be prepared by National Grid. Any exceedances of action levels listed in the CAMP will be reported by National Grid to NYSDEC and NYSDOH Project Managers.

F-14 ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors off-site. Specific odor control methods to be used on a routine basis will include limiting the areal extent of open excavations, covering excavations with polyethylene sheeting or tarps, etc. If nuisance odors are identified at the Site/Off-Site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until nuisance odors have been abated. NYSDEC and NYSDOH will be notified by National Grid of odor events and of any other complaints about the project. Implementation of odor controls, including the halt of work, is the responsibility of the National Grid's Remediation Engineer, and any measures that are implemented will be discussed in the PRR to be prepared by National Grid.

Necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to conditions on the Site or the Off-Site Property or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

F-15 DUST CONTROL PLAN

Dust (i.e., particulate) monitoring will be performed in accordance with the CAMP provided in Appendix G to the ISMP during invasive activities to be conducted on the Site/Off-Site Property in areas of known or potential impacted soils. A dust suppression plan that addresses dust management during invasive activities, will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of hand-held water sprays of a dedicated on-site water truck for road wetting. The truck will be capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

National Grid maintains responsibility to prepare the Dust Control Plan, as necessary**F-16**

OTHER NUISANCES

A plan for rodent and noise control will be developed by National Grid's QEP, as necessary.

APPENDIX G

HEALTH AND SAFETY PLAN AND COMMUNITY AIR MONITORING PLAN

(To be updated prior to Site intrusive work)

Health and Safety Plan for Quarterly Groundwater Monitoring/Sampling and Off-Site Investigation Activities

at

Patchogue Former MGP Site

234 West Main Street

Village of Patchogue, Suffolk County, NY 11772

June 2015

Revision 7

BC Project Number: 142128

Prepared by:

Brown AND Caldwell

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Prepared for:

NATIONAL GRID

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Hicksville, NY 11801

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Approval Page

for

Health and Safety Plan for Quarterly Groundwater Monitoring/Sampling and Off-Site Investigation Activities

at

Patchogue Former MGP Site

(Revision 7)

This Health and Safety Plan (HASP) has been prepared and reviewed by the following Brown and Caldwell (BC) personnel for use at: Patchogue Former MGP Site (BC Project Number: 142128).

	Name	Signature	Title	Date
Prepared By:	Thakur Chaturgan		Field Operations Lead	6/9/15
Reviewed By:	Keith Bogatch		Project Manager	6/9/15
Reviewed By:	Thomas Parel		Site Safety Officer	6/9/15
Reviewed By:	Jim Bucha, CIH, CSP		Director of Health and Safety	6/9/15
Effective Dates:	June 2015	through	July 2016	

THE AMERICAN BOARD OF INDUSTRIAL HYGIENE INCORPORATED
CERTIFICATION NUMBER 6738 CP
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JAMES A. BUCHA, CIH

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CRITICAL PROJECT INFORMATION

This HASP was developed consistent with requirements in National Grid's generic HASP, entitled "Generic Environmental Health and Safety Plan for Site Investigations at Non-Owned Former MGP Sites" (Foster Wheeler, November 2002), referred herein to as the "Generic HASP".

Primary Known Compound(s) of Concern:

Compounds of Concern and Materials of Concern as identified in "Final Remedial Investigation Report for the Patchogue Former MGP Site, Patchogue, Suffolk County, New York" (Tetra Tech EC, Inc., December 2009) are as follows:

- Benzene
- Toluene
- Ethylbenzene
- Xylenes
- PAHs
- Cyanide
- NAPL/Tar
- Purifier Waste

Minimum Level of Personal Protective Equipment: ☒ Level D ☐ Level C

Note: Upgrade to Level C is allowed on this project with the exception of Cyanide. If cyanide is measured via colorimetric tube, or direct-reading instrument, to be above 2.5 ppm, then work stoppage will occur.

Standard PPE for Level D for this project consists of:

- Work shirt and long pants;
- ANSI- or ASTM-approved steel-toed boots or safety shoes,
- ANSI-approved safety glasses;
- ANSI-approved hard hat (where required on-site or when overhead hazards are present);
- Outer nitrile gloves (11 mil or thicker) and inner nitrile surgical gloves when direct contact with chemically affected soils or groundwater is anticipated (nitrile surgical gloves may be used for collecting or classifying samples as long as they are removed and disposed of immediately after each sampling event);
- Full-body Tyvek suits (non-chemical resistant) to prevent exposure to ticks, chiggers and other insects; and
- High-visibility traffic safety vest.

SEE SECTION 10 FOR SITE EMERGENCY CONTINGENCY PROCEDURES

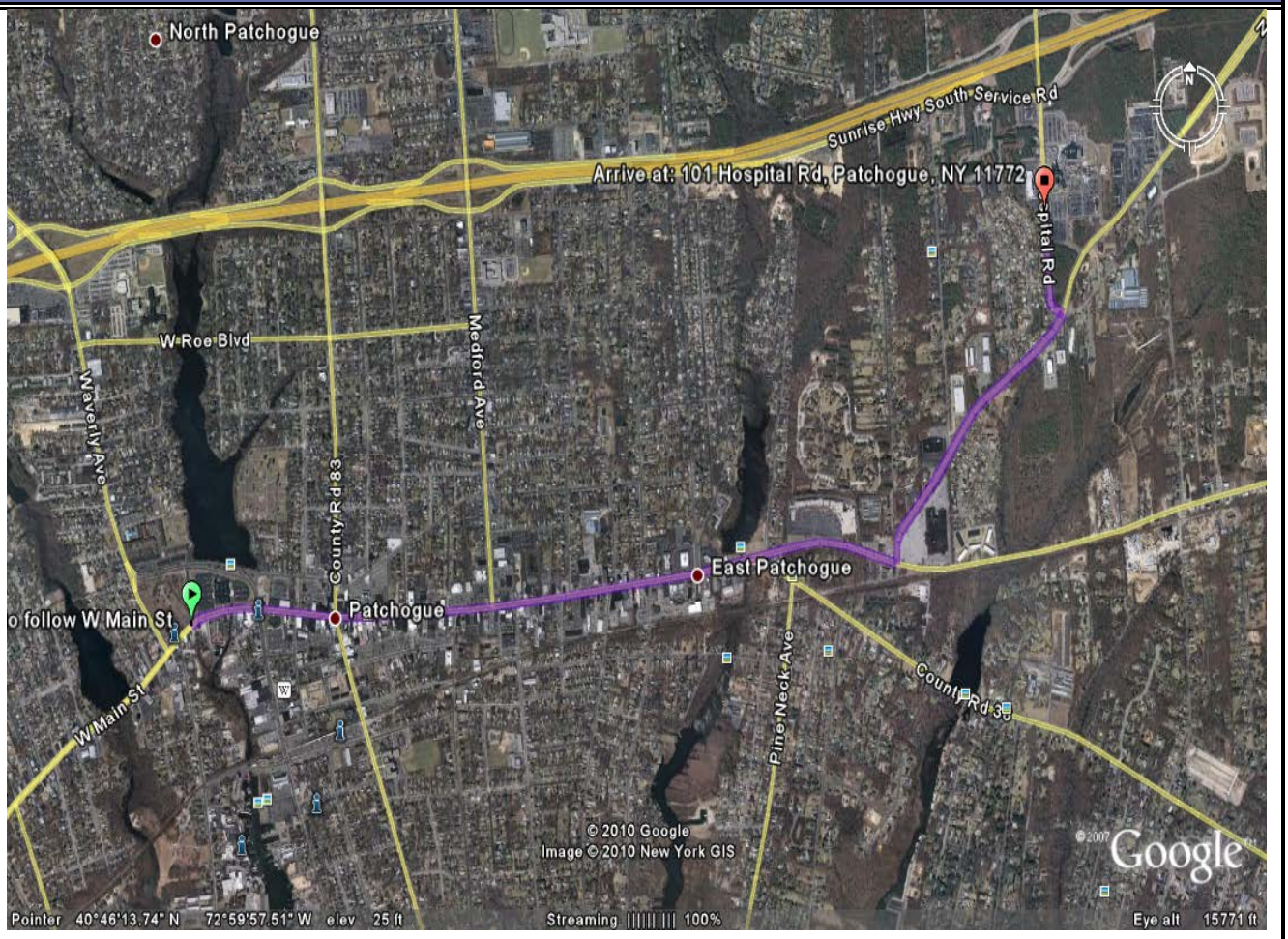
Do not endanger your own life. Survey the situation before taking any action.

BC Office	**2 Park Way, Suite 2A Upper Saddle River, New Jersey 07458** **Phone: 201-574-4700**
Site Location Address	**234 West Main Street** **Patchogue, New York 11772**

EMERGENCY PHONE NUMBERS: In the event of emergency, contact the Project Manager and/or Regional Safety Unit Manager.

Emergency Services (Ambulance, Fire, Police)	911
Poison Control	(800) 876-4766 or (800) 222-1222
Hospital Name	**Brookhaven Memorial Hospital** **101 Hospital Road** **Patchogue, NY**
Hospital Phone Number	**(631) 654-7100**
BC Project Manager (PM): Keith Bogatch	Office: 201-574-4765 Cell: 201-739-2320
BC Field Operations Lead: Thakur Chaturgan	Office: 201-574-4752 Cell: 718-506-2460
Site Safety Officer (SSO): Thomas Parel	Office: 201-574-4700 Cell: 516-301-0535
BC Director of Health and Safety Jim Bucha, CIH, CSP	Office: (916) 853-5308 Cell: (916) 216-6374
BC Regional Safety Unit Manager (RSUM): Lydia Crabtree, CSP	Office: 615-250-1236 Cell: 615-202-1311
Corporate Risk Management	Property Loss Blythe Buetzow: (925) 210-2470 Injury Angela Hale: (925) 210-2218
Client Contact: **Sarah Aldridge**	Office: 516-545-2568 Cell: 860 334-0554
Subcontractor: Zebra Technical Services, LLC Contact: David Vines	Phone: 516-596-6300
Subcontractor: Bertin Engineering, Associates Contact: Mikki Rehak	Phone: 201-670-6688
OTHER CONTACT(s)	None identified as of 6/03/15.

HOSPITAL LOCATION MAP



HOSPITAL DIRECTIONS:

1. Head northeast on County Road 85/ West Main Street toward West Ave
2. go 2 miles
3. Turn left at East Patchogue Yaphank Road/ Sills Road
4. go 0.7 mi
5. Turn left at Hospital Road
6. go 0.3 mi
7. Destination will be on the right

HOSPITAL INFORMATION:

Brookhaven Memorial Hospital and Medical Center
101 Hospital Road
Patchogue, NY

Phone: (631) 654-7100

Est. Travel Distance: 3 miles
Est. Travel Time: 7 minutes

EMERGENCY FIRST AID PROCEDURES

THE RESPONDER SHOULD HAVE APPROPRIATE TRAINING TO ADMINISTER FIRST AID OR CPR

1. Survey the situation. Do not endanger your own life. DO NOT ENTER A CONFINED SPACE TO RESCUE SOMEONE WHO HAS BEEN OVERCOME. FOLLOW PROTOCOLS INCLUDING THAT A STANDBY PERSON IS PRESENT. IF APPLICABLE, REVIEW MSDSs TO EVALUATE RESPONSE ACTIONS FOR CHEMICAL EXPOSURES.
2. Call 911 (if available) or the fire department **IMMEDIATELY**. Explain the physical injury, chemical exposure, fire, or release.
3. Decontaminate the victim if it can be done without delaying life-saving procedures or causing further injury to the victim.
4. If the victim's condition appears to be non-critical, but seems to be more severe than minor cuts, he/she should be transported to the nearest hospital by the SSO or designated personnel: let the doctor assume the responsibility for determining the severity and extent of the injury. If the condition is obviously serious, contact emergency medical services (EMS) for transport or appropriate actions.

Notify the PM and Regional Safety Unit Manager immediately and complete the appropriate incident investigation reports as soon as possible.

STOP BLEEDING AND CPR GUIDELINES	
To Stop Bleeding	**CPR**
1. Give medical statement by indicating you are trained in First Aid. 2. Assure: airway, breathing and circulation. 3. Use **DIRECT PRESSURE** over the wound with clean dressing or your hand (use non-permeable gloves). Direct pressure will control most bleeding. 4. Bleeding from an artery or several injury sites may require **DIRECT PRESSURE** on a **PRESSURE POINT**. Use pressure points for 30 -60 seconds to help control severe bleeding. 5. Continue primary care and seek medical aid as needed.	1. Give medical statement by indicating you are trained in CPR. 2. Arousal: Check for consciousness. 3. Call out for help, either call 911 yourself or instruct someone else to do so. It is very important to call for emergency assistance prior to initiating CPR. 4. Open airway with chin-lift. 5. Look, listen and feel for breathing. 6. If breathing is absent, give 2 slow, full rescue breaths, 1 second per breath. 7. If breathing remains absent, initiate CPR; 30 compressions for each two breaths. Repeat for 5 cycles before re-analyzing patient or until help arrives. 8. If an automated external defibrillator (AED) is available, use it in accordance with the AED instructions.

REVISION HISTORY

Revision No.	Revision Date	Reason	Editor
0	May 2010	New Project	N. Lordan/ J. Bucha
1	December 2010	Addition of Quarterly GW Sampling to SOW	C. Trent/ J. Bucha
2	June 2011	Addition of Hollow Stem Augers to SOW	C. Trent/ J. Bucha
3	August 2011	NG near-miss incident report	C. Trent/ J. Bucha
4	April 2012	Addition to SOW – Utility Corridor Work Plan Implementation	C. Trent/ J. Bucha
5	June 2013	Deletion of Investigation Activities and Utility Corridor Work Plan Implementation/Annual Update	K. Bogatch/ L. Crabtree/ J. Bucha
6	April 2014	Addition of Off-Site Investigation Activities	J. Marolda
7	June 2015	Revised schedule for groundwater monitoring and addition of Off-Site Investigation Activities	T. Chaturgan

Section 1

Introduction

Brown and Caldwell (BC) has prepared this Health and Safety Plan (HASP) for use during the Semi-annual Groundwater Monitoring/Sampling and Off-Site Investigation activities to be conducted at the Patchogue Former MGP Site located at West Main Street, Patchogue, Suffolk County, NY 11772 ("the Site"). Activities conducted under BC's direction at the Site will be in compliance with applicable Occupational Safety and Health Administration (OSHA) regulations, particularly those in Title 29 of the Code of Federal Regulations, Part 1910.120 (29 CFR 1910.120), and other applicable federal, state, and local laws, regulations, and statutes. A copy of this HASP will be kept on site during scheduled field activities.

This HASP addresses the identified hazards associated with planned field activities at the Site. It presents the minimum health and safety requirements for establishing and maintaining a safe working environment during the course of work. In the event of conflicting requirements, the procedures or practices that provide the highest degree of personnel protection will be implemented. If scheduled activities change or if site conditions encountered during the course of the work are found to differ substantially from those anticipated, the Regional Safety Unit Manager and Project Manager will be informed immediately upon discovery, and appropriate changes will be made to this HASP.

BC's health and safety programs and procedures, including medical monitoring, respiratory protection, injury and illness prevention, hazard communication, and personal protective equipment (PPE), are documented in the BC Health & Safety Manual. The Health & Safety Manual is readily accessible to BC employees via the BC Pipeline. These health and safety procedures are incorporated herein by reference, and BC employees will adhere to the procedures specified in the manual.

BC's HASP has been prepared specifically for this project and is intended to address health and safety issues solely with respect to the activities of BC's own employees at the site. A copy of BC's HASP may be provided to subcontractors in an effort to help them identify expected conditions at the site and general site hazards. The subcontractor shall remain responsible for identifying and evaluating hazards at the site as they pertain to their activities and for taking appropriate precautions. For example, BC's HASP does not address specific hazards associated with tasks and equipment that are particular to the subcontractor's scope of work and site activities (e.g., operation of a drill rig, excavator, crane or other equipment). Subcontractors are not to rely on BC's HASP to identify all hazards that may be present at the Site.

Subcontractors are responsible for developing, maintaining, and implementing their own health and safety programs, policies, procedures and equipment as necessary to protect their workers, and others, from their activities. Subcontractors shall operate equipment in accordance with their standard operating procedures as well as manufacturer's specifications. Any project monitoring activities conducted by BC at the Site shall not in any way relieve subcontractors of their critical obligation to monitor their operations and employees for the determination of exposure to hazards that may be present at the Site and to provide required guidance and protection. If requested, subcontractors will provide BC with a copy of their own HASP for this project or other health and safety program documents for review.

1.1 Site History

The Site description and history below is as presented in the Final Remedial Investigation Report, Patchogue Former MGP Site (Tetra Tech EC, Inc., December 2009).

1.1.1 Site History

The following is a brief summary of operations conducted at the site from 1904 until present based on the available records:

- 1904: Earliest records of site use for coal gasification
- 1904 – 1926: Site owned and operated by Patchogue Gas Company
- 1914: Site converted into a high pressure gas distribution facility
- 1915 – 1918: Site used to store and distribute high pressure gas produced off-site
- 1922 – 1925: Site used to produce emergency water gas
- 1926: Eight gas aboveground storage tanks (ASTs) installed on-site
- 1976: Long Island Lighting Company sold the site and MGP and gas distribution operations eased. Site sold to third party.
- 1976 – 2006: Site used as a refrigeration-scrap storage yard
- 2005: Site re-acquired by KeySpan
- 2006: KeySpan demolished a warehouse and detached garage

Present: Inactive and vacated site with concrete slabs remaining at the ground surface.

1.2 Site Description

The Patchogue Former MGP Site is located at 234 West Main Street south of Main Street, east of River Avenue, and adjacent to Patchogue River in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York. The site is approximately 3.6 acres with a maximum length (north-south) of approximately 680 feet and a maximum width (east-west) of 180 feet. The average elevation of the site is 10 feet above mean sea level (msl) and the site has a relatively flat topography. The site is located along the Patchogue River just south of where the river exits Patchogue Lake. An overflow pond is also located south/southwest of the site. The site is currently vacant and the southern area of the property is overgrown with brush and trees. Two concrete slabs are located adjacent to one another in the northern area of the site and are approximately 240 feet by 60 feet in combination. The site is secured by locked perimeter fencing, and private properties border the site.

The site is bordered to the east by the Patchogue River and small industrial properties. The surrounding area is primarily used for commercial and residential purposes. A commercial/industrial area is located north of the site and a residential area lies south of the site. Above All Store Fronts and the Patchogue River border the site to the east, while Costanza Marine Contractors is situated to the west. The River Avenue Elementary School is located approximately one-tenth of a mile southwest and upgradient of the site, with residential homes between the site and the school. The Village of Patchogue's waste water treatment plant (WWTP) is located upstream of the site on the eastern side of the Patchogue River.

1.3 Scope of Work

Brown and Caldwell personnel will be observing and documenting subcontractor activities. Brown and Caldwell personnel will also be conducting media sampling (i.e. water and soil).

1.3.1 Groundwater Monitoring and NAPL Gauging

Two semi-annual groundwater monitoring events will be conducted at the Site on an annual basis. Each groundwater monitoring event will consist of water level measurements, NAPL gauging, and collection of groundwater samples for laboratory analysis from all available monitoring wells at the time of the sampling. Field activities for each groundwater monitoring event will be conducted by a two-person field crew from BC. Each groundwater monitoring event will be completed in approximately three (3) days. Depth to water measurements and NAPL gauging will be conducted prior to groundwater sampling. In the event that NAPL is detected in a monitoring well during the two groundwater sampling events, a groundwater sample will not be collected from that well.

Groundwater samples will be collected according to the United States Environmental Protection Agency (USEPA) low-flow sampling protocol, 2010, and in accordance with procedures outlined in the Generic Field Sampling Plan for Site Investigations at Non-Owned Former MGP Sites (Foster Wheeler, November 2002) (referred to as "FSP").

1.3.2 Off-Site Investigation

Utility Clearance

Prior to conducting the intrusive activities described below, New York 811, the Village of Patchogue, and Suffolk County Water Authority will be contacted to clear underground utilities. In addition, a private utility locating service will be contracted to evaluate the proposed boring locations for the presence of subsurface utilities. Based on the results of the utility mark-outs, the proposed drilling locations may be adjusted to provide adequate clearance from underground and aboveground utilities, as necessary.

The final locations for the drilling locations will be determined in the field following the mark-out of underground utilities and completion of the utility survey by private contractor.

Soil Borings

Off-site investigation activities will be performed, via the implementation of a soil boring program, to further delineate and finalize the limits of the remediation on the off-site property to the east of the former MGP site. Soil borings will be completed at nine proposed locations. If impacts are observed in the borings, "step-out" borings will be completed to further evaluate the extent of the impacts.

The soil borings will be either be advanced using direct-push technology (e.g., GeoProbe®) or conventional drilling methods [e.g., hollow-stem augers (HSA)] and continuously sampled with either a four-foot long sampler (e.g., Dual Tube® or Macrocore®) or two-foot long split spoon sampler, respectively. With the exception of a boring proposed in the vicinity of PASB-41 in which the boring will be advanced to approximately 30 feet bgs, all other proposed soil borings will be advanced from ground surface to a minimum of 10 feet bgs. However, in the event that impacts are identified near the base of the boring, efforts will be made to further evaluate the vertical extent of impacts by extending the borings to deeper depths until a clean zone is established.

Up to two soil samples from each of the borings will be collected and submitted for analysis of benzene, toluene, ethylbenzene and isomers of xylene (BTEX), and polycyclic aromatic hydrocarbons (PAHs). In addition, at locations where no visible or olfactory indications of potential MGP-related impacts are observed, the collected samples will be analyzed for an expanded list of PAHs (including 34 commonly identified PAH compounds consisting of 18 parent [non-alkylated] PAH compounds and 16 alkylated PAH compounds) as part of a forensic evaluation to assess whether the distribution of PAHs (if detected) are indicative of MGP-related materials or other materials not associated with former MGP operations.

Survey

Surveying of the soil borings that are completed, including any "step-out" borings that are drilled will be performed following completion of the drilling program. The survey will include location coordinates, and ground surface elevation data. Coordinates will be referenced to the State Plane coordinate system for New York using the North American Datum of 1983 (NAD 1983) in units of feet. Elevations will be referenced to the North American Vertical Datum of 1988 (NAVD88) in units of feet. The survey will be performed by a New York State licensed surveyor.

Section 2

Key BC Project Personnel and Responsibilities

Keith Bogatch is the Project Manager (PM). Jim Bucha, CIH, CSP is the BC Director of Health and Safety. Lydia Crabtree, CSP is the BC Regional Safety Unit Manager (RSUM). Thakur Chaturgan is the BC Field Operations Lead and Thomas Parel has been designated as the BC Site Safety Officer (SSO) for this project. The BC project field staff have completed 40 hours of comprehensive health and safety training, which meets the requirements of 29 CFR 1910.120.

The responsibilities of key BC project personnel are presented below.

2.1 BC Project Manager

The PM is responsible for evaluating hazards anticipated at the Site and working with designated field staff and the RSUM to prepare this HASP to address the identified hazards. The PM is also responsible for the following.

- Informing project participants of safety and health hazards identified at the Site.
- Providing a copy of and requiring that each BC project team member, including subcontractors, reads or is briefed on the HASP.
- Checking that the BC project team is adequately trained and perform safety briefings in accordance with this HASP.
- Providing the resources necessary for maintaining a safe and healthy work environment for BC personnel.
- Communicating project safety concerns to the RSUM for determining corrective actions.

2.2 BC Site Safety Officer

The SSO has on-Site responsibility for verifying that BC team members, including subcontractors, comply with the provisions of this HASP. The SSO has the authority to monitor and correct health and safety issues as noted on-Site. The SSO is responsible for the following.

- Reporting unforeseen or unsafe conditions or work practices at the Site to the PM or RSUM.
- Stopping operations that threaten the health and safety of BC field team or members of the surrounding community.
- Monitoring the safety performance of Site personnel to evaluate the effectiveness of health and safety procedures.
- Performing air monitoring, as necessary, as prescribed in this HASP.
- Documenting field team compliance with this HASP by completing the appropriate BC forms contained in the Appendices of this document.
- Conducting daily tailgate safety meetings and assuring that project personnel understand the requirements of this HASP (as documented by each BC field team member's signature on the Signature Page).

- Limiting access to BC work areas on the Site to BC field team members and authorized personnel.
- Enforcing the "buddy system" or minimum 2-person teams as appropriate for Site activities.
- Performing periodic inspections to evaluate safety practices at the Site.
- Identifying the location and route to nearby medical facility and emergency contact information and coordinating appropriate responses in the event of emergency.

2.3 BC Regional Unit Safety Manager

The RSUM is responsible for final review and modification of this HASP. Modifications to this HASP that result in less protective measures than those specified may not be employed by the PM or SSO without the approval of the RSUM. In addition, the RSUM has the following responsibilities.

- Developing and coordinating the overall BC health and safety program.
- Advising the PM and SSO on matters relating to health and safety on this project.
- Recommending appropriate safeguards and procedures.
- Modifying this HASP, if necessary, and approving changes in health and safety procedures at the Site.

2.4 BC Team Members

BC employees and subcontractors are responsible for familiarizing themselves with health and safety aspects of the project and for conducting their activities in a safe manner. This includes attending site briefings, communicating health and safety observations and concerns to the SSO, maintaining current medical and training status and maintaining and using proper tools, equipment and PPE. Proper work practices are part of ensuring a safe and healthful working environment. Safe work practices are essential and it is the responsibility of BC employees and team members to follow safe work practices when conducting scheduled activities. Safe work practices to be employed during the entire duration of fieldwork include, but are not limited to, the following.

- Following the provisions of this HASP, company health and safety procedures and regulatory requirements.
- Reviewing safety-related information from other parties (i.e., client or contractors) as it relates to BC's activities.
- Inspecting personal protective equipment (PPE) before on-site use, using only intact protective clothing and related gear, and changing suits, gloves, etc. if they are damaged or beyond their useful service life.
- Set up, assemble, and check out all equipment and tools for integrity and proper function before starting work activities.
- Assisting in and evaluating the effectiveness of Site procedures (including decontamination) for personnel, protective equipment, sampling equipment and containers, and heavy equipment and vehicles.
- Practice the "buddy system" as appropriate for site activities.
- Do not use faulty or suspect equipment.
- Do not use hands to wipe sweat away from face. Use a clean towel or paper towels.
- Practice contamination avoidance whenever possible.
- Do not smoke, eat, drink, or apply cosmetics while in chemically-affected areas of the site or before proper decontamination.

- Wash hands, face and arms before taking rest and lunch breaks and before leaving the site at the end of the workday.
- Check in and out with the SSO upon arrival and departure from the site.
- Perform decontamination procedures as specified in this HASP.
- Notify the SSO immediately if there is an incident that causes an injury, illness or property loss. Incidents that could have resulted in injury, illness or property loss (close call) will also be reported to the SSO.
- Do not approach or enter an area where a hazardous environment (i.e., oxygen deficiency, toxic or explosive) may exist without employing necessary engineering controls, proper PPE and appropriate support personnel.
- Use respirators correctly and as required for the Site; check the fit of the respirator with a negative or positive pressure test; do not wear respirator with facial hair or other conditions that prevent a face-to-face piece seal.
- Confined spaces will not be entered without appropriate evaluation, equipment, training and support personnel.

2.5 BC Subcontractors

Subcontractor personnel are expected to comply fully with subcontractor's HASP and to observe the minimum safety guidelines applicable to their activities which may be identified in the BC HASP. Failure to do so may result in the removal of the subcontractor or any of the subcontractor's workers from the job site.

Section 3

Hazard Analysis

Hazards at the Site may include physical hazards, chemical hazards or biological hazards. Each type of identified hazard is addressed in the following sections. Hazards that are the specialty of a subcontractor (i.e., operation of a drill rig or excavator) are not addressed in this HASP. Subcontractors are responsible for identifying potential hazards associated with their activities and implementing proper controls.

3.1 Chemical Hazards

Exposure pathways of concern for chemical compounds that may be present at the Site are inhalation of airborne contaminants, direct skin contact with contaminated materials, and incidental ingestion of affected media. Wearing protective equipment and following decontamination procedures listed in Section 7 can minimize dermal contact and incidental ingestion. To minimize inhalation hazards, dust or vapor control measures will be implemented, where necessary, and action levels will be observed during scheduled activities. Site-specific action levels and air monitoring requirements are presented in Section 5.

Site Specific Chemical Concerns			
Known or Suspected Compounds	Source (soil/water/sludge, etc.)	Known Concentration Range Specify (ppm, mg/kg, mg/l)	
		Lowest	Highest
Benzene	Soil	Not detected (ND)	6.3 mg/kg
	Groundwater	ND	46 µg/l
Toluene	Soil	ND	22 mg/kg
	Groundwater	ND	120 µg/l
Ethylbenzene	Soil	ND	130 mg/kg
	Groundwater	ND	390 µg/l
Xylene, Total	Soil	ND	195 mg/kg
	Groundwater	ND	460 µg/l
Total Polycyclic Aromatic Hydrocarbons (PAHs)	Soil	ND	16,410 mg/kg
	Groundwater	ND	2,041 µg/l
Cyanide, Total (Typically present at MGP sites as iron cyanide complexes)	Soil	ND	3.95 mg/kg
	Groundwater	ND	15 µg/l

Chemical descriptions of select chemicals of concern, including health effects and exposure limits, are presented in the following paragraphs. Each chemical description includes physical and odor recognition characteristics, the health effects associated with exposure, and exposure limits expressed as an 8-hour time-weighted average (TWA). Provided are federal OSHA (OSHA) permissible exposure limits (PELs; located in 29 CFR 1910.1000) and the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLVs).

3.1.1 Benzene

Benzene is a clear, volatile liquid. It is colorless, highly flammable, and toxic, with a characteristic odor. It is a severe eye and moderate skin irritant. Human effects by inhalation and ingestion include euphoria, changes in sleep and motor activity, nausea and vomiting, other blood effects, dermatitis, and fever. In industry, inhalation is the primary route of chronic benzene poisoning. If the liquid is aspirated into the lung it may cause pulmonary edema. Poisoning by skin contact has also been reported. Exposure to high concentrations (3,000 ppm) may result in acute poisoning, which is characterized by the narcotic action of benzene on the central nervous system. Chronic poisoning occurs most commonly through inhalation and dermal absorption. Benzene is a known human carcinogen that can cause leukemia.

- The OSHA PEL is listed as 1 ppm.
- The TLV is listed as 0.5 ppm.

Note: Published exposure limits designate a skin notation indicating that dermal contact can contribute to the overall exposure.

3.1.2 Toluene

Toluene is a colorless liquid with a benzol-like odor. Human systemic effects of exposure to toluene include central nervous system changes, hallucinations or distorted perceptions, motor activity changes, psychophysiological changes, and bone marrow changes. It is a severe eye irritant and an experimental teratogen. Inhalation of high vapor concentrations may cause impairment of coordination and reaction time, headaches, nausea, eye irritation, loss of appetite, a bad taste in the mouth, and lassitude.

- The OSHA PEL is listed as 200 ppm.
- The TLV is listed as 20 ppm.

Note: Published exposure limits designate a skin notation indicating that dermal contact can contribute to the overall exposure.

3.1.3 Ethylbenzene

Ethylbenzene is a clear, colorless liquid. It is mildly toxic by inhalation and skin contact. Inhalation can cause eye, sleep, and pulmonary changes. It is an eye and skin irritant at levels as low as 0.1% (1,000 ppm) of the vapor in air. At higher concentrations, it is extremely irritating at first, then can cause dizziness, irritation of the nose and throat, and a sense of constriction in the chest. Exposure to high concentrations of ethylbenzene vapor may result in irritation of the skin and mucous membranes, dizziness, irritation of the nose and throat, and a sense of constriction of the chest.

- The OSHA PEL is listed as 100 ppm.
- The TLV is listed as 20 ppm.

3.1.4 Xylene

Xylene is a clear, colorless liquid. It exhibits the general chlorinated hydrocarbon central nervous system effects, olfactory (smell) changes, eye irritation and pulmonary changes. It is a severe skin irritant. There are three isomers: ortho, meta, and para. Exposure to high concentrations of xylene vapor may result in eye and skin irritation. Eye irritation may occur at concentrations of about 200 ppm.

- The OSHA PEL is listed as 100 ppm.
- The TLV is listed as 100 ppm.

3.1.5 Polynuclear Aromatic Hydrocarbons (PAHs)

Polynuclear Aromatic Hydrocarbons (PAHs) constitute a class of materials of which benzo[a]pyrene (BaP) is one of the most common and also the most hazardous. In general, PAHs can be formed in any hydrocarbon combustion process. The less efficient the combustion process, the higher the PAH emission factor is likely to be. The major sources are stationary sources, such as heat and power generation, refuse burning, industrial activity, such as coke ovens, and coal refuse heaps. PAHs may also be released from oil spills. Because of the large number of sources, people are exposed to very low levels of PAHs every day.

Certain PAHs, such as the more common BaP, have been demonstrated to be carcinogenic at relatively high exposure levels in laboratory animals. BaP is a yellowish crystalline solid that consists of five benzene rings joined together. It is highly soluble in fat tissue and has been shown to produce tumors in the stomachs of laboratory mice. In addition, skin cancers have been induced in a variety of animals at very low levels and unspecified lengths of application.

It is important to recognize the PAHs' ability to adhere to soil and other particulates. Therefore, good particulate emission controls and the use of air purifying respirators with particulate filters are required for protection against airborne PAH hazards.

- The OSHA PEL is listed as 0.2 mg/m3 (as coal tar pitch volatiles).
- The TLV is listed as 0.2 mg/m3 (coal tar pitch volatiles, as benzene soluble aerosol).

3.1.6 Hydrogen cyanide

Hydrogen cyanide (HCN) is a colorless or pale blue liquid or gas (above 78° F) with a bitter, almond-like odor. It is a deadly human poison by all routes of exposure. Symptoms of mild exposure include cyanosis, headache, dizziness, unsteadyness of gait, a feeling of suffocation, and nausea. In cases of acute cyanide poisoning, death is extremely rapid (exposure to concentrations of 100 to 200 ppm for periods of up to 60 minutes can cause death).

HCN is a very dangerous fire hazard when exposed to heat, flame, or oxidizers. When heated to decomposition or in reaction with water, steam, or acid, it produces highly toxic fumes of CN-.

- The OSHA PEL is listed as 10 ppm (11 mg/m3).
- The TLV Ceiling Limit is listed as 4.7 ppm for hydrogen cyanide and 5 mg/m3 as a ceiling level for cyanide salts.

Note: Published exposure limits designate a skin notation indicating that dermal contact can contribute to the overall exposure.

3.2 Hazard Communication

In accordance with the Hazard Communication standard, material safety data sheets (MSDSs) will be maintained on site for chemical products used by BC personnel at the Site (i.e., spray paint, PVC cement, etc.). Subcontractors will be responsible for maintaining MSDSs for chemical products they bring on Site. In addition, containers will be clearly labeled in English to indicate their contents and appropriate hazard warnings. Please note that labeling containers includes, but is not limited to, any waste, used PPE, and/or decontamination materials collected.

3.3 Opening Wells and Well Vaults

Direct-reading instrumentation specified in Section 5 will be used to monitor any work in a well vault at the site where VOCs are a concern. The well vault will be opened carefully with the BC employee staying upwind as much as possible and then left open for a minimum of three minutes to allow the vault to vent. If the well cap is then removed, allow another three minutes for the well head to vent before proceeding. Please note that if there are other established protocols that differ from 3 minutes; the more protective time increment will be followed. Personnel should stay upwind as much as possible while working in and around the vault.

When removing a well cap, personnel will remain upwind as much as possible and will carefully remove the cap by opening it away from them in order to minimize the likelihood of exposure to vapors. Personnel will wait a minimum of three minutes to allow the well to vent before proceeding.

3.4 Physical Hazards

The following physical hazards, as marked below, have been identified and may be encountered during scheduled field activities.

- ☒ **Slips, Trips and Falls**
- ☐ Heavy Equipment
- ☒ **Excavations**
- ☒ **Noise**
- ☒ **Overhead Utilities**
- ☐ Electrical Hazards
- ☐ Confined Spaces
- ☒ **Sharp Objects/Cutting Utensils**
- ☐ Elevated Platforms/Working Surfaces
- ☒ **Traffic**
- ☐ Arc Flash Protection
- ☒ **Water Hazards** (non-boating)
- ☐ Removing Manhole Covers
- ☒ **Housekeeping**
- ☒ **Materials and Equipment Handling - Lifting**
- ☒ **Drilling**
- ☒ **Underground Utilities**
- ☐ Equipment Refueling
- ☐ Lockout/Tagout
- ☐ Fire/Explosion
- ☒ **Cutting Acetate Sleeves**
- ☐ Ladder Use
- ☒ **Driving**
- ☐ Boating Safety
- ☐ Building Collapse
- ☒ **Personal Safety – Urban Setting**

Actions to be taken to protect against the hazards identified are provided in the sections below.

3.4.1 Slip, Trips and Falls

Slipping hazards may exist due to uneven terrain, wet or slick surfaces, leaks or spills. Tripping hazards may be present from elevation changes, debris, poor housekeeping or tools and equipment. Some specific hazards may include: climbing/descending ladders, scaffolding, berms or curbing. Collectively, these types of injuries account for nearly 50 percent of all occupational injuries and accepted disabling claims. Prevention requires attention and alertness on the part of each worker, following and enforcing proper procedures, including good housekeeping practices, and wearing appropriate protective equipment.

3.4.2 Housekeeping

Personnel shall maintain a clean and orderly work environment. Make sure that all materials stored in tiers are stacked, racked, blocked, interlocked, or secured to prevent sliding, falling, collapse, or overturning. Keep aisles and passageways clear and in good repair to provide for free and safe movement of employees and material-handling equipment. Do not allow materials to accumulate to a degree that it creates a safety or fire hazard.

During construction activities, scrap and form lumber with protruding nails and other items shall be kept clear from work areas, passageways, and stairs. Combustible scrap and debris shall be removed at regular intervals. Safe means must be provided to facilitate removal of debris.

Containers must be provided for collecting and separating waste, used rags and other debris. Containers used for garbage and other oily flammable or hazardous waste such as caustics, acids, harmless dusts, etc., must be separated and equipped with covers. Garbage and other waste shall be disposed of at frequent and regular intervals.

3.4.3 Heavy Equipment

Equipment, including earth-moving equipment, drill rigs, or other heavy machinery, will be operated in compliance with the manufacturer's instructions, specifications, and limitations, as well as any applicable regulations. The operator is responsible for inspecting the equipment prior to use each work shift to verify that it is functioning properly and safely.

The following precautions should be observed whenever heavy equipment is in use:

- PPE, including steel-toed boots, safety glasses, high visibility vests, and hard hats must be worn.
- Personnel must be aware of the location and operation of heavy equipment and take precautions to avoid getting in the way of its operation. Workers must never assume that the equipment operator sees them; eye contact and hand signals should be used to inform the operator of the worker's intent.
- Personnel should not walk directly in back of, or to the side of, heavy equipment without the operator's knowledge. Workers should avoid entering the swing radius of equipment and be aware of potential pinch points.
- Nonessential personnel will be kept out of the work area.

3.4.4 Materials and Equipment Handling - Lifting

The movement and handling of equipment and materials on the Site pose a risk to workers in the form of muscle strains and minor injuries. These injuries can be avoided by using safe handling practices, proper lifting techniques, and proper personal safety equipment such as steel-toed boots and sturdy work gloves. Where practical, mechanical devices will be utilized to assist in the movement of equipment and materials. Workers will not attempt to move heavy objects by themselves without using appropriate mechanical aids such as drum dollies or hydraulic lift gates.

Proper lifting techniques include the following:

- Lift with the strength of your knees, not your back.
- Firmly plant your feet approximately shoulder-width apart.
- Turn your whole body, don't bend or twist at the waist.
- Be sure that the path is clear of obstructions or tripping hazards; avoid carrying objects that will obstruct your vision.
- Use caution when holding an object from the bottom to prevent crushing of the hands or fingers when lowering.

3.4.5 Excavations

A competent person who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them, will be present during excavation activities.

The atmosphere will be tested in excavations, before employees are permitted to enter and begin work, greater than 4 feet in depth or where oxygen deficiency or toxic or flammable gases are likely to be present. The atmosphere shall be ventilated and re-tested until flammable gas concentrations less than 5 percent of the lower explosive limit (LEL) and site-specific action levels are obtained. Worker entry will not be allowed if the oxygen concentration is less than 20 percent. In addition, a safe means of access and egress (i.e., a ladder, stairs or ramp) must be provided so that no more than 25 feet of lateral travel is required by employees.

Workers will not enter unstable excavations or excavations greater than 5 feet in depth without appropriate protective systems such as benching, sloping, or shoring. If shoring or shielding systems are not used, side slopes will not be steeper than 1½:1 without written confirmation from the competent person that the slope is safe for the soil conditions. Excavations will be constructed in accordance with the OSHA Excavation Safety Standard (29CFR1926 Subpart P).

The competent person will inspect excavations daily. If there is evidence that a cave-in or slide is possible, work will cease until the necessary safeguards have been taken. Excavated material will be placed far enough from the edge of the excavation (a minimum of 2 feet) so that it does not fall back into the opening or affect the integrity of the sidewall. At the end of each day's activities, open excavations will be clearly marked and secured to prevent nearby workers or unauthorized personnel from entering them. Remote sampling techniques will be the preferred method of sample collection in excavations.

3.4.6 Drilling

During all drilling activities, the operator must verify that the appropriate level of protection and appropriate safety procedures are utilized. The operator will verify that equipment "kill switches" are functioning properly at the start of each day's use. Hard hats, steel-toed boots, and ear and eye protection will be required at all times when working around drill rigs. The proximity of underground and overhead utilities must be identified before any drilling is attempted. The rig may not be moved with the mast in the upright position.

Workers can effectively manage hazards associated with working around heavy equipment if a constant awareness of these hazards is maintained. These hazards include the risk of becoming physically entangled in rotating machinery, slipping and falling, impact injury to eyes, head and body, and injury from machinery operations. Never work or walk on piles of well casings. Make sure all high-pressure lines and hoses have whip checks attached. Constant visual or verbal contact with the equipment operator will facilitate such awareness.

3.4.7 Noise

Noise may result primarily from the operation of heavy equipment, process machinery or other mechanical equipment. Hearing protection with the appropriate noise reduction rating (NRR) shall be worn in areas with high noise levels. A good rule of thumb to determine if hearing protection is needed is the inability to have a conversation at arms length without raising voice levels. If loud noise is present or normal conversation becomes difficult, hearing protection in the form of ear plugs, or equivalent, will be required.

3.4.8 Underground Utilities

Reasonable efforts will be made to identify the location(s) of underground utilities (e.g., pipes, electrical conductors, fuel lines, and water and sewer lines) before intrusive soil work is performed. The state underground utility notification authority (e.g., USA, Dig Alert, Blue Stake, etc.) will be contacted prior to the start of intrusive field activities in accordance with local notification requirements. In areas not evaluated or serviced by the underground utility notification authority, and a reasonable potential for underground utilities exists, one or more of the following techniques will be employed to determine the location of subsurface structures.

- Contracting the services of a qualified private utility locator.
- Having a survey of the subject area conducted by staff trained in the use of subsurface utility locating equipment.
- Subsurface testing (i.e., hand digging or potholing) to the expected depth of probable utilities (not less than 5 feet).

If utilities cannot be located or if unlocated utilities are suspected to be present, subsurface activities (i.e., borings, excavation) should not be conducted before the location(s) or absence of underground utilities is confirmed.

Typical subsurface location marks are as follows:

- Red – electrical,
- Yellow – gas/oil/steam,
- Blue – water,
- Green – sanitary/storm drains/culverts,
- Orange – communications, and
- White – proposed excavation or boring.

Intrusive work should be limited to the area 3.3 feet (1 meter) on either side of the location marks. In some special cases such as fiber optics and high-pressure pipelines this area should be expanded to 16.5 feet (5 meters) on either side of the utility.

3.4.9 Overhead Utilities

If work is to be conducted in the vicinity of overhead electrical utilities, the owner of the overhead line will be contacted to determine the maximum voltage. Any overhead utility will be considered to be energized unless and until the person owning or operating such line verifies that the line is not energized, and the line is visibly grounded at the work site.

Workers will not perform work in proximity to energized high-voltage lines (including scaffolding, well drilling, pile driving, or hoisting equipment) until danger from accidental contact with high-voltage lines has been effectively guarded against.

Equipment with articulated upright booms or masts are not permitted to operate within 15 feet of an overhead utility line (less than 50kV) while the boom is in the upright position. For transmission lines in excess of 50kV, an additional distance of 4 inches for each 10 kV over 50kV will be used.

3.4.10 Equipment Refueling

Care shall be exercised while refueling generators, pumps, vehicles, and other equipment to prevent fire and spills. Personnel shall eliminate static electricity by grounding themselves (touching metal) prior to using refueling hoses and or containers of petroleum liquids. Items being refueled shall be grounded or

be located on the ground and not on a trailer, work bench or inside a truck bed. Equipment that is hot must be allowed to cool prior to refueling. Spill response materials shall be available when conducting refueling operations.

3.4.11 Electrical Hazards

Electrical equipment to be used during field activities will be suitably grounded and ed. Ground-fault circuit interrupters (GFCI), or equivalent, will be used with electrical equipment to reduce the potential for serious electrical shock. Electrical equipment including batteries, generators, panels and extension cords shall be kept dry during use. Extension cords may not be used as a permanent means of providing power and will be removed from service if they are worn, frayed, or if the grounding prong is missing.

Extension cord precautions include the following:

- Be aware of exposed or bare wires, especially on metal grating. Warning: Electrical contact with metal can cause fatal electrocution.
- Prior to use, inspect cords for exposed or bare wires, worn or frayed cords, and incorrect splices. Splices are permitted, but there must be insulation equal to the cable, including flexibility.
- Cables and extension cords in passageways, steps or any area where there may be foot traffic should be secured so as to not create a tripping hazard. Overhead cables and extension cords shall be rigged to a height greater than 6 feet.
- Shield extension cords that must run across driveways or areas where vehicle traffic is present.
- Do not run cords across doorways or windows where they can be frayed or cut by a closed door or window.
- Do not run wires through wet or puddled areas.
- Flexible cord sets that are used on construction sites or in damp locations shall be of hard usage or extra hard usage type.

Observation of energized machinery will take place from a safe distance. Only qualified personnel will remove guards, hatch covers, or other security devices if necessary. Equipment lockout procedures and the appropriate facility work permit requirements will be followed. Lockout/tagout procedures will be conducted before activities begin on or near energized or mechanical equipment that may pose a hazard to site personnel. Workers conducting the operation will positively isolate the piece of equipment, lock/tag the energy source, and verify effectiveness of the isolation. Only employees who perform the lockout/tagout procedure may remove their own tags/locks. Employees shall complete lockout/tagout training before initiating this procedure.

Only qualified personnel will remove covers of electrical equipment to expose energized electrical parts. Entering electrical rooms/vaults or areas with live exposed electrical part by BC employees shall be permitted only when accompanied by a qualified personnel after notification and approval of the appropriate facility personnel.

3.4.12 Lockout/Tagout

Lockout/tagout (LO/TO) procedures in accordance with 29 CFR 1910.147 will be performed before activities begin on or near energized or mechanical equipment that may pose a hazard to site personnel. The purpose of the lockout/tagout (LO/TO) system is to safeguard exposure from machinery, energized electrical circuits, piping under pressure, or any type of energy source from unexpected energization or start up that could cause harm to an individual. Workers conducting the operation will positively isolate the piece of equipment, lock/tag the energy source, and verify effectiveness of the

isolation. Only employees who perform the lockout/tagout procedure may remove their own tags/locks. Employees must be thoroughly trained before initiating this procedure.

Whenever multiple personnel (or multiple employers are working on the same worksite) are to be engaged in activities requiring LO/TO, employees/employers shall inform each other of their activities and coordinate their respective LO/TO procedures. When applicable, BC shall request an owner's representative to initiate the LO/TO procedure and apply the first lock. When initiated by others, BC will remove their locks prior to leaving a facility. Whenever a group lockout/tagout procedure must be performed, they shall utilize a procedure that affords the same level of protection as that provided by the implementation of a personal lockout or tagout device. Group LO/TO devices shall meet the requirements of 29 CFR 1910.145(f)(3).

Basic Lockout/Tagout Procedures

1. Each person will maintain their own lock, key, and lockout device so that no one else can remove the lock.
2. Always notify the operator when work is to be done.
3. Use your own lock to lock out electrical power. Attach a tag or sign to the power disconnect to indicate that maintenance work is in progress. Use the wording "Do Not Operate."
4. Bleed all pressure from pneumatic, hydraulic, or other fluid lines, or safely isolate them from the area where work is being done.
5. Drain contents of lines or tanks as needed. Lock valves open or closed to prevent buildup of pressure.
6. Ground electrical systems as needed.
7. Secure any device under tension or compression so as to prevent accidental movement. Move suspended parts that could drop or cycle to a safe position and block, clamp, or chain them in place.
8. Verify (test) that the mechanism has been isolated from the source of energy.
9. Ensure that all workers remove their individual locks after work is completed. The last worker should remove the locking devices.
10. Ensure that the last person double-checks that all is clear and safe before start-up.

Portable Equipment

Portable electrical equipment such as hand drills, computers, and power saws that use plug type connectors must be unplugged prior to any task that may expose the employee to energized portions of the equipment. Removal of the plug from the power source, such as the generator or wall socket, may be combined with a tagout system, particularly if the plug is at a distance from the equipment being repaired

3.4.13 Confined Spaces

Entry into confined spaces will be conducted in strict accordance with 29 CFR 1910.146. Confined spaces will be evaluated prior to entry to determine if hazards are present that could pose a risk to entrants. Before workers may enter a permit-required confined space, an entry permit must be completed by the PM or SSO, approved by the RSUM and, all requirements for entry must be met.

- Confined spaces may be described as having, but not being limited to, the following characteristics:
- is large enough to permit an employee to enter and perform work; and

- has limited or restricted means of entry and exit; and
- is not equipped, designed, or intended for continuous human occupancy.

If there is any serious health and safety hazard present in the confined space, the space is considered a permit-required confined space (permit space). A permit-space is a confined space that has one or more of the following characteristics:

- contains or has the potential to contain a hazardous atmosphere; or
- contains or has the potential to contain a material with the potential to engulf or entrap an employee; or
- is so configured that an employee may become trapped, disoriented, or asphyxiated by wall configurations or floors that taper to smaller cross sections; or
- contains any other established safety or health hazard (examples may include sources of energy, moving parts or thermal considerations).

All fluid, electrical, and steam lines and other sources of energy that could harm entrants must be completely isolated before entry. The following atmospheric conditions must be met before entry is permissible (air monitoring may be necessary to verify these conditions are met):

- flammable vapor or dust must be at a concentration less than 5 percent of the lower explosive limit (LEL); and
- oxygen must be at a concentration greater than 20 percent and less than 22 percent; and
- hydrogen sulfide concentration must be less than 5 parts per million (ppm); and
- toxic substances must be at a concentration less than half their respective permissible exposure limits or specified action limits.

In addition, the following roles must be designated before entry into permit-required confined spaces is allowed: Entry Supervisor; Attendant; and Authorized Entrant(s). Confined space entry for each project also requires training for the project team on written operating procedures, including the use of the Confined Space Entry Permit form.

BC employees are not trained in rescue services. Such services are to be arranged locally, prior to entry operations, by the PM. Rescue services can typically be provided by the local fire department or contracted service provider.

3.4.14 Fire/Explosion

Site workers should have an increased awareness concerning fire and explosion hazards whenever working with or near flammable materials, especially when performing any activity that may generate sparks, flame, or other source of ignition. Intrinsically safe equipment is required when working in or near environments with the potential for an explosive or flammable atmosphere. The SSO will verify facility requirements for a “hot work” permit before activities that may serve as a source of ignition are conducted.

Flammable materials will be kept away from sources of ignition. In the event of fire, work will cease, the area will be evacuated, and the local fire response team will be notified immediately. Only trained, experienced fire fighters should attempt to extinguish substantial fires at the Site. Site personnel should not attempt to fight fires, unless properly trained and equipped to do so. A fully charged ABC dry chemical fire extinguisher will be readily available for use during all scheduled activities at the Site.

3.4.15 Sharp Objects/Cutting Utensils

Frequently field tasks require the cutting of items such as rope, packaging or containers. Care should be exercised in using knives and/or cutting implements while performing such cutting tasks. Personnel should cut down and away from their body and other personnel. The item being cut should be braced or secured from movement while cutting. When slicing open acetate liners, such as those utilized in direct push drilling, personnel should use a hook blade cutting implement designed for this task versus a straight blade knife.

3.4.16 Cutting Acetate Sample Sleeves

The cutting of acetate sleeves presents a potential hazard to sampling personnel. By following proper procedures, the risk associated with this activity can be effectively minimized. To remove the soil sample the acetate liner must be cut with a bladed tool or knife. Knives are more frequently the source of disabling injuries than any other hand tool. The principal hazard in the use of knives is the hand slipping from the handle onto the blade or the blade strikes another part of the body. To prevent this, the following safety procedures should be followed:

- Provide a safety blade holder with a retraction spring on a track where blade mounts. Use a hook type linoleum blade which has a reduced cutting edge. When the hook of the blade is cutting the acetate liner it keeps the blade extended. If the blade breaks or the operator's hand slips the blade automatically retracts into the handle of the safety blade holder.
- Replace blades when they become dull. If material becomes hard to cut then the blade is dull.
- Wear leather cut-resistant (such as Kevlar) gloves.
- Wear safety glasses.
- The cutting stroke should be away from the body. If that is not possible, then the hands and body should be in the clear.
- Provide an angle iron device to place the liner in when cutting. This gives a holder for the liner.
- If you drop the knife, just let it fall to the ground and DO NOT try to catch it.
- If you lay the knife down, make sure the blade is retracted into the holder or the knife is placed in a protective holder.

3.4.17 Elevated Platforms / Working Surfaces

When working at heights that expose employees to falls greater than 6 feet, especially on sloping roofs and elevated platforms, the requirements of 29 CFR 1926.502 shall be observed. In such instances, a safety harness shall be worn and the lanyard secured at a level not lower than the employee's waist, limiting the free-fall distance to a maximum of 6 feet.

Elevated work platforms shall be constructed, used, and maintained in accordance with Subpart L of the OSHA Construction Safety Orders. Scaffolds and hoisting lines shall be inspected daily by a competent person to verify the integrity of the components. If a material is determined to be defective, it may not be used for any purpose and will be replaced immediately.

A standard railing shall consist of top rail, intermediate rail, toe board, and post. It shall have a vertical height of approximately 42 inches (±3 inches) from the top surface of the top rail to the floor, platform, runway, or ramp. The top rail shall have a smooth surface throughout. The intermediate rail shall be set half way between the top rail and the floor, platform, runway, or ramp.

A cover of standard strength and construction that is secured against accidental displacement shall guard floor holes, hatchways, or any other openings into which a person can walk. When the cover is not in place, the openings shall be guarded with a standard railing (equipped with a toe board) on all exposed sides. Any cover on floor openings shall be properly labeled or stenciled with letters at least one inch high or greater stating "OPENING – DO NOT REMOVE".

Personal Fall Protection Equipment

Full body harness is the only acceptable means of fall arrest for personnel working over surfaces greater than six feet in height. A Fall Arrest System consisting of safety harness and anchor lanyard must be worn by anyone working on elevated surfaces that lack "general" fall protection such as railings, etc.

Lanyards must be tied off at a point above the worker's head and to a firm structure or a portion thereof designed to hold a weight of 5,000 lbs. Only hooks with locking snaps that operate in "as new" condition will be used. These hooks are also referred to as "double action lanyard hooks".

When other possible means of fall protection (railings, etc.) are not available, individuals working at heights of less than 6 feet must tie-off if there is danger of impalement, especially if the impalement hazard cannot be mitigated in accordance with OSHA standards.

All workers must perform routine inspection of belts/harnesses and lanyards prior to their use. The employer shall conduct regular inspections (every three months) of all fall protection equipment. In addition, there shall be an inspection of all workers' personal tools and equipment prior to the employees using them on the job.

Lanyards are to be used for tie-off purposes only, and damaged belts, harnesses, and lanyards must be retired and discarded.

3.4.18 Ladder Use

Ladders are to be maintained in good condition at all times, with tight joints, hardware, and fittings securely attached, and moveable parts freely operating without binding or undo play. Defective ladders must be "tagged" out of service. Safety "feet" shall be kept in good condition. Ladders are to be visually inspected for possible signs of damage or defects daily, before each use.

Where possible, portable straight rung ladders shall be set up so that the horizontal distance from the top support to the foot of the ladder is ¼ of the working length of the ladder. The ladder shall be secured by tying it off to a firm point, or held in place by another worker while in use. If the ladder is used to gain access to a roof or platform, the side rails shall extend at least 3 feet beyond the point of support at the edge of the roof or platform.

Step ladders shall always be set up properly, so that they are in the "A" frame position, level and with all four feet on firm ground, and fully opened with the spreaders locked in place. Personnel are forbidden to stand on the top cap or on the last step of a step ladder, or to stand on the hinged back of a step ladder. A step ladder shall never be used at a straight ladder.

3.4.19 Traffic

Vehicular traffic presents opportunities for serious injury to persons or property. Traffic may consist of street traffic or motor vehicles operated by facility employees or visitors to the Site. Workers and other pedestrians are clearly at risk during periods of heavy traffic. Risk from motor vehicle operations may be minimized by good operating practices and alertness, and care on the part of workers and pedestrians.

Site personnel will wear high-visibility traffic safety vests whenever activities are conducted in areas of heavy traffic. Work vehicles will be arranged to be used as a barrier between site workers and nearby traffic. If required by local ordinances or site location, a traffic control plan will be developed and implemented. Consider using amber/yellow warning lights to alert traffic to the work zone. Note that amber/yellow warning lights may be required by specific clients or ordinances.

It is important to be conscious of all vehicular traffic that may be present during conduct of field operations. Use caution tape, barricades, or safety cones to denote the boundaries of the work area and to alert vehicle operators to the presence of operations which are non-routine to them. Be careful when exiting the work area and especially when walking out from between parked vehicles to avoid vehicular traffic.

Never turn your Back on Traffic. When working in or near a roadway, walk and work with your face to the oncoming traffic. If you must turn your back to traffic, have a coworker watch oncoming traffic for you.

Vehicle and Worksite Position. Whenever possible, place a vehicle between your worksite and oncoming traffic. Not only is the vehicle a large, visible warning sign, but if an oncoming car should fail to yield or deviate, the parked vehicle, rather than your body, would absorb the first impact of a crash. Turn the wheels so that if the vehicle were struck, it would swing away from the worksite. Even though the vehicle would protect you in a crash, it might be knocked several feet backward. Always leave some room between the rear of the vehicle and the work area.

Use of Signs and Cones to Direct Traffic. Traffic signs and cones are used to inform drivers and direct traffic away from and around you. Cones and signs are only effective if they give oncoming drivers enough time to react and make it clear how traffic should react.

Cone Positioning. The most common coning situation is setting a taper of cones that creates a visual barrier for oncoming motorists and gradually closes a lane.

The position of the taper depends on the road width, position and size of the work area, and also on the characteristics of the traffic.

3.4.20 Driving

A lot of driving is required to get to, from, and between project Sites. Safe vehicle maintenance and operation must be a priority. It requires knowledge of directions to (and conditions of) the Site in advance, careful exiting and merging into traffic, anticipating the unexpected, remaining alert to one's physical and mental condition, resisting distractions such as cell phone use, other car activities and contacting assistance when needed. Report all vehicle collisions/incidents to BC's Risk Manager.

3.4.21Arc Flash Protection

An arc flash is a short circuit through the air when insulation or isolation between electrified conductors is breached or can no longer withstand the applied voltage. Statistics show that there are 5 to 10 arc flash explosions a day near electrical equipment that result in hospitalization of a burn victim. An arc flash can be caused by common occurrences such as dropping tools, accidental contact with electrical systems, and build up of dirt or corrosion.

The temperature of an arc can reach more than 35,000 F as it creates a brilliant flash of light and a loud noise. Concentrated energy explodes outward from the electrical equipment, spreading hot gases, molten metal, causing death or severe burns, and creating pressure waves that can damage hearing or brain function and a flash that can damage eyesight. The fast-moving pressure wave also can send loose material such as pieces of equipment, metal tools, and other objects flying, injuring anyone standing nearby.

Regulations require the calculation of the "flash protection boundary" inside which qualified workers must be protected when working. This boundary is an imaginary sphere surrounding the potential arc point, "within which a person could receive a second-degree burn if an electrical arc flash were to occur," according to the National Fire Protection Association (NFPA) 70E standard. Brown and Caldwell's Health and Safety Manual gives direction of when and where to establish this boundary.

BC's Electrical Safety/Arc Flash Policy provides information and instruction for BC employees who work on or near energized power circuits, electrical distribution equipment, electrical utilization equipment and those who inspect energized equipment, where a phase-to-ground or phase-to-phase short or fault occurrence may cause an Arc Flash event.

BC employees must comply with BC's Electrical Safety and Lock-Out/Tag-Out Policy in the Health and Safety Manual and treat electrical equipment and circuits as energized until:

1. Lock-Out/Tag-Out protection is in place and the equipment or circuit has been tested to verify "no voltage" present, by a trained and qualified electrical worker, or
2. The equipment or circuit has been physically isolated from every power source, tested, and clearly labeled.

For those BC employees involved with energized electrical work (i.e. design verification, equipment check-out, or start-up adjustments), the following ordered approach must be used:

1. BC employees will seek to have a trained and qualified electrical worker perform all energized electrical hands-on work (i.e. switching, metering, testing, etc.) while BC employees remain outside the flash protection boundary, with the exception of those BC employees who have completed NFPA 70 E and have appropriately planned, including appropriate PPE, for the task.
2. BC employees that closely supervise work within the flash protection boundary should document the possible electrical hazards, appropriate PPE, and mitigation techniques to be implemented during the project with a detailed project work plan attached to this plan's appendices. The Electrical Safety Officer (ESO) or similarly qualified person must approve all project work plans with identified shock or arc flash hazards.
3. Prior to performing this work, the Project Manager (PM) will verify that the above-mentioned project work plan is prepared and approved and reviewed by the PM, the project field team, the SSO, and cognizant Health and Safety Manager.
4. Only BC employees with NFPA 70E Qualified Person training shall enter the flash protection boundary wearing the proper Personal Protective Equipment (PPE) and only for Hazard/Risk Categories 0-2 – see the 'Warning' section below.

WARNING

Qualified BC personnel are limited to work in Hazard/Risk Categories 0-2, and therefore only require PPE meeting the requirements of Hazard/Risk Categories 0-2.

Only qualified electricians may conduct work categorized as a Hazard/Risk Category of 3 or 4.

Qualified BC personnel are NOT to cross a flash protection boundary which involves a Hazard/Risk Category 3 or 4 situation.

BC employees and management shall review the Arc Flash policy in BC's Health and Safety Manual for detailed requirements.

Questions concerning this policy should be directed to the BC Electrical Safety Officer RSUM.

Definitions

Energized Electrical Work. Work performed on or near energized electrical systems or equipment with exposed components operating at 50 volts or greater. Electrical system testing, thought to be de-energized, but not yet proven to be (for example, a LO/TO effectiveness check).

Flash Protection Boundary. The distance from energized exposed electrical equipment at which an unprotected person will receive a curable burn: 2nd degree burn or blistering. Work performed inside this boundary requires that the person be a "qualified person" and the use of appropriate personal protective equipment (PPE) to protect against arc flash burns.

Newly installed/serviced electrical equipment may contain an Arc Flash Label that will identify the energy, hazard category and PPE requirements associated with the equipment. For all other unlabeled equipment, where the specific flash protection boundary (energy, hazard category, and applicable PPE) is not established or cannot be established first (prior to live electrical exposure), BC personnel must maintain a 4-foot minimum observation distance (10 feet is preferred) from the exposed (i.e. doors open, covers off) live electrical equipment rated 600V and below. In the event that the flash protection boundary must be crossed, qualified BC personnel will don PPE appropriate for Hazard/Risk Category 2. For equipment rated above 600V, BC personnel must maintain a 10-foot minimum observation distance and not enter the flash protection boundary unless qualified and approved to do so.

Qualified BC Employee. A person with the training and experience having knowledge of energized electrical equipment hazards from an operational standpoint and from the safety training standpoint.

Educational credentials alone do not make a person qualified. Determination of qualification must be established by the employee's supervisor or other designated knowledgeable management representative.

3.4.22 Boating Safety

Boating or similar activities on aerated water treatment ponds and/or tanks by BC personnel is not permitted. The aeration process affects the buoyancy of the liquid and therefore boats can not consistently stay afloat.

Performing work activities from a boat can present unique hazards to employees. The following guidelines can help mitigate the risk. The boat can become unstable if the weight in it is excessive or loaded improperly. Too much weight will reduce maneuverability and freeboard (the height of the boat sides above the water) and can increase the risk of sinking.

When boarding the boat, the operator must be sure that the boat is secure. With one hand on the boat, each employee should quickly lower themselves straight down into the center of the boat. A United States Coast Guard (USCG) certified personal floatation device will be worn by each BC employee in the boat. In addition, other USCG-required items (i.e., throwable cushion, retrieval line, etc.) will be present on the boat. To move around in a boat, one should step along the fore-and-aft centerline of the boat while the boat is held in place along the pier.

Do not board the boat while carrying equipment, rather first board the craft and then have someone hand in the equipment or place the equipment in the boat prior to launch The amount and location of weight is critical and can reduce the risk of capsizing. Weight should be kept towards the middle or centerline of the boat, both fore and aft and side to side, also the weight should be kept low to the bottom of the boat to reduce the center of gravity.

It is not anticipated that waves of substantial size will be encountered, however, if a wave approaches the boat, steer the bow towards the oncoming wave. Overloading the boat increases draw and the potential for swamping. Watercraft must be operated within the boat manufacturers weight limits.

Should the boat capsize, Brown and Caldwell personnel shall abandon the boat and return to shore as quickly as possible. It is important that the employees attempt to remove themselves from the water as soon as possible, and get inside and call for help. Hypothermia (cold stress) is a significant risk for anyone involved in a boating mishap due to the rapid conduction of body heat by cold water. Wet or dry suits are recommended for cold weather/cold water (less than 45° F) operations.

3.4.23 Water Hazards (non-boating activities)

Wading in streams poses a few natural hazards such as uneven terrain, and potentially dangerous water levels. Field work should be halted when there has been significant rainfall within the past 24 hours or during the course of a work day. The potential for rapidly rising water levels is present in many of these streams/rivers within the project area. SSO shall evaluate field conditions after a rainfall and halt field work if there is the possibility of the development of a hazardous condition.

Open Water

Streams or stormwater ditches may be located near freeways and highways. High stream flows commonly associated with storm events present a threat to workers. Slippery conditions, streamside vegetation, and unstable stream banks could cause a worker to fall into a stream. The risks of a fall include bodily injury, hypothermia and drowning. Work in and around streams will require the use of the buddy system for safety purposes. During storm events that cause streams and rivers to rise to dangerously high conditions, employees should discontinue their work until safe working conditions resume. Prior to entering water, employees must evaluate the need to wear PFDs, rubber boots, or waders and use them as is deemed necessary based on conditions present. Some factors to consider when evaluating the need to wear a PFD are stream current speed, stream bed material (e.g. slippery stones vs. small gravel/sand), water depth, and how far out from the bank the employee will be required to go into the stream.

Changing Water Levels

When precipitation falls in the area, water levels within the stream may change quickly. Rising water levels may be dangerous. All personnel should exit the stream once wet weather has occurred in the area. If the forecast calls for rain, the group should meet and discuss alternative activities that may be planned for the day. After a rain, the SSO must evaluate field conditions and halt field work if there is the possibility of the development of a hazardous condition. When walking in the stream, efforts will be made to walk in the shallow and/or slower moving parts of the stream whenever possible.

3.4.24 Building Collapse

Buildings collapse for a variety of reasons. Natural phenomena such as earthquakes, hurricanes, floods, mudslides, avalanches, and storms are the usual cause for building collapses. Vacant buildings may be at risk for collapse since maintenance-related activities have been often neglected thus resulting in structural damage.

Project personnel should attempt to answer the following questions whenever working near suspect building structures:

- Are there any vacant buildings present on site?
- Will it be necessary to enter or work next to the vacant building(s)?
- Are there any apparent hazards including external damage, falling objects, sticky doors, structural instability, or possible asbestos and/or lead paint?

  - External damage may include, but not necessarily be limited to, foundation cracks, damaged or missing porch roofs and overhangs, supports, gaps between steps and the structure, missing supports or portions of walls, and “washed away” ground.
  - Falling objects may include, but not necessarily be limited to, building cornices, gutters, bricks, and roofs/roofing materials.
- Be aware that when entering a building, if the door sticks at the top it could mean the ceiling is ready to fall. If you force the door open, stand outside the doorway clear of falling debris.
- Has the building(s) been inspected by a qualified professional and deemed safe for entry?
- Are there any viable alternatives for conducting work that preclude the need to enter or work next to the suspect building(s)?

If you have any concerns about entering the building after answering the above questions, speak with the PM immediately. The client will need to be informed that a proper building inspection or engineering controls may be needed before work can be performed.

If you don't feel safe entering a building, notify the PM and RSUM and stay outside the building at an appropriate distance to avoid falling debris.

3.4.25 Removing/Replacing Manhole Covers

Manhole structures are the principal means of access into wastewater collection systems and into other underground utilities and facilities. In general, manhole entries are conducted to determine the physical conditions of manholes and pipelines, collect data, and for maintenance activities.

Removing and replacing manhole covers can present potential hazards (overexertion, struck by, caught between, contaminated air, traffic, etc.) to personnel. Therefore, personnel should always first seek to have client or contractor personnel remove and install the manhole cover whenever possible. If this is not possible, then BC personnel need to plan and carefully consider all the potential hazards and controls associated with the removal and installation. Hard hat, safety glasses, safety boots, and leather/cut-resistant gloves must be used when attempting to remove manhole covers.

When working in the vicinity of an open sewer manhole, air monitoring must be performed to verify that the atmosphere is safe for work activities. At no time are personnel to break the plane of the manhole with any part of their body. Where entry must be made, the requirements of the Confined Spaces section of this HASP must be complied with at all times (i.e. training, air monitoring, ventilation, permitting, rescue, etc.).

General Procedures for Removing/Replacing Manhole Covers

The following are general guidelines for the removal and replacement of manhole covers. Use procedures as they apply to the specific covers to be removed. Additional tools or different procedures may be necessary for a particular location.

Freeing the Manhole Cover

When the cover is stuck in its frame, remove any encrustation with a cold chisel. Next, place a block of wood on the cover near the rim and hit the block of wood with a heavy hammer. Do this at different points around the rim until the cover has loosened.

Unseating the Manhole Cover

Lift the cover with the Hook and Lifter tool. Next, attach the hook and lifter tool to the outer edge/rib before trying to move the cover. Unseat the cover, about four inches, by pulling and lifting with a fluid motion.

Removing the Manhole Cover

Evaluate the area surrounding the manhole cover to be removed and verify conditions that could present a hazard during removal have been properly mitigated. Use proper body mechanics – using the leg and arm muscles to lift and pull the cover – don't use your back.

With your feet properly positioned evenly apart and footing secure, pull the cover clear of the frame. Once clear of the frame keep pulling the cover with a steady motion and remove it from the work area. Potential pinch points exist to the hands, fingers, and feet. Never place your hands, fingers, or feet under the manhole cover. Whenever possible, have someone assist with the removal and replacement of the manhole cover.

Replacing the Manhole Cover

Stand parallel to the desired direction of travel for moving the manhole and check the cover frame of the manhole to make sure it is free of any obstructions or debris.

Place the point of the Hook and Lifter tool under the edge of the cover, lift slightly, and drag the cover toward its frame.

Move to the opposite side of the cover and repeat the lifting and dragging motion.

Continue alternating the lifting and dragging until the cover is partially over the manhole frame.

With the hook, lift the edge that is farthest from the opening until the cover slides into the frame of the manhole.

Check the cover for proper seating in the manhole cover frame.

3.4.26 Personal Safety - Urban Setting

Working in a distressed neighborhood may present hazards associated with street violence or other crime. In these situations, mental preparation before going to the Site and awareness while on Site are of key importance. If in doubt, always ask Site or client personnel about the safety of a neighborhood. Forethought should be given to arranging to work during daylight hours if possible. Take advantage of any Site security measures (monitoring cameras, security guards) and investigate such measures prior to the field work. Once in the field, work in parties of two or more and stay within view of the general public. Keep a charged cell phone nearby or on your person at all times. Become familiar with your location so you can effectively communicate it over the phone.

In addition to these basic principals, the following is a list of common personal safety rules that apply not only to work at the Site, but to general safety practices while in the field and also between work shifts:

- If at all possible, work/travel in groups. Do not venture out alone.
- Be alert. Notice who passes you and who's behind you. Maintain distance between yourself and strangers. Know where you are, and note potential exit paths.
- If work has paused, do not appear slack or distracted. Do not sit in a vehicle with the doors unlocked.
- Walk in well-lighted areas. Don't walk close to bushes, alleys, and so on. In dark or deserted neighborhoods, walk down the middle of the street (be alert to vehicle traffic).
- If a car pulls up slowly, or the occupants of the vehicle bother you, cross the street and walk or run in the other direction. If you are pursued, dial 911.
- If you feel someone is following you, turn around and check. Proceed to the nearest lighted house or place of business.

- Don't overburden yourself with bags or packages, which might impede running or taking care of yourself.
- Be aware of loose clothing, packs/purses and hair. These give an assailant an easier method of grabbing and controlling you. Wear unrestrictive clothing for ease of movement (but not overly loose).
- Carry a non-weapon personal safety device (such as a whistle, panic button, or key light) - anything that could visually or audibly draw attention to your location.
- What you carry in your hand(s) is important. Valuables make you a potential target. Items such as a hand auger or tool may help you be perceived as a less-than-inviting victim.
- Carry as little cash as possible.
- Hold your purse tightly, close to your body. Keep your wallet in a front or in a buttoned, hip pocket. When at a fixed location, lock your valuable items away and out of site (i.e., in a trunk).
- Be careful when people stop you for directions or information. Always reply from a distance; never get too close to a stranger's car.
- If you feel that you are in danger, don't be afraid to scream and run.
- Toss wallet/keys away from direction of escape.
- Don't attach car keys to house keys.
- Leave large valuables (purse, laptop) locked and hidden in the vehicle.

3.5 Natural Phenomena

Natural phenomena such as weather-related emergencies and acts of nature can affect employees' safety. Natural phenomena can occur with little or no warning. If an emergency situation arises as a result of natural phenomena, adhere to the contingency procedures outlined in Section 10. The following natural phenomena have been identified and may be encountered during scheduled field activities.

- ☒ **Sunburn**
- ☒ **Cold Stress**
- ☒ **Hurricanes/Nor' Easters**
- ☐ Earthquakes
- ☒ **Heat Stress**
- ☒ **Lightning/Electrical Storms**
- ☐ Tornados and Strong/Straight Line Winds
- ☒ **Flooding**

3.5.1 Sunburn

Working outdoors with the skin unprotected for extended periods of time can cause sunburn to the skin. Excessive exposure to sunlight is associated with the development of skin cancer. Field staff should take precautions to prevent sunburn by using sunscreen lotion and/or wearing hats and long-sleeved garments.

3.5.2 Heat Stress

Climate conditions, particularly heat, are important considerations in planning and conducting site operations. Heat-related illnesses range from heat fatigue to heat stroke, with heat stroke being the most serious condition. Workers should be trained and aware of signs and symptoms of heat-related illnesses, as well as first aid for these conditions. These are summarized in the table below. The SSO and site workers will monitor each other for signs of heat stress. If an employee exhibits signs or symptoms of heat-related illness, the SSO, or designee, must be notified and the appropriate response procedures initiated.

Heat Related Illness			
Condition	Signs	Symptoms	Response
Heat Rash or Prickly Heat	Red rash on skin.	Intense itching and inflammation.	Increase fluid intake and observe affected worker.
Heat Cramps	Heavy sweating, lack of muscle coordination.	Muscle spasms, and pain in hands, feet, or abdomen.	Increase fluid uptake and rest periods. Closely observe affected worker for more serious symptoms.
Heat Exhaustion	Heavy sweating; pale, cool, moist skin; lack of coordination; fainting.	Weakness, headache, dizziness, nausea.	Remove worker to a cool, shady area. Administer fluids and allow worker to rest until fully recovered. Increase rest periods and closely observe worker for additional signs of heat exhaustion. If symptoms of heat exhaustion recur, treat as above and release worker from the day's activities after he/she has fully recovered.
Heat Stroke	Red, hot, dry skin; disorientation; unconsciousness	Lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse.	Immediately contact emergency medical services by dialing emergency medical services. Remove the victim to a cool, shady location and observe for signs of shock. Attempt to comfort and cool the victim by administering small amounts of cool water (if conscious), loosening clothing, and placing cool compresses at locations where major arteries occur close to the body's surface (neck, underarms, and groin areas). Carefully follow instructions given by emergency medical services until help arrives.

The effects of ambient temperature can cause physical discomfort, loss of efficiency, and personal injury, and can increase the probability of mishaps. In particular, protective clothing that decreases the body's ventilation can be an important factor leading to heat-related illnesses.

To reduce the potential for heat-related illness, workers are encouraged to drink plenty of water/fluids to stay properly hydrated. in addition, a work schedule will be established that will provide sufficient rest periods for cooling down (at least five minutes when workers feel the need to do so) and have access to shade from the sun (which, in addition to natural shade or canopies, includes resting inside a vehicle with the air conditioner running). Personnel must maintain an adequate supply of non-caffeinated drinking fluids on site for personal hydration – a minimum of one quart of water per employee per hour.

3.5.3 Cold Stress

Workers performing activities during winter and spring months may encounter extremely cold temperatures, as well as conditions of snow and ice, making activities in the field difficult. Adequate cold weather gear, especially head and foot wear, is required under these conditions. Workers should be aware of signs and symptoms of hypothermia and frostbite, as well as first aid for these conditions. These are summarized in the table below.

Cold Stress Symptoms and Response			
Condition	Signs	Symptoms	Response
Hypothermia	Confusion, slurred speech, slow movement.	Sleepiness, confusion, warm feeling.	Remove subject to a non-exposed, warm area, such as truck cab; give warm fluids; warm body core; remove outer and wet clothing and wrap torso in blankets with hot water bottle or other heat source. Get medical attention immediately.

Cold Stress Symptoms and Response			
Condition	Signs	Symptoms	Response
Frostbite	Reddish area on skin, frozen skin.	Numbness or lack of feeling on exposed skin.	Place affected extremity in warm, not hot, water, or wrap in warm towels. Get medical attention.
Trench Foot	Swelling and/or blisters of the feet	Tingling/itching sensation; burning; pain in the feet	Remove wet/constrictive clothing and shoes. Gently dry and warm feet with slight elevation. Seek medical attention.

3.5.4 Lightning/Electrical Storms

Lightning can be unpredictable and may strike many miles in front of, or behind, a thunderstorm. Workers will therefore cease field operations at the first sign of a thunderstorm and suspend activities until at least 30 minutes after the last observed occurrence of lightning or thunder. For purposes of this HASP, signs of a thunderstorm will include any visible lightning or audible thunder.

In the event of a thunderstorm, field personnel will take the following actions:

- Get inside a permanent building structure (not a shed or canopy) or fully enclosed metal vehicle (not a convertible or camper shell) with the windows fully up.
- If in a house or building, do not use the telephone or any electrical appliance that's connected to the building's electrical wiring.
- Stay away from tall isolated objects, such as trees, drill rigs, telephone poles, or flag poles.
- Avoid large open areas, such as fields or parking lots, where a person is the relatively highest object.
- Stay away from lakes, ponds, railroad tracks, fences, and other objects that could transmit current from a distant lightning strike.
- If caught out in the open without time to escape or find shelter, seek a low area (if time permits), crouch down, and bend forward holding the ankles. Tuck the head so that it's not the highest part of the body, without letting it touch the ground. Under no circumstances lay down.

If a person is struck by lightning contact emergency medical services, even if he/she appears only stunned or otherwise unhurt as medical attention may still be needed. Check for burns, especially at fingers and toes, and areas next to buckles and jewelry.

3.5.5 Hurricanes/Nor' Easters

The key to responding to hurricane conditions is being informed. Before taking to the roads to leave for or from a jobsite during suspect hurricane conditions, listen to the radio for current and forecast conditions. Know what the weather reports mean by "watch" and "warning." A hurricane watch means hurricane conditions are possible in the specified area of the watch, usually within 36 hours. A hurricane warning indicates hurricane conditions are expected in the specified area of the warning, usually within 24 hours.

If watch or warning conditions exist, employees will communicate with the project manager to determine the appropriate course of action. Travel to or from work is not recommended if the employee will travel in the vicinity of a hurricane warning area. Restrictions on travel during hurricane watches are largely dependent on the actual weather conditions at the time. Employees are discouraged from driving during weather conditions where visibility and vehicle control are severely limited.

Nor'easters have the potential to cause as much damage as hurricanes, with powerful winds, rain or snow and large waves. They can pound and erode beaches with heavy surf, affect inland areas with flooding, or coat the land with thick layers of ice and snow.

Nor'easters result from the counterclockwise rotation of a low pressure system and the clockwise rotation of a high pressure system, combining to bring wind and moisture to the northeast. The nor'easter's ferocity will depend on the strength of the two systems.

One reason nor'easters are so dangerous is that they tend to move much more slowly than hurricanes. That slow movement allows the storm's effects to accumulate in a given area.

A nor'easter's wind circulation can cause tidal waters in back bays to be held in place, and not allow the water to drain through inlets and into the ocean. The accumulation of more and more water in tidal areas can cause widespread flooding.

Nor'easters can occur all year long, but are primarily a risk between September and April.

In the event of a hurricane or nor' easter, be prepared by:

- Checking NOAA Weather Radio All Hazards, your local radio and TV stations (i.e, The Weather Channel) for updates, watches, warnings or emergency instructions.
- Know the Coastal Evacuation Route for coastal areas or an inland area with chronic flooding.

For long term projects with temporary or permanent office area, keep an emergency preparedness kit consisting of, but not limited to:

- Current project/office contacts list – (how to reach folks in an emergency),
- Blankets,
- Flashlights,
- Radio (operated by batteries),
- Batteries for flashlight and radio (note: batteries should be replaced annually to assure freshness) ,
- Water (unless there is a water bubbler that can be used with no electricity), and
- Snack crackers, dried fruit, etc. - a source of food that won't go bad.

3.5.6 Tornados and Strong/Straight Line Winds

Tornados and strong or straight line winds are potentially dangerous weather conditions because both have the ability to generate on very short notice (in some cases under one hour from clear weather conditions). Tornados and strong or straight line winds both have the same warning properties and recommendations. If a tornado "watch" is issued for your area, it means that a tornado is "possible". If a tornado "warning" is issued, it means that a tornado has actually been spotted, or is strongly indicated on radar, and it is time to go to a safe shelter immediately.

Be alert to what is happening outside, but do not place yourself in jeopardy by standing next to windows. Some common observations during a tornado include: a sickly greenish or greenish-black color to the sky; if there is a watch or warning announced or posted; an abrupt fall of hail (however, hail can occur in the absence of a tornado); a strange quiet that occurs within or shortly after a thunderstorm; clouds moving by very fast, especially in a rotating pattern or converging toward one area of the sky; a sound like a waterfall or rushing air at first, but turning into a roar as it comes closer (the sound of a tornado has been likened to that of both railroad trains and jets); debris dropping from the sky; an obvious "funnel-shaped" cloud that is rotating; or debris such as branches or leaves being pulled upwards, even if no funnel cloud is visible.

During a tornado warning or tornado occurrence, each employee is instructed to do the following:

- Proceed to interior rooms and halls on the lowest floor (do not use an elevator to exit an upper floor). Avoid halls that open to the outside in any direction. If there are no interior hallways,

avoid those that open to the southwest, south, or west, since that is usually the direction from which the tornado will come.

- Stay away from glass, both windows and doors. Crouch down, and make as small a "target" as possible. If you have something with which to cover your head, do so, otherwise, use your hands.
- Exercise extreme caution when leaving your area of shelter. Be aware of potential hazards (i.e., natural gas smell, smoke, fire). In the event these hazards are encountered in your area of shelter, immediately evacuate the shelter. If the building/shelter has been damaged by a tornado, do not flush the toilets, as the sewer lines may have been damaged.
- If you are traveling in an automobile and can see a tornado, do not stay in your car and try to outrun a tornado. If possible, stop the car and enter the nearest business and seek shelter.
- If you are outside and it is not possible to get inside, seek a low lying ditch, culvert, etc. and keep your body as low to the ground and as braced as possible.

3.5.7 Earthquakes

Earthquakes strike suddenly, violently, and without warning. If your project is located near a fault line, earthquakes are an unpredictable possibility. For long term projects with temporary or permanent office area, keep an emergency preparedness kit consisting of, but not limited to:

- Current project/office contacts list - how to reach folks in an emergency,
- Blankets,
- Flashlights,
- Radio (operated by batteries),
- Batteries for flashlight and radio (note: batteries should be replaced as needed to assure freshness),
- Water (unless there is a water bubbler that can be used with no electricity), and
- Snack crackers, dried fruit, etc. - a source of food that won't go bad.

This kit is meant to serve as overnight survival in the event that it becomes unsafe to leave the project site. The kit's contents should be suited to meet the size and needs of your project. If you feel the earth shaking, consider the following tips:

- Drop down; take cover under a desk or table and hold on.
- Stay indoors until the shaking stops and you are sure it is safe to exit.
- Stay away from bookcases, shelves, or anything that could fall on you.
- Stay away from windows.
- If inside a building, expect fire alarms and sprinklers to go off during the quake.
- If you are outdoors, find a clear spot away from buildings, trees, and power lines. Drop to the ground and cover your head.
- If you are in a car, slow down and drive to a clear place, preferably away from power lines. Stay in the car until the shaking stops.

3.5.8 Flooding

Flooding may occur at or en-route to and from the Site and may be the result of weather conditions or due to thawing of ice and snow (especially in the Spring).

In the event flooding starts to occur:

– Stay tuned to NOAA Weather Radio All Hazards, your local radio and TV stations (i.e., The Weather Channel) for updates, watches, warnings or emergency instructions.

- Know the Coastal Evacuation Route for coastal area or an inland area with chronic flooding
- If the waters start to rise inside before you have evacuated, retreat to higher ground, including the roof. Use cell phone or land line to call for help. Take a flashlight and a portable radio. Then, wait for help. Don't try to swim to safety; wait for rescuers to come to you.
- Avoid flooded areas. Do not attempt to cross any flooded areas in a vehicle or on foot. Flood waters may be deeper than they look.
- Avoid low-lying areas like ditches, creeks, and rivers.
- Before entering or re-entering a building, check for any signs of structural damage.
- When entering a building, do not use matches, lighters, or open flame. Use a flashlight only.
- After a flood, steps and floors are often slippery with mud and covered with debris, including nails and broken glass. Be careful walking around.

3.6 Biological Hazards

The following biological hazards have been identified and may be encountered during scheduled field activities.

- ☐ Bloodborne Pathogens/Sanitary Waste
- ☒ **Reptiles/Snakes**
- ☒ **Mosquitoes**
- ☒ **Spiders/Scorpions**
- ☒ **Poisonous Plants**
- ☒ **Rodents and Mammals**
- ☒ **Venomous Insects**
- ☐ Fire Ants
- ☒ **Ticks**

If any biological hazards are identified at the Site, workers in the area will immediately notify the SSO and nearby personnel.

3.6.1 Bloodborne Pathogens/Sanitary Waste

Potential exposure to bloodborne pathogens may occur during some work activities (e.g., sewer video surveys or source sampling), rendering first aid or CPR. Direct contact is an important route of exposure for bloodborne pathogens due to puncture injuries, contact with abraded skin, or contact with areas such as the eyes, without appropriate protection. While very few organisms can enter the body through normal intact skin, direct contact with sewage, blood and body fluids is to be avoided. Site personnel should thoroughly wash their hands and face before eating, drinking or smoking and before leaving the work site.

Exposure controls and Universal Precautions are required at suspect locations, in order to prevent contact with blood or other potentially infectious materials as specified in Brown and Caldwell's Bloodborne Pathogens Program. All blood or other potentially infectious material will be considered infectious regardless of the perceived status of the source individual. A Hepatitis B vaccination will be offered to BC personnel before the person participates in a task where direct exposure to potentially infectious materials is a possibility (i.e., first aid or CPR). For personnel who have potential exposure to sanitary wastes, a current tetanus/diphtheria inoculation or booster is recommended.

3.6.2 Rodents/Mammals

Animals may potentially carry the rabies virus or disease causing agents. Do not attempt to feed or touch animals. Feces from some small mammals may contain diseases such as Hanta Virus. Avoid generating dust in the vicinity of rodent feces. In addition, animals such as dogs or wild predators (i.e., cougars or coyotes) may pose an attack hazard. Persons should slowly back away in a

non-threatening manner if an encounter with a threatening animal occurs. In order to avoid such encounters, use the buddy system and make noise when working in areas where such animals may be present.

3.6.3 Reptiles/Snakes

The primary reptiles of concern are venomous snakes (rattlesnake, water moccasin, and copperhead). Avoid contact and areas that may harbor snake populations including high grass, shrubs, and crevices. In the event of a bite, immobilize the affected area and contact emergency medical services. If more than 30 minutes from emergency care, apply bandage wrap two to four inches above the bite (note: bandage should be loose enough to slip your finger underneath).

Wear shoes and heavy pants when walking and hiking in areas where snakes are likely found. Do not reach into rocky cracks, under logs, or large rocks. Even if a snake looks dead, do not touch it. A snake can still bite up to one hour after its death. Do not get near or tease a snake. Snakes are shy creatures and generally will not attack unless bothered.

Diamond Back Rattle Snake

Diamond backs are large snakes. They have a row of dark diamonds down the back and a rattle on their tail. These snakes have cat-like eyes and a pit between their nostril and eye. Eastern diamond backs like pine flat woods and scrub areas where palmetto thickets and gopher tortoise burrows are found. These snakes travel during the day and hide at night.

Timber Rattle Snake

Timber rattle snakes have a reddish-brown stripe running down the center of their back and black cross bands. Their tails are solid black with a rattle. These snakes have cat-like eyes and a pit between their nostril and eye. Timber rattlers live in damp river beds, pine flat woods, swamps, and cane thickets.

Pygmy Rattle Snake

These small snakes are light to dark grey in color. They have a tiny rattle. Pygmy rattle snakes have cat-like eyes and a pit between their nostril and eye. These snakes are found in lowland pine flat woods, prairies, around lakes, ponds, and swamps. Pygmy rattlers are aggressive and will strike anything within striking range.

Cottonmouth (Water Moccasin)

Young cottonmouths are often mistaken for copperheads because of their reddish-brown cross bands. As these snakes age, their cross bands darken until they become almost solid black. Cottonmouths live near water sources like lakes, streams, rivers, ponds, and swamps. When threatened, cottonmouths may coil and open their mouths as though ready to bite. The white inside of the mouth is what gives this snake its name, "cottonmouth".

Copperhead

Copperheads have dark coppery red-brown hourglass cross bands on a lighter brown color. The top of the head is covered with large plate-like scales. Copperheads have cat-like eyes and a pit between their nostril and eye. These snakes live in rocky, wooded areas and low, wet swampy areas. Copperheads are sluggish and rarely bite, unless stepped on or touched.

Coral Snake

The body of this snake is ringed with black, yellow and red bands. (Remember: Red on yellow can kill a fellow. Red on black, venom lack.) The head of a coral snake is black, while the tail is black and yellow.

3.6.4 Venomous Insects

Common examples include bees, fire ants and wasps. Avoid contact with insects and their hives. If stung, remove the stinger by gently scraping it out of the skin (do not use tweezers). If the worker is stung by an insect, immediately apply an ice pack to the affected area and wash area with soap and water and apply antiseptic. If an allergic reaction occurs, contact emergency medical services for appropriate treatment. Seek medical attention immediately if you are allergic to venomous stings such as bees or if anaphylaxis symptoms are present.

3.6.5 Mosquitoes

Mosquitoes may transmit diseases such as West Nile Virus. Symptoms of West Nile Virus include: fever, headache, tiredness, body aches, and occasional rash. Avoid mosquito bites by wearing long sleeved shirt and long pants. Apply insect repellent to clothes and/or skin (if FDA approved for topical use). Report any dead birds in the area to local health officials. Mosquitoes are most active from dusk to dawn.

3.6.6 Fire Ants

Red and Black Fire Ants are capable of inflicting numerous stings (7 to 9) per ant in a matter of seconds, and large numbers of fire ants will typically attack at the same time. Fire ants are very aggressive and will sting simply upon coming in contact with skin. Individuals who are allergic to bees should carry bee sting kits when there is the potential to come in contact with fire ants. Fire ants are predominantly located in the southern United States.

The best way to avoid fire ants is to avoid disturbing their mounds. Fire ant mounds are typically constructed in disturbed habitats such as open fields, along roadsides, lawns, and many other open sunny areas. The mounds are constructed of dirt and/or other organic materials. Mounds are typically 10” to 24” in diameter and approximately 18” in height. If you disturb a mound, get away from the mound immediately.

Fire ant stings typically leave tiny red blisters and sometimes white pustules. Symptoms of stings include blistering, burning, swelling, pain, and irritation of the affected area. Recommended treatment consists of antihistamines along with topical antibiotic cream. Anaphylaxis symptoms such as shortness of breath, discomfort, lowered heart rate, etc. may also accompany fire ant stings. Seek medical attention immediately if you are allergic to venomous stings such as bees or if anaphylaxis symptoms are present.

3.6.7 Spiders/Scorpions

The black widow and brown recluse spiders are the most venomous. Avoid contact with spiders and scorpions and areas where they may hide. They favor dark hiding places. Inspect clothing and shoes before getting dressed. Wear gloves and safety shoes when working with lumber, rocks, inspecting buildings, etc. Signs and symptoms of bites include: headache, cramping pain/muscle rigidity, rash and/or itching, nausea, dizziness, vomiting, weakness or paralysis, and convulsions or shock. Wash bite area with soap and water and apply antibiotic cream. Contact emergency medical services if allergic reaction or severe symptoms occur.

3.6.8 Ticks

Deer ticks may carry and transmit Lyme disease to humans. Signs of Lyme disease include a reddish “bulls-eye” around the affected area approximately a week after the bite. Symptoms include headache, fever, and muscle/joint pain. Persons suspecting infection should contact a health professional. Whenever possible, avoid areas likely to be infested with ticks during the spring and summer months.

Wear light-colored clothing so ticks can be easily spotted and removed. Wear long sleeves and pants and tuck pant legs into boots or socks. Apply insect repellents to clothing and skin (if FDA approved for topical application). Persons with long hair should tie their hair back to minimize the potential for ticks to nestle in the scalp.

Personnel should self perform tick checks once daily field work is completed. If a tick is embedded in the skin, use tweezers to grasp the tick's head (near the skin) and pull straight out. Consider saving the removed tick for laboratory analysis.

3.6.9 Poisonous Plants

Common examples include poison ivy, poison oak and poison sumac. Avoid contact. Long-sleeved shirts and pants will allow some protection against inadvertent contact. If contact occurs, immediately wash the affected area thoroughly with soap and water. If an allergic reaction occurs, seek the care of a medical professional.

Poison Ivy is a trailing or climbing woody vine or a shrub-like plant with leaves that are each divided into three broad, pointed leaflets. The leaflets are commonly dark glossy green on top and slightly hairy underneath. They produce small yellowish or greenish flowers followed by berry-like drupes.

Poison Oak is a member of the same family as poison ivy and has a very similar appearance. Poison oak has leaves divided into three leaflets and generally has three to seven distinct lobes. Typically they are a shrubby type plant that can grow to eight feet in height, or sometimes can be a climbing plant.

The best way to prevent exposure is the ability to recognize these plants. Conduct an initial survey of the area to determine if the plants are present in the work area, and avoid contact with them.

If plants are located and work must be conducted in that area, have the plants removed if possible. If this is not possible, wear long sleeved shirts, gloves, and a heavy material type pants. Remember not to touch contaminated clothing. There are products available that can be applied to exposed skin, (similar to sunscreen products) prior to working around the plants. Tyvek suits may be another option used at the wearer's discretion to keep poisonous plant oils from getting on clothing. Please note that using Tyvek suits may increase the risk of heat stress conditions so extra precautions should be taken such as more frequent breaks and drinking plenty of fluids

Section 4

Personal Protective Equipment

The purpose of PPE is to protect employees from hazards and potential hazards they are likely to encounter during site activities. The amount and type of PPE used will be based on the nature of the hazard encountered or anticipated. Respiratory protection will be utilized when an airborne hazard has been identified using real-time air monitoring devices, or as a precautionary measure in areas designated by the RSUM or SSO.

Dermal protection, primarily in the form of chemical-resistant gloves and coveralls, will be worn whenever contact with chemically affected materials (e.g., soil, groundwater, sludge) is anticipated, without regard to the level of respiratory protection required.

On the basis of the hazards identified for this project, the following levels of personal protective equipment (PPE) will be required and used. Changes to the specified levels of PPE will not be made without the approval of the SSO after consultation with the RSUM.

4.1 Conditions Requiring Level D Protection

In general, site activities will commence in Level D PPE unless otherwise specified, or if the SSO determines on site that a higher level of PPE is required. Air monitoring of employee breathing zones will be routinely conducted using real-time air monitoring devices to determine if upgrading to Level C PPE is necessary. Level D PPE will be permitted as long as air monitoring data indicate that airborne concentrations of chemicals of concern are maintained below the site-specific action levels defined in Section 5.2. Level A or B PPE is not anticipated and is therefore not addressed in this plan. If Level A or B PPE is necessary, this HASP will be revised to reflect changes as appropriate.

It is important to note that dermal protection is required whenever contact with chemically-affected materials is anticipated. The following equipment is specified as the minimum PPE required to conduct activities at the Site:

- Work shirt and long pants,
- ANSI- or ASTM-approved steel-toed boots or safety shoes,
- ANSI-approved safety glasses,
- ANSI-approved hard hat (where required on-site or when overhead hazards are present);
- Outer nitrile gloves (11 mil or thicker) and inner nitrile surgical gloves when direct contact with chemically affected soils or groundwater is anticipated (nitrile surgical gloves may be used for collecting or classifying samples as long as they are removed and disposed of immediately after each sampling event);
- Full-body Tyvek suits (non-chemical resistant) to prevent exposure to ticks, chiggers and other insects, and
- High-visibility traffic safety vest.

Other personal protection readily available for use, if necessary, includes the following items.

- Chemical goggles when in contact with chemical liquids can be reasonably expected or when handling corrosive chemicals. In addition, a face shield may be required to protect the face from splash hazards.

- Chemical-resistant clothing (e.g., Tyvek or polycoated Tyvek coveralls) when contact with chemically affected soils or groundwater is anticipated.
- Safety shoes/boots with protective overboots or knee-high PVC polyblend boots when direct contact with chemically affected soils is anticipated.
- Hearing protection.
- Sturdy work gloves.

Work will cease and PPE upgraded if action levels specified in Section 5.2 are exceeded. The RSUM will be notified whenever PPE is upgraded or downgraded.

4.2 Conditions Requiring Level C Protection

If air monitoring indicates that the site-specific action levels defined in Section 5.2 are exceeded, workers in the affected area(s) will upgrade PPE to Level C. In addition to the protective equipment specified for Level D, Level C also includes the following items.

- NIOSH-approved half- or full-face air-purifying respirator (APR) equipped with appropriate cartridges (reference Section 5.2). Note: safety glasses are not required when wearing a full-face APR.

Respirators will be stored in clean containers (i.e., self-sealing bag) when not in use. Respirator cartridges will be replaced in accordance with the following change-out schedule.

Respirator Cartridge Replacement	
Type of Cartridge	Cartridge Change-out Schedule
Particulate (i.e., HEPA)	At least weekly or sooner the employee detects an increase in breathing resistance. This will occur as the filter becomes loaded with particulate matter.
Sorbent (i.e., organic vapor)	At the end of each day's use or sooner if the employee detects an abnormal odor or other indicator.

Personnel who wear air-purifying respirators must be trained in their use and must have successfully passed either a qualitative or quantitative respirator fit test, and medical evaluation within the last 12 months in accordance with and 29 CFR 1910.134.

4.3 Stop Work Conditions

If air monitoring indicates that the site-specific action levels defined in Section 5.2 are exceeded, activities will cease, and personnel must evacuate the designated Exclusion Zone. The PM and RSUM will be contacted immediately.

Work will also cease if unanticipated conditions or materials are encountered or if an imminent danger is identified. The SSO will immediately contact the RSUM for consultation.

Section 5

Air Monitoring Plan

Real-time air monitoring devices will be used to analyze airborne contaminant concentrations approximately every 15 minutes in the workers' breathing zones while workers are in the designated Exclusion Zone, or when task or exposure conditions change (whichever frequency is less). If elevated concentrations are indicated, the monitoring frequency will be increased, as appropriate.

Background concentrations will be determined at the beginning of each work shift by collecting several instrument readings upwind of the scheduled activities. Alternatively, background levels can be determined by collecting readings from a nearby (upwind) area that can reasonably be considered unaffected by Site activities.

Real-time measurements will be made as near as feasible to the breathing zone of the worker with the greatest exposure potential in each active work area. If authorized by the RSUM, real time measurements may cease being taken when sufficient historical data is generated to warrant its cessation. Air monitoring will be reinstated if potential exposure conditions change.

The equipment will be calibrated daily, and the results will be recorded on BC's Air Monitoring Form. The results of air monitoring will also be recorded on the Air Monitoring Form and will be retained in the project files following completion of field activities. A copy of the Air Monitoring Form is located in Appendix A.

5.1 Monitoring Instruments

On-site worker exposure to airborne contaminants will be monitored during intrusive site activities.

5.1.1 Photoionization Detector and Flame ionization Detector

A calibrated photoionization detector (PID) with a lamp strength of 10.6 eV or flame ionization detector (FID) will be used to monitor changes in personnel exposure to volatile organic compounds (VOCs). The SSO, or designee, will perform routine monitoring during site operations to evaluate concentrations of VOCs in employee breathing zones. If VOCs are detected above predetermined action levels specified in Section 5.2, the procedures found in Section 4 of this HASP will be followed.

5.1.2 Real-Time Aerosol Monitor

A miniature real-time aerosol monitor (mini-RAM or equivalent) will be used to monitor exposure to airborne dusts. The SSO, or designee, will perform routine monitoring during site operations to evaluate concentrations of airborne dusts in employee breathing zones. If airborne dusts are detected above predetermined action levels specified in Section 5.2, the procedures found in Section 4 of this HASP will be followed.

5.1.3 Colorimetric Tubes

A hand-held Draeger pump along with Cyanide 2/a colorimetric Draeger tubes will be used to monitor changes in exposure to cyanide during intrusive site activities if purifier wastes are encountered. Alternatively, a real-time cyanide detector (i.e., Draeger Pac III) may be used. The SSO, or designee, will perform routine monitoring during site operations to evaluate concentrations of cyanide in employee

breathing zones. If cyanide is detected above predetermined action levels specified in Section 5.2, the procedures found in Section 4 of this HASP will be followed.

In addition, Draeger tubes will be used to monitor for the presence of benzene per the action levels specified in the tables below.

5.1.4 Combustible Gas and Hydrogen Sulfide Gas Monitoring

A multi-gas detector will be used to monitor changes in levels/exposure to combustible gases (lower explosive limit; LEL) and hydrogen sulfide gas during intrusive site activities. The SSO, or designee, will perform routine monitoring during site operations to evaluate concentrations of target compound in the vicinity of boreholes, test pits, sewers, or elsewhere, as necessary. If target compounds are detected above predetermined action levels specified below, work will cease and the Regional Safety Unit Manager will be contacted immediately.

5.2 Site Specific Action Levels

The following action levels were developed for exposure monitoring with real-time air monitoring instruments. Air monitoring data will determine the required respiratory protection levels at the Site during scheduled intrusive activities. The action levels are based on sustained readings indicated by the instrument(s). Air monitoring will be performed and recorded at up to 15-minute intervals.

If elevated concentrations are indicated, the monitoring frequency will be increased, as appropriate. If during this time, sustained measurements are observed, the following actions will be instituted, and the PM and RSUM will be notified. For purposes of this HASP, sustained readings are defined as the average airborne concentration maintained for a period of one (1) minute above established background levels.

5.2.1 Action Levels for Volatile Organic Compounds

Draeger tubes will be used to determine the presence or absence of benzene when PID/FID readings exceed 1 ppm.

VOC – Action Levels		
Activity	**Action Level**	**Level of Respiratory Protection**
Soil-intrusive activities, including groundwater monitoring	< 5 ppm above background (no benzene indicated)	Level D: No respiratory protection required. Note: For PID/FID values above 1 ppm, benzene is to be analyzed for with a colorimetric tube.
	5 to 25 ppm above background (no benzene indicated) or Benzene indicated < 1.0 ppm (colorimetric tube)	Level C: Half- or full-face air-purifying respirator fitted with organic vapor cartridges: Increase engineering control efforts and re-monitor effectiveness. Note: For PID/FID values above 1 ppm, benzene is to be analyzed for with a colorimetric tube. Contact Director or RSUM prior to respirator upgrade.

VOC – Action Levels		
Activity	**Action Level**	**Level of Respiratory Protection**
	> 25 ppm above background (no benzene indicated) or Benzene indicated > 1.0 ppm (colorimetric tube)	Cease operations and evacuate work area. Contact Director or RSUM and PM immediately.

5.2.2 Action Levels for Airborne Dust

Dust – Action Levels		
Activity	**Action Level**	**Level of Respiratory Protection**
Soil-intrusive activities	< 0.5 mg/m^3 above background	Level D: No respiratory protection required.
	0.5 to 2.5 mg/m^3	Level C: Half- or full-face air-purifying respirator fitted with HEPA (P-100) cartridges: Increase engineering control efforts and re-monitor effectiveness. Contact Director and RSUM prior to respirator upgrade.
	> 2.5 mg/m^3	Cease operations and evacuate work area. Contact Director or RSUM and PM immediately.

5.2.3 Action Levels for Cyanide

Cyanide – Action Levels		
Activity	**Action Level**	**Level of Respiratory Protection**
Soil-intrusive activities if purifier wastes are encountered	< 2.5 ppm	Level D: No respiratory protection required.
	≥ 2.5 ppm	Cease operations and evacuate work area. Contact Director or RSUM and PM immediately.

5.2.4 Action Levels for Hydrogen Sulfide and LEL

Hydrogen Sulfide and LEL – Action Levels		
Activity	**Action Level**	**Level of Respiratory Protection**
Not Anticipated for this Project	< 5 ppm H_2S < 5% LEL	Level D: No respiratory protection required.
	< 5 ppm H_2S < 5% LEL	Cease operations and evacuate work area. Contact Director or RSUM and PM immediately.

5.3 Community Air Monitoring Plan

Community air monitoring will be performed in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan, included in Appendix F. Air monitoring readings will be recorded in a logbook and will be available for review by the NYSDEC and NYSDOH. Real-time air monitoring will be conducted during work activities for VOCs and particulates (i.e., dust). Air monitoring will be performed continuously for all ground intrusive activities.

The Community Air Monitoring Plan (CAMP) is not intended for use in establishing action levels for worker respiratory protection.

5.3.1 CAMP VOC Action Levels

The following action levels for VOCs are in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan:

Action Level	Response
Below 5 ppm above background for the 15-minute average	Continue and/or resume work activities
> 5 ppm above background for the 15-minute average	Temporarily halt work and continue monitoring
5 to < 25 ppm	Work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions and continue monitoring
> 25 ppm	Cease operations. Contact PM and BC Director of Health and Safety or designee immediately.

The NYSDOH CAMP is provided in Appendix F for additional details associated with work stoppage and restart.

5.3.2 CAMP Particulate Action Levels

The following action levels for particulates are in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan:

Action Level	Response
> 0.1 mg/m^3 above background for the 15-minute average or if airborne dust is observed leaving the work area	Employ dust suppression techniques

Action Level	Response
0.1 to 0.15 mg/m^3	Work may continue with dust suppression techniques provided downwind PM-10 particulate levels do not exceed 0.15 mg/m^3 above background for the 15-minute average and airborne dust is not observed leaving the work area
> 0.15 mg/m^3 with dust suppression techniques implemented	Cease operations. Contact PM and BC Director of Health and Safety or designee immediately.

The NYSDOH CAMP is provided in Appendix F for additional details associated with work stoppage and restart.

Section 6

Site Control Measures

The SSO will conduct a safety inspection of the work site before each day's activities begin to verify compliance with the requirements of the HASP. Results of the first day's inspection will be documented on the Site Safety Checklist. A copy of the checklist is included in Appendix B. Thereafter, the SSO should document unsafe conditions or acts, along with corrective action, in the project notes or field log book.

Procedures must be followed to maintain site control so that persons who may be unaware of site conditions are not exposed to hazards. The work area will be barricaded by tape, warning signs, or other appropriate means. Site equipment or machinery will be secured and stored safely.

Access to the specified work area will be limited to authorized personnel. Only BC employees and designated BC subcontracted personnel, as well as designated employees of the client, will be admitted to the work site. Personnel entering the work area are required to sign the signature page of this HASP, indicating they have read and accepted the health and safety practices outlined in this plan.

In some instances it may be necessary to define established work zones: an Exclusion Zone, a Contamination Reduction Zone, and a Support Zone. Work zones may be established based on the extent of anticipated contamination, projected work activities, and the presence or absence of non-project personnel. The physical dimensions and applicability of work zones will be determined for each area based on the nature of job activity and hazards present. Within these zones, prescribed operations will commence using appropriate PPE. Movement between zones will be controlled at checkpoints.

Considerable judgment is needed to maintain a safe working area for each zone, balanced against practical work considerations. Physical and topographical barriers may constrain ideal locations. Field measurements combined with climatic conditions may, in part, determine the control zone distances. Even when work is performed in an area that does not require the use of chemical-resistant clothing, work zone procedures may still be necessary to limit the movement of personnel and retain adequate site control.

Personnel entering the designated Exclusion Zone should exit at the same location. There must be an alternate exit established for emergency situations. In all instances, worker safety will take precedence over decontamination procedures. If decontamination of personnel is necessary, exiting the Site will include the decontamination procedures described in the following section.

Section 7

Decontamination Procedures

Decontamination will take place in the decontamination area identified on-Site. Workers, PPE, sampling equipment, and heavy equipment leaving the exclusion area will be inspected to determine the level of decontamination necessary to prevent the spread of potentially hazardous materials. Unnecessary equipment and support vehicles are to be left outside the designated Exclusion Zone so that decontamination will not be necessary.

Despite protective procedures, personnel may come in contact with potentially hazardous compounds while performing work tasks. If so, decontamination needs to take place using an Alconox or TSP wash, followed by a rinse with clean water. Standard decontamination procedures for levels C and D are as follows.

- equipment drop,
- boot cover and outer glove wash and rinse,
- boot cover and outer glove removal,
- suit removal,
- safety boot wash and rinse,
- inner glove wash and rinse,
- respirator removal,
- inner glove removal, and
- field wash of hands and face.

Site workers should employ only applicable steps in accordance with level of PPE worn and extent of contamination present. The SSO shall maintain adequate quantities of clean water to be used for personal decontamination (i.e., field wash of hands and face) whenever a suitable washing facility is not located in the immediate vicinity of the work area.

Disposable items will be disposed of in an appropriate container. Wash and rinse water generated from decontamination activities will be handled and disposed of properly. Non-disposable items (i.e., respirators) may need to be cleaned or sanitized before reuse. Each site worker is responsible for the maintenance, decontamination, and sanitizing of their own PPE.

Used equipment may be decontaminated as follows.

- Remove adhered materials (i.e., dirt or mud) to increase the effectiveness of the decontamination process.
- An Alconox or TSP and water solution may be used to wash the equipment.
- The equipment will then be rinsed with clean water until it is determined clean.

Each person must follow these procedures to reduce the potential for transferring chemically affected materials off site.

Section 8

Training Requirements

BC Site personnel, including subcontractors and visitors conducting work in controlled areas of the Site, must have completed the appropriate training as required by 29 CFR 1910.120. In addition, the SSO will have completed the 8-hour Site Supervisor course, have current training in first aid and CPR, and any additional training appropriate to the level of site hazards. Further site-specific training will be conducted by the SSO prior to the initiation of project activities. This training will include, but will not necessarily be limited to, emergency procedures, site control, personnel responsibilities, and the provisions of this HASP. Each employee will document that they have been briefed on the hazards identified at the site and that they have read and understand the requirements of this HASP by signing the H&S Plan Acknowledgement Form attached as Appendix C.

A daily morning briefing to cover safety procedures and contingency plans in the event of an emergency is to be included with a discussion of the day's activities. These daily meetings will be recorded on the Daily Tailgate Safety Meeting Form. A copy of the Daily Tailgate Safety Meeting Form is included in Appendix D.

Exception: When there is only one employee performing field activities for the project, a formal and documented daily tailgate safety meeting (or completion of the form) is not required. However, personnel are still expected to plan their work activities and attend any site specific safety meetings or training so that tasks are performed safely.

Section 9

Medical Surveillance Requirements

BC Site personnel, including subcontractors and site visitors, who will or may work in an area designated as an exclusion zone must have fulfilled the appropriate medical monitoring requirements in accordance with 29 CFR 1910.120(f). Each individual entering an exclusion zone must have successfully completed an annual surveillance examination and/or an initial baseline examination within the last 12 months.

Medical surveillance is conducted as a routine program for BC field staff in accordance with the requirements of 29 CFR 1910.120(f). There will not be any special medical tests or examinations required for staff involved in this project.

A Hepatitis B vaccination will be offered to BC personnel before the person participates in a task where direct exposure to potentially infectious materials is a possibility (i.e., first aid or CPR). For personnel who have potential exposure to sanitary wastes, a current tetanus/diphtheria inoculation or booster is recommended.

Section 10

Contingency Procedures

Minimum emergency equipment maintained on site will include a fully charged ABC dry chemical fire extinguisher, an adequately stocked first aid kit, and an emergency eyewash station (when corrosive chemicals are present). In addition, employees will consider maintaining the personal emergency supply items listed in Section 3: Natural Phenomena, as appropriate.

In the event of an emergency, site personnel will signal distress with three blasts of a horn (a vehicle horn will be sufficient), or other predetermined signal. Communication signals, such as hand signals, must be established where communication equipment is not feasible or in areas of loud noise.

It is the SSO's duty to evaluate the seriousness of the situation and to notify appropriate authorities. The first part of this plan contains emergency telephone numbers as well as directions to the hospital. Nearby telephone access must be identified and available to communicate with local authorities. If a nearby telephone is not available, a cellular telephone will be maintained on site during work activities. The operation of the cellular phone will be verified to confirm that a signal can be achieved at the work location.

The SSO, or designee, should contact local emergency services in the event of an emergency. After emergency services are notified, the PM and RSUM will be notified of the situation as soon as possible. If personal injury, property damage or equipment damage occurs, the PM and BC Risk Manager will be contacted as soon as practicable. An Incident Investigation Report will be completed within 24 hours by the SSO, or other designated person. A copy of the Incident Investigation Report is included in Appendix E.

10.1 Injury or Illness

If an exposure or injury occurs, work will be temporarily halted until an assessment can be made to determine it is safe to continue work. The SSO, in consultation with the RSUM, will make the decision regarding the safety of continuing work. The SSO will conduct an investigation to determine the cause of the incident and steps to be taken to prevent recurrence.

In the event of an injury, the extent and nature of the victim's injuries will be assessed and first aid/CPR will be rendered as appropriate. If necessary, emergency services will be contacted or the individual may be transported to the nearby medical center. The mode of transportation and the eventual destination will be based on the nature and extent of the injury. A hospital route map is presented at the front of this HASP.

In the event of a life-threatening emergency, the injured person will be given immediate first aid and emergency medical services will be contacted by dialing the number listed in the Critical Project Information section at the beginning of this plan. The individual rendering first aid will follow directions given by emergency medical personnel via telephone.

10.2 Vehicle Collision or Property Damage

If a vehicle collision or property damage event occurs, the SSO, or designee, will contact the BC Risk Manager for appropriate action.

10.3 Fire

In the event of fire, the alarm will be sounded and Site personnel will evacuate to a safe location (preferably upwind). The SSO, or designee, should contact the local fire department immediately by dialing 911. When the fire department arrives, the SSO, or designated representative, will advise the commanding officer of the location and nature of the fire, and identification of hazardous materials on site. Only trained, experienced fire fighters should attempt to extinguish substantial fires at the Site. Site personnel should not attempt to fight fires, unless properly trained and equipped to do so. Site personnel should not attempt to fight a fire if it poses a risk to their personal safety.

Note that smoking is not permitted in controlled areas (i.e., exclusion or contamination reduction zones), near flammable or combustible materials, or in areas designated by the facility as non-smoking areas.

10.4 Underground Utilities

In the event that an underground conduit is damaged during subsurface work, mechanized equipment will immediately be shut off and personnel will evacuate the area until the nature of the piping can be determined. Depending on the nature of the broken conduit (e.g., natural gas, water, or electricity), the appropriate local utility will be contacted.

10.5 Site Evacuation

The SSO will designate evacuation routes and refuge areas to be used in the event of a Site emergency. Site personnel will stay upwind from vapors or smoke and upgradient from spills. If workers are in an Exclusion or Contamination Reduction Zone at the start of an emergency, they should exit through the established decontamination corridors, if possible. If evacuation cannot be done through an established decontamination area, site personnel will go to the nearest safe location and remove chemically-affected clothing there or, if possible, leave it near the Exclusion Zone. Personnel will assemble at the predetermined refuge following evacuation and decontamination. The SSO, or designated representative, will count and identify site personnel to verify that all have been evacuated safely.

10.6 Spill of Hazardous Materials

If a hazardous material spill occurs, site personnel should locate the source of the spill and determine the hazard to the health and safety of site workers and the public. Attempts to stop or reduce the flow should only be performed if it can be done without risk to personnel.

Isolate the spill area and do not allow entry by unauthorized personnel. De-energize sources of ignition within 100 feet of the spill, including vehicle engines. Should a spill be of the nature or extent that it cannot be safely contained, or poses an imminent threat to human health or the environment, an emergency cleanup contractor will be called out as soon as possible. Spill containment measures listed below are examples of responses to spills.

- Right or rotate containers to stop the flow of liquids. This step may be accomplished as soon as the spill or leak occurs, providing it is safe to do so.
- Sorbent pads, booms, or adjacent soil may be used to dike or berm materials, subject to flow, and to solidify liquids.
- Sorbent pads, soil, or booms, if used, must be placed in appropriate containers after use, pending disposal.
- Contaminated tools and equipment shall be collected for subsequent cleaning or disposal.

Section 11

Documentation

The implementation of the HASP must be documented on the appropriate forms (see appendices) to verify employee participation and protection. In addition, the regulatory requirements must be met for recordkeeping on training, medical surveillance, injuries and illnesses, exposure monitoring, health risk information, and respirator fit-tests. Documentation of each BC employee's health and safety records is maintained by the Health and Safety Data Manager in Walnut Creek, California.

Health and safety documentation and forms completed, as specified by this plan, are to be retained in the project file.

Other relevant project-specific health and safety documents, such as MSDSs or client-specified procedures, will be attached to this HASP in Appendix F.

Appendix A:

Air Monitoring Form

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Air Monitoring Form

Instructions: Complete this form immediately prior to project start.
File in project folder when complete.

Name of Project/Site:	Project No:
Project/Site Location:	
Employee Performing Air Monitoring: (Print and Sign):	Date:

Instrument(s)

Manufacturer/Model:	Manufacturer/Model:
Manufacturer/Model:	Manufacturer/Model:

Does the instrument(s) have a current calibration per the manufacturer's instructions? ☐ Yes ☐ No

Was the instrument(s) field checked (i.e bump tested or field calibrated) per the manufacturer's instructions? ☐ Yes ☐ No

Remarks:

Monitoring Data

TIME	LOCATION AND ACTIVITY	P/FID (PPM)	COLORIMETRIC TUBES (PPM)	RAM (mg/m³)	MULTI-GAS DETECTION %LEL	H2S	O2	OTHER

Appendix B:

Site Safety Checklist

Brown AND Caldwell

Site Safety Checklist

Instructions: Complete this form immediately prior to project start.

File in project folder when complete.

Name of Project/Site:	Project No:
Project/Site Location:	
Employee Completing Checklist: (Print and Sign):	Date:

Yes	No	N/A		Yes	No	N/A	
☐	☐	☐	Written Health and Safety (H&S) Plan is on site?	☐	☐	☐	Respirators are available, properly cleaned, and stored?
☐	☐	☐	Addenda to the H&S Plan are documented on site?	☐	☐	☐	Overhead utilities do not present a hazard to equipt./personnel?
☐	☐	☐	H&S Plan information matches conditions/activities at the site?	☐	☐	☐	Traffic control measures have been implemented?
☐	☐	☐	H&S Plan read/signed by all site personnel, including visitors?	☐	☐	☐	Trenches and excavations are safe for entry?
☐	☐	☐	Daily tailgate H&S meetings have been held/documented?	☐	☐	☐	Soil Spoils are at least 2 feet from the edge of the excavation?
☐	☐	☐	Site personnel have required training and medical?	☐	☐	☐	Emergency/FA equipt. is on site as described in the H&S Plan?
☐	☐	☐	Air monitoring is performed/documented per the H&S Plan?	☐	☐	☐	Drinking water is readily available?
☐	☐	☐	Air monitoring equipment has been calibrated daily?	☐	☐	☐	Phone is readily available for emergency use?
☐	☐	☐	Site zones are set up and observed where appropriate?	☐	☐	☐	Utility locator has cleared subject locations?
☐	☐	☐	Access to the work area limited to authorized personnel?	☐	☐	☐	Proper drum and material handling techniques are used?
☐	☐	☐	Decontamination procedures followed/match the H&S Plan?	☐	☐	☐	Waste containers/drums are labeled appropriately?
☐	☐	☐	Decontamination stations (incl. hand/face wash) are set up and used?	☐	☐	☐	Ext. cords are grounded/protected from water/vehicle traffic?
☐	☐	☐	PPE used matches H&S Plan requirements?	☐	☐	☐	Tools and equipment are in good working order?
☐	☐	☐	Hearing protection used where appropriate?	☐	☐	☐	GFCIs used for portable electrical tools and equipment?

Notes

(All "no" answers must be addressed and corrected immediately. Note additional health and safety observations here):

Appendix C:

H&S Plan Acknowledgement Form

H&S Plan Acknowledgement Form

Instructions: Complete this form immediately prior to project start or as new personnel join the project.
File in project folder when complete.

Name of Project/Site:	Project No:
Project/Site Location:	
Employee Performing Briefing: (Print and Sign):	Date:

Employee Acknowledgement:

The following signatures indicate that these personnel have read and/or been briefed on this Health and Safety (H&S) Plan and understand the potential hazards/controls for the work to be performed.

Important Notice to Subcontractor(s):

Subcontractors are responsible for developing, maintaining, and implementing their own health and safety programs, policies, procedures and equipment as necessary to protect their workers, and others, from their activities. Subcontractors shall operate equipment in accordance with their standard operating procedures as well as manufacturer's specifications. Any project monitoring activities conducted by BC at the Site shall not in any way relieve subcontractors of their critical obligation to monitor their operations and employees for the determination of exposure to hazards that may be present at the Site and to provide required guidance and protection. If requested, subcontractors will provide BC with a copy of their own H&S Plan for this project or other health and safety program documents for review.

BC's Health and Safety Plan has been prepared specifically for this project and is intended to address health and safety issues solely with respect to the activities of BC's own employees at the site. A copy of BC's H&S Plan may be provided to subcontractors in an effort to help them identify expected conditions at the site and general site hazards. The subcontractor shall remain responsible for identifying and evaluating hazards at the site as they pertain to their activities and for taking appropriate precautions. For example, BC's H&S Plan does not address specific hazards associated with tasks and equipment that are particular to the subcontractor's scope of work and site activities. (e.g., operation of a drill rig, excavator, crane or other equipment). Subcontractors are not to rely on BC's H&S Plan to identify all hazards that may be present at the Site. Subcontractor personnel are expected to comply fully with subcontractor's Health and Safety Plan and to observe the minimum safety guidelines applicable to their activities which may be identified in the BC H&S Plan. Failure to do so may result in the removal of the subcontractor or any of the subcontractor's workers from the job site.

Print	Sign	Date	Print	Sign	Date

Appendix D:

Daily Tailgate Meeting Form

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DAILY TAILGATE MEETING FORM

Name of Project/Site:	**Project No:**
Project/Site Location:	
Employee Completing Form (*print and sign*):	**Date:**

Employee Acknowledgement:

The following signatures indicate that these personnel have read and/or been briefed on this Health and Safety (H&S) Plan and understand the potential hazards/controls for the work to be performed.

Important Notice to Subcontractor(s):

Subcontractors are responsible for developing, maintaining, and implementing their own health and safety programs, policies, procedures and equipment as necessary to protect their workers, and others, from their activities. Subcontractors shall operate equipment in accordance with their standard operating procedures as well as manufacturer's specifications. Any project monitoring activities conducted by BC at the Site shall not in any way relieve subcontractors of their critical obligation to monitor their operations and employees for the determination of exposure to hazards that may be present at the Site and to provide required guidance and protection. If requested, subcontractors will provide BC with a copy of their own H&S Plan for this project or other health and safety program documents for review.

BC's Fieldwork Safety Plan has been prepared specifically for this project and is intended to address health and safety issues solely with respect to the activities of BC's own employees at the site. A copy of BC's H&S Plan may be provided to subcontractors in an effort to help them identify expected conditions at the site and general site hazards. The subcontractor shall remain responsible for identifying and evaluating hazards at the site as they pertain to their activities and for taking appropriate precautions. For example, BC's H&S Plan does not address specific hazards associated with tasks and equipment that are particular to the subcontractor's scope of work and site activities. (e.g., operation of a drill rig, excavator, crane or other equipment). Subcontractors are not to rely on BC's H&S Plan to identify all hazards that may be present at the Site. Subcontractor personnel are expected to comply fully with subcontractor's Fieldwork Safety Plan and to observe the minimum safety guidelines applicable to their activities which may be identified in the BC H&S Plan. Failure to do so may result in the removal of the subcontractor or any of the subcontractor's workers from the job site.

Print	Sign	Date	Print	Sign	Date

Plan of the Day

(Describe the activities that are planned to be performed today)

Potential Hazards and Topics Discussed

(Describe the potential hazards and controls that may be associated with planned activities)

☐ Physical ☐ Natural Phenomena ☐ Chemical ☐ Electrical ☐ Biological ☐ Radiological

☐ Other (specify):

Place a copy in the project file.

Appendix E:

Incident Investigation Report

Preliminary Incident Investigation Report Form

Privileged and Confidential
Do Not Distribute

Instructions:

If an incident occurs, complete all applicable information in this form, make a copy for your records, and immediately forward the original to the office Health and Safety Coordinator (HSC). If fields are not applicable, indicate with "N/A". Use separate sheet(s) if necessary and attach sketches, photographs, witness statements, or other information that may be helpful in understanding how the accident/incident occurred. For assistance in completing this form, contact your office H&S Coordinator/Specialist or your Regional Safety Unit Manager (RSUM).

HSC – Review and enter report into the BC Online Incident Reporting System within 3 workdays of receipt. File original in appropriate office health and safety file.

NOTE:

This report is important – please take the time necessary to properly complete it. Incomplete reports will be forwarded to appropriate management for review and action.

General Information

Date of Accident/Incident	Time of Accident/Incident:	Date Accident/Incident Reported:	To Whom:
Exact Location of Accident/Incident (Street, City, State):			BC Office:
Name Project:			Project Number:
Employee Completing the Investigation (Print and Sign):			Date:

Injured/Ill Employee/Property Damage Information

Employee Name:	Employee No.	Department:	Phone Number:
Job Title:		Manager's Name and Phone Number:	
Nature of Injury/Illness (laceration, contusion, strain, etc.):		Body Part Affected (arm, leg, head, hand, etc.):	
Describe Property Damage and Estimate Loss :			

Description of Accident/Incident

Describe the accident sequentially, beginning with the initiating event, and followed by secondary and tertiary events. End with the nature and extent of injury/damage. Name any object or substance and tell how they were included. Examples: 1) Employee was pulling utility cart that was loaded with wastepaper from office area to hallway. Wheel of utility cart caught against door casing. Bags of heavy wastepaper that were in cart fell to end of cart. Cart tipped over onto foot of employee. Right foot was crushed between utility cart and door casing, resulting in severe contusion to right foot of employee. 2) Employee was driving rental car from office to project site. Car struck icy section of road. Employee lost control of vehicle, which skidded across road into concrete abutment on side of road. Accident resulted in damage to right fender, tire, headlight, and grill.

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Preliminary Incident Investigation Report Form

Privileged and Confidential
Do Not Distribute

Analysis of Accident Causes

Immediate Causes - Substandard Actions

What substandard actions caused or could have caused the accident/incident? State the actions on the part of the employee or others that contributed to the occurrence of the accident/incident. Examples: 1) Employee overloaded the utility cart with wastepaper. 2) Employee exceeded safe speed on icy road, and was inattentive to hazard.

Codes (check all that apply)

- ☐ Failure to recognize hazard(s)
- ☐ Failure to use equipment or use it properly
- ☐ Failure to use PPE or use it properly
- ☐ Failure to warn, secure, or barricade
- ☐ Horseplay
- ☐ Improper lifting
- ☐ Improper loading, placement, or position for task
- ☐ Performing excessive repetitive activities
- ☐ Operating equipment without authority
- ☐ Removing or making safety devices inoperable
- ☐ Servicing equipment in operation
- ☐ Using defective equipment
- ☐ Unclassified (not determined)
- ☐ Other (specify): _____

Immediate Causes - Substandard Conditions

What substandard conditions caused or could have caused the accident/incident? State the conditions that existed at the time of the accident (the specific control factors that were or may have been the direct or immediate cause or causes of the accident). Examples: 1) Wheel of utility cart was worn and would not roll properly; utility cart was overloaded with wastepaper. 2) Road was covered with icy spots; weather was foggy.

Codes (check all that apply)

- ☐ Congested or restricted area
- ☐ Defective tools, equipment, or materials
- ☐ Fire or explosion hazards
- ☐ Hazardous environmental conditions (vapors, dusts, etc.)
- ☐ High or low temperature exposures
- ☐ Inadequate guards or barriers
- ☐ Inadequate or excessive illumination
- ☐ Inadequate ventilation
- ☐ Inadequate walking/working surfaces
- ☐ Noise Exposures
- ☐ Poor housekeeping
- ☐ Radiation exposures
- ☐ Unclassified (not determined)
- ☐ Other (specify): _____

Basic Causes - Personal and Job Factors

What personal and/or job factors caused or could have caused the accident/incident? State the influencing factors or underlying causes, either conditions or actions or both, that contributed to the accident/incident. Examples: 1) Employee had not been instructed in overloading hazards. 2) Employee had not been trained in driving under winter conditions; company has no driver training program.

Codes (check all that apply)

Personal Factor Codes

- ☐ Alcohol or drug influence (possible)
- ☐ Fatigue
- ☐ Inadequate skill, capability, knowledge, or training
- ☐ Inattention
- ☐ Rushing to complete work
- ☐ Unclassified (not determined)
- ☐ Other (specify): _____

Job Factor Codes

- ☐ Inadequate engineering
- ☐ Inadequate leadership/supervision
- ☐ Inadequate maintenance, wear, abuse, or misuse
- ☐ Inadequate planning or accelerated schedule
- ☐ Inadequate tools/equipment
- ☐ Inadequate work standards/procedures
- ☐ Unclassified (not determined)
- ☐ Other (specify): _____

Remedial Actions

Describe the actions taken or planned to prevent recurrence of accident/incident - provide the implementation date and person responsible for any planned corrective action.. Examples: 1) Wheels of utility cart were replaced with larger size wheels; all carts were inspected for safe operation; employees were instructed in overloading hazards. 2) All project personnel were instructed at the safety training meeting on driving under hazardous conditions; driver training program will be implemented.

Codes (check all that apply)

- ☐ Equipment repair or replacement
- ☐ Improve design or construction
- ☐ Improve housekeeping
- ☐ Improve PPE
- ☐ Install safety guard or device
- ☐ Reinstruction or reprimand of personnel involved
- ☐ Temporary/permanent reassignment of personnel
- ☐ Work method change
- ☐ Use safer materials or equipment
- ☐ Develop and publish lessons learned
- ☐ Unclassified (not determined)
- ☐ Other (specify): _____

Appendix F:

Miscellaneous Health and Safety Information

APPENDIX H

GENERIC QUALITY ASSURANCE PROJECT PLAN

GENERIC
QUALITY ASSURANCE PROJECT PLAN

FOR

SITE INVESTIGATIONS

AT NON-OWNED FORMER MGP SITES

Prepared for:
Niagara Mohawk
300 Erie Boulevard West
Syracuse, New York

Prepared By:
Foster Wheeler Environmental Corporation
One Park Place
300 South State Street, Suite 620
Syracuse, New York

NOVEMBER 2002

Reviewed and Approved by: _____ _____
(Project Quality Assurance Manager) (Signature) (Date)

Site Specific
Revisions Attached: Supplement No. _____ Date _____

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Attachment 1 Field PAH and PCB Soil Test Technical Guides and Test Kit Instructions

1.0 GENERAL

This Generic Quality Assurance Project Plan (QAPP) has been prepared to specify procedures that will provide data of known, documented quality, and which will be legally defensible, should the need exist. This document specifically supplements the Generic Field Sampling Plan (FSP), also attached as an appendix to the Site-Specific Work Plan. To the extent discrepancies exist between this Generic QAPP and the Site-Specific Work Plan, the Site-Specific Work Plan shall control.

2.0 PROJECT DESCRIPTION

The project sites are Former Non-owned Manufactured Gas Plant (MGP) sites. The purpose of the investigations is to gather sufficient data to enable the New York State Department of Environmental Conservation (NYSDEC) and Niagara Mohawk, a National Grid Company (NM) to characterize chemical substances which are or may be present at the Sites and to enable the NYSDEC and NM to determine whether such substances pose a significant threat to public health or the environment.

The data collected as a result of these investigations will be used to support the Site Characterizations and Remedial Investigation/Feasibility Studies (RI/FS) as described in the Site-Specific Work Plans. The types, numbers, and locations of environmental samples to be collected are also described in the Site-Specific Work Plans. Field procedures for all environmental sampling activities are detailed in the FSP.

3.0 PROJECT ORGANIZATION

The project organization is described in detail in the Site-Specific Work Plan. The project organization describes the relationship between the NM Project Manager, NYSDEC Project Manager, NM's Engineering Consultant, and subcontractors (e.g. laboratories, data validators, drillers, etc.).

For the purpose of quality control, the Engineering Consultant's Project Quality Assurance Manager (PQAM) will be responsible for review of data upon receipt from the analytical laboratory. The PQAM will assure that data validation screening is performed by trained and experienced data validators using the applicable criteria specified in the NYSDEC 2001 Analytical Services Protocol (ASP). For the purposes of this document, all references to ASP indicate the 2001 NYSDEC Analytical Services Protocol. The specific requirements for data validation screening are given in Section 9.3. The PQAM will be responsible for ensuring that all analytical data are in conformance with requirements of this QAPP.

4.0 QA/QC OBJECTIVES FOR MEASUREMENT OF DATA

The overall quality assurance (QA) objective for the project is to develop and implement procedures which will provide data of known, documented quality. Field and laboratory quality assurance/quality control (QA/QC) requirements defined in the NYSDEC ASP and other applicable guidelines ensure acceptable levels of data quality will be maintained throughout the sampling and analysis program.

The QA/QC objectives for all measurement data include precision, accuracy, representativeness, completeness, and comparability. The data reduction, validation, and reporting scheme is presented in Figure 1. The quality assurance samples to be collected (type and frequency of collection) are specified in the Site-SpecificWork Plans.

4.1 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (USEPA, 1987). Precision is usually stated in terms of standard deviation, but other estimates such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), and relative range are common. For this project, precision will be evaluated by recording duplicate measurements of the same parameter on similar sample aliquots under the same conditions and calculating the relative percent difference (RPD) between the values. The formula for calculating RPD is presented in Section 13.2.

RPDs can only be calculated when the duplicate samples both contain detectable concentrations of the analyte. If an analyte is considered not detected at the detection limit, then RPD cannot be calculated. Instead, the results of the analysis of the two-spiked laboratory samples will be used to determine precision.

Measurement data for this project will include field data as well as laboratory analytical data. Laboratory precision will be performed according to the requirements described in the associated analytical methods. The field measurement data may include immunoassay polycyclic aromatic hydrocarbon (PAH) and/or polychlorinated biphenyl (PCB) screening, pH, conductivity, temperature, turbidity, organic vapor readings, and water level measurements. The objective for precision of field data collection methods is to take replicate (minimum of two for every 20 samples) measurements for field parameters to determine the reproducibility of the measurements.

Precision of the immunoassay screening will be evaluated by the field analysis of replicate samples as equivalent levels of PAHs/PCBs. As the screening is not quantitative (i.e., the screening determines if the constituents are present above or below standard values and does not provide a numeric result), RPDs cannot be calculated on the field-analyzed samples. Therefore, measurement of equivalent levels of constituent (i.e., detected below the same standard or within the same range of two standards) will be considered as denoted precision of the screening test.

For the pH meter, precision will be tested by multiple readings in the medium of concern. Consecutive

readings should agree within 0.1 pH units after the instrument has been field calibrated with standard buffers before each use. The thermometer will be visually inspected prior to each use to ensure its condition is satisfactory. Consecutive measurements of a given sample should agree to within 1°Celsius. After calibration, the conductivity meter will be tested for precision at ± 1% of full-scale, depending on the meter/scale. The organic vapors will be measured using a Photovac Microtip (or equivalent) photoionization detector (PID). Daily background and upwind readings of drilling and sampling activities will be measured prior to commencing work and at periodic intervals throughout each day's activities. The natural variation/fluctuation in measurements at background or upwind locations will be used for baseline background values, and the variability will be noted. Water level indicator readings will be precise within 0.01 feet for duplicate measurements or additional water level measurements will be collected to determine whether the difference is due to operator or instrument error. Turbidity measurements will be calibrated to a precision of ± 2% nephelometric turbidity units (NTUs).

4.2 Accuracy

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

The accuracy of laboratory-measured data will be evaluated by determining the percent recovery of both matrix and blank spike samples as described in Section 13.1. For the measurement of organics by gas chromatography (GC) or GC/mass spectroscopy (MS), the recovery of a surrogate spiked into each sample, blank, and standard will also be used to assess accuracy.

Accuracy between the immunoassay screening and the laboratory analytical results will be evaluated by the confirmatory testing of 10 percent (i.e., one in ten) of the environmental samples at the off-site laboratory. The rate of potential false positives and negatives should be less than 15 percent. Screening samples will not be spiked in the field by the addition of known parameter concentrations. However, the confirmatory samples sent to the off-site laboratory will undergo surrogate spiking and recovery evaluation and, to the extent possible, may be chosen as the site-specific matrix spike sample(s) for additional accuracy determination.

The objective for accuracy of the other field measurements is to achieve and maintain factory equipment specifications for the field equipment. Field measurements cannot be assessed for accuracy by spiking the medium with the analytical parameter and measuring the increase in response;

therefore, these instruments can only be assessed for accuracy by the response to a known sample (such as a calibration standard) used to standardize them. The pH meter, conductivity meter, and turbidity meter are calibrated with solutions traceable to the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards).

All volatile organic detectors (such as the PID) will be calibrated to an appropriate standard daily prior to use.

4.3 Representativeness

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

Field and laboratory procedures will be performed in such a manner as to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure chemical compounds will not be introduced into the sample via sample containers, handling, or analysis. Decontamination of sampling devices and digging equipment will be performed between samples as outlined in the FSP. Laboratory sample containers will be thoroughly cleaned in accordance with procedures outlined in Section 5.2. Analysis of field blanks, trip blanks, and method blanks will also be performed to monitor for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated through the analysis of field duplicate samples, coded to ensure the samples are treated and analyzed as separate samples. The analytical laboratory will make every reasonable effort to assure the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received. Many means of homogenization expose the sample to significant risk of contamination or loss through volatilization, and these should be avoided if possible.

Chain-of-custody procedures will be followed to document that contamination of samples has not occurred during container preparation, shipment, and sampling. Details of blank/duplicate and chain-of-custody procedures are presented in Sections 5.3 and 6.1.

4.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid. The QC objective for completeness is generation of valid data for 100 percent of the analysis requested. Any data deficiencies and their impact on project goals will be evaluated during data validation and discussed in the Data Usability Summary Report (DUSR) (see Section 9.3.2).

4.5 Comparability

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

- Using identified standard methods for both sampling and analysis phases of this project;
- Ensuring traceability of all analytical standards and/or source materials to USEPA or NIST;
- Verifying all calibrations with an independently prepared standard from a source other than that used for calibration;
- Using standard reporting units and reporting formats including the reporting of QC data;
- The validation of all analytical results, including the use of data qualifiers in all cases where appropriate; and
- The requirement that all validated flags be used any time an analytical result is used for any purpose whatsoever.

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

5.0 SAMPLING PROCEDURES

5.1 Sampling Program

The objective of the sampling program is to provide current data concerning the presence and nature and extent of contamination of groundwater, surface water, soils (surface and subsurface), and/or sediment. Sampling and analysis may include as identified in the Site-SpecificWork Plan:

- groundwater samples
- surface water samples
- sediment samples
- surface and/or subsurface soil samples
- air samples

5.2 Sampling Procedures and Handling

Sample Container Preparation

Sample containers will be properly washed and decontaminated by the factory or laboratory prior to use. All preservatives will be added to containers prior to shipment by the laboratory. The types of containers and preservation techniques are shown in Table 1. Records of the sources of bottles and preservatives will be kept by the analytical laboratory.

Methods of Sampling

As a minimum, sampling procedures will be in accordance with the most recent NYSDEC or USEPA guidelines and/or regulations, as appropriate. Alternate techniques will be utilized when such guidelines and/or regulations are inappropriate or non-existent. Alternate techniques will be implemented only after consultation with NYSDEC, whenever possible.

Referenced sampling procedures are listed below. All procedures will be the latest in effect as of the date of this Generic QAPP.

- USEPA - 600-4-79-020, "Methods for Chemical Analysis of Water and Wastes"
- National Water Well Association - "Manual of Ground-water Sampling Procedures"
- USEPA - 600-4-83-040, "Characterization of Hazardous Waste Sites - a Methods Manual: Volume II. Available Sampling Methods"
- USEPA - OSWER - 9950.1 "RCRA Ground-water Monitoring Technical Enforcement Guidance Document"
- USEPA - 540/S-95/504, "Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures"

- NYSDEC – "Technical and Administrative Guidance Memoranda" (TAGMs)

All sampling methods are explained in detail in the FSP.

5.3 Quality Assurance Samples

Field Quality Control Samples

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. The blanks will include:

Trip Blank - A trip blank will be prepared by the laboratory, and will consist of 40-ml volatile organic analysis (VOA) vials containing distilled, deionized water which accompanies the other sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for which analysis for Target Compound List (TCL) volatiles or benzene, toluene, ethylbenzene and total xylenes (BTEX) is planned. The trip blank will be analyzed for TCL volatile organic compounds or BTEX to assess any contamination introduced as a result of sampling and transport, , handling and storage.

Equipment Blank - Equipment blanks will be taken at a minimum frequency of one per 20 field samples per sample matrix as specified in the Site-SpecificWork Plan. Equipment blanks are used to determine the effectiveness of the decontamination procedures for sampling equipment. It is a sample of deionized, distilled water provided by the laboratory, which has passed through or over the sampling apparatus. It is usually collected as a last step in the decontamination procedure, prior to collecting a sample. The equipment blanks will be analyzed for the same parameters as the matrix being sampled.

In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and matrix spike (MS)/matrix spike duplicates (MSD)/matrix duplicates (MD).

The duplicates will consist of:

Field Duplicate - To determine the reproducibility and homogeneity of samples, coded field duplicates will be collected. The samples are termed "coded" because they will be labeled in such a manner that the laboratory will not be able to determine that they are a duplicate sample. This will eliminate any possible bias that could arise. The frequency of collection of these samples is one per 20 field samples as specified in the Site-SpecificWork Plans. The criteria for assessing coded field duplicates are given in Section 6.0.

Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate (MS/MSD/MD) - MS/MSD/MD samples (MSD for organics; MD for inorganics) will be collected at a frequency of one pair per 20 field samples per seven day sample delivery group (SDG). The reproducibility and homogeneity of the samples can be assessed by determining the

RPD for both spike and non-spike compounds as described in Section 13.0. The MS, MSD, and MD samples should be Site-Specific, unless otherwise authorized by the Engineering Consultant's Project Manager and/or PQAM after consultation with NM and NYSDEC personnel whenever possible.

6.0 SAMPLE TRACKING AND CUSTODY

Sample chain-of-custody (COC) will be initiated by the laboratory with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling the samples will be minimized.

In-situ or on-site monitoring data will be controlled and entered in permanent logbooks. Personnel involved in the COC and transfer of samples will be trained on the purpose and procedures prior to implementation.

Evidence of sample traceability and integrity will be provided by COC procedures. These procedures document the sample traceability from the selection and preparation of the sample containers by the laboratory, to sample collection, to sample shipment, to laboratory receipt and analysis. The sample custody flowchart is shown in Figure 2. A sample will be considered to be in a person's custody if the sample is:

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

6.1 Field Sample Custody

A COC record will accompany the sample from time of collection to receipt by the analytical laboratory. If samples are split and sent to different laboratories, COC records will be sent with each sample. Figure 3 is a typical example of a chain-of-custody record. The "remarks" column will be used to record specific considerations associated with sample acquisition such as: sample type, container type, sample preservation methods, and analyses to be performed. Two copies of this record will accompany the samples to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the Engineering Consultant's Project Manager.

Individual sample containers, provided by the laboratory, will be used for shipping/couriering samples. The shipping containers are insulated, and ice will be used to maintain samples at approximately four degrees Celsius until samples are returned and in the custody of the laboratory. All sample bottles within each shipping container will be individually labeled and controlled.

Each sample shipping container will be assigned a unique identification number by the laboratory, and will be marked with indelible ink on the outside of the shipping container. This number will be recorded on the COC record. The field sampler will indicate each individual sample designation/location number in the space provided on the appropriate COC form for each sample collected. The shipping container will then be closed, and a seal provided by the laboratory affixed to the latch. This seal must be broken to open the container. Tampering may be indicated if the seal

is broken before receipt at the laboratory. The laboratory will contact the FOL or Engineering Consultant's Project Manager, and the associated samples will not be analyzed if tampering is apparent.

6.2 Laboratory Sample Custody

The FOL will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The laboratory sample program will meet the following criteria:

- The laboratory will designate a sample custodian who is responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check the original chain-of-custody documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the COC record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of any discrepancy in documentation, the laboratory will immediately contact the Engineering Consultant's Project Manager and/or PQAM as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. That assessment will be recorded as part of the incoming COC procedure.
- The samples will be stored in a secured area at a temperature of approximately four degrees Celsius until analyses are to commence.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking form will accompany the laboratory report and will become a permanent part of the project records.

6.3 Sample Tracking System

A sample tracking system will be implemented to monitor the status of sampling events and laboratory analysis of samples. Sample numbers, types, analytical parameters, sampling dates, and sample delivery group (SDG) designations for samples, and required due dates for receipt of analytical results will be entered into the system. The Engineering Consultant's Project Manager will use the tracking system to monitor the project sampling schedules and the status of analytical reports, and to implement any penalty clauses for late delivery per standard laboratory subcontracts when necessary.

A description of the sample tracking system follows:

1. For each day that samples are collected, the Field Operations Lead (FOL) or designee will complete a COC form (Figure 3) and a Daily Status and Monitoring Report (Figure 4) listing all appropriate samples.
2. The FOL or designee will retain the client copy of the COC, and forward the laboratory copy of the COC with the sample shipment.
3. The FOL or designee will fax copies of the completed COC form and Daily Status and Monitoring Report to the Engineering Consultant's PM. The Engineering Consultant's PM or a designated employee will confirm sample shipment with the laboratory and resolve any sample transfer issues.
4. The status of analytical results will be tracked by the Engineering Consultant's PM or designee using the information provided on the completed COC form and Daily Status and Monitoring Report. The information shall be summarized in a computerized database, as warranted.

Upon receipt of the analytical results from the laboratory, the Engineering Consultant's PM or designee will review the data package for completeness and contract compliance. The Engineering Consultant's PM will then forward the result package to the data validator for validation. The data validator shall be required to submit a complete set of validated data to the Engineering Consultant's PM within 60 days of receipt of the data package report.

The Engineering Consultant's Project Manager or a designated representative will maintain day-to-day contact with the laboratory concerning specific samples and analyses directly or by assignment.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

7.1 Field Instrumentation Calibration

The FOL will be responsible for ensuring that instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to their specific calibration protocols/procedures.

All field measurement instruments must be calibrated according to the manufacturer's instructions prior to the commencement of the day's activities. Exceptions to this requirement shall be permitted only for instruments that have fixed calibrations pre-set by the equipment manufacturer. Calibration information shall be documented on instrument calibration and maintenance log sheets or in a designated field logbook. The calibration information (log sheet or logbook) shall be maintained at the site during the on-site investigation and, once the field work is completed, shall be placed in the Engineering Consultant's project files. Information to be recorded includes the date, the operator, and the calibration standards (concentration, manufacturer, lot number, expiration date, etc.). All project personnel using measuring equipment or instruments in the field shall be trained in the calibration and usage of the equipment, and are personally responsible for ensuring that the equipment has been properly calibrated prior to its use.

In addition, all field instruments must undergo response verification checks at the end of the day's activities and at any other time that the user suspects or detects anomalies in the data being generated. Verification checks may also be performed at the request of NM or NYSDEC representatives. The checks consist of exposing the instrument to a known source of analyte (e.g., the calibration solution), and verifying a response. If an unacceptable instrument response is obtained during the check (i.e., not within specifications), the data shall be labeled suspect, the problem documented in the site logbook, and appropriate corrective action taken.

Any equipment found to be out of calibration shall be re-calibrated. When instrumentation is found to be out of calibration or damaged, an evaluation shall be made to ascertain the validity of previous test results since the last calibration check. If it is necessary to ensure the acceptability of suspect items, the originally required tests shall be repeated (if possible), using properly calibrated equipment, to acquire replacement data for the measurement in question.

Any instrument consistently found to be out of calibration shall be repaired or replaced within 24 hours or field work will be terminated until the malfunctioning equipment is repaired/replaced.

7.2 Laboratory Instrumentation Calibration

Personnel at the laboratory will be responsible for ensuring that analytical instrumentation are of the proper range, type and accuracy for the test being performed, and that all of the equipment are calibrated at their required frequencies, according to specific protocols/procedures.

Off-site laboratory equipment shall be calibrated using certified/nationally recognized standards and according to the applicable methodologies and the laboratory Standard Operating Procedures (SOPs).

In addition, these methods/procedures specify the appropriate operations to follow during calibration or when any instrument is found to be out of calibration.

8.0 ANALYTICAL PROCEDURES

All off-site laboratory samples will be analyzed according to the methods provided in Exhibit D of the NYSDEC ASP. QA/QC procedures given in Exhibit E and I of the ASP will be followed. Regardless of the method used, all analytical and extraction holding times must meet the NYSDEC ASP requirements for that analytical group (i.e., volatile analyses, including BTEX, have a holding time of seven days, if unpreserved). Holding times will be calculated from verified time of sample receipt at the laboratory. For NYSDEC ASP, samples must be received at the laboratory within 48 hours of sample collection. The analytical laboratory chosen for the project will be certified, and must maintain certification, under the New York State Department of Health's Environmental Laboratory Approval Program for analyses of solid and hazardous waste. The breakdown of investigative samples is detailed in the Site-Specific Work Plan. Laboratory analytical methods and quantitation limits are presented in Tables 2 and 3 of this Generic QAPP. The method detection limits (MDLs) for the analytes will be specified by the laboratory selected for the project based on its most recent MDL studies, and subject to approval by the NYSDEC.

Field screening samples will be analyzed according to the NYSDEC ASP and the manufacturer's instructions. Unless site-specific requirements dictate a change in concentration limits (which would be explained within the Site-Specific Work Plan), the standard levels for the PAH and PCB screening will be 1 ppm and 10 ppm. The test system user shall be technically qualified individual who has received training in the immunoassay analysis requirements, procedures and potential risks prior to field screening of samples. Use of the field screening test kits will only occur in a controlled environment, following the storage and handling procedures outlined in the NYSDEC ASP and the manufacturer's instructions. Additional technical information on the field screening testing are presented in Attachments 1 and 2.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

The criteria used to identify and quantify the analytes will be those specified for the applicable methods in the ASP.

The data package provided by the laboratory will contain all items specified in the ASP, as appropriate to the analyses performed. Category B reporting will be used.

9.1 Chain-of-Custody Records

Completed copies of the COC records accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the report of analytical testing.

9.2 Data Handling

One complete copy and one additional copy of the analytical data summary report will be provided by the laboratory. One set of the analytical data will be forwarded directly to the data validator by the laboratory. The Engineering Consultant's Project Manager will immediately arrange for filing of the complete package, after the QA/QC reviewer checks the package to ensure all deliverables have been

provided. The second data summary report will be used to generate summary tables. These tables will form the foundation of a working database for assessment of the site contamination condition.

The Engineering Consultant's Project Manager will maintain close contact with the QA/QC reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA/QC review has been completed, the Engineering Consultant's Project Manager may direct the team leaders or others to initiate and finalize the analytical data assessment.

9.3 Data Validation

9.3.1 Full Data Validation

Data validation is a basic step in the control and processing of the project data generated by the laboratory. The data validation process will consist of a systematic review of the analytical results and QC documentation, and will be performed in accordance with the guidelines identified in Section 9.3.1. All off-site laboratory data will undergo full validation, unless otherwise stated in the Site-Specific Work Plan. On the basis of this review, the data validator will make judgments and express concerns and comments on the quality and limitations of specific data, as well as on the validity of the overall data package. The data validator will prepare documentation of his or her review and conclusions in a Data Usability Summary Report (DUSR; see Section 9.3.2).

The data validator will inform the Engineering Consultant's Project Manager of data quality and limitations, and assist the Project Manager in interacting with the laboratory to correct data omissions and deficiencies. The laboratory may be required to rerun or resubmit data depending on the extent of the deficiencies, and their importance in meeting the data quality objectives within the overall context of the project. The validated laboratory data will be reduced into a computerized tabulation which will be suitable for inclusion in the Site Characterization and RI Reports and will be designed to facilitate comparison and evaluation of the data. The data tabulations will be sorted by classes of constituents and by sample matrix. Each individual table will present the following information:

- Sample matrix, designations, and locations;
- Sample dates;
- Constituents for which positive results were obtained;
- Reported constituent concentrations in the field and/or trip blanks associated with the samples;
- Constituent concentration units;
- Name and location of laboratory which performed the analyses;
- Data qualifiers provided by the laboratory; and
- Data qualifiers and comments provided by the data validator, if any.

9.3.1 Data Usability Summary Report (DUSR)

A Data Usability Summary Report (DUSR) will be prepared after reviewing and evaluating the analytical data. The parameters to be evaluated in reference to compliance with the analytical method protocols includes all sample chain-of-custody forms, holding times, raw data (instrument print out data and chromatograms), calibrations, blanks, spikes, controls, surrogate recoveries, duplicates and sample data. If available, the field sampling notes should also be reviewed and any quality control problems should be evaluated as to their effect on the usability of the sample data.

The DUSR will describe the samples and analysis parameters reviewed. Data deficiencies, analytical method protocol deviations and quality control problems will be described and their effect on the data will be discussed in the DUSR.

Resampling/reanalysis recommendations, if applicable, will be made. Data qualifications are documented for each sample analyte following the NYSDEC ASP guidelines.

This work will be performed by trained and experienced data validators who meet the NYSDEC

approval criteria. The Environmental Scientist preparing the DUSR must submit a resume to the NYSDEC Quality Assurance Unit documenting relevant experience in environmental sampling and analysis methods and data review and documentation of a Bachelors Degree in Natural Science or Engineering. The results of the data validation screening (i.e. missed holding times or data rejected due to blank contamination) will be incorporated into the data summary tables used in the final investigative report. The DUSR identifies data gaps caused by non-compliant or rejected data, and will indicate what steps have been or will be taken to fill these gaps.

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

10.1 Quality Assurance Batching

Each set of samples will be analyzed concurrently with calibration standards, method blanks, MS, MSD or MD, and QC check samples (if required by the protocol). The MS/MSD/MD samples will be designated by the field personnel. If no MS/MSD/MD samples have been designated, then the laboratory must contact the Project Quality Assurance Officer (PQAO) or Engineering Consultant's Project Manager for corrective action.

10.2 Organic Standards and Surrogates

All standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or earlier based upon data indicating deterioration.

10.3 Laboratory Quality Control Samples

The quality control samples included are detailed below.

Method Blanks/Preparation Blanks: Analyses for organic compounds (method blank) and inorganics (preparation blank) include a blank analysis of the laboratory reagent water. The blank is analyzed with each set of samples or more often as required to verify that contamination has not occurred during the analytical process. The concentration of target compounds in the blanks must be less than or equal to the method detection limits specified in the ASP for the selected method of analysis.

Matrix Spike/Matrix Spike Duplicate Analysis - This analysis is used to determine the effects of matrix interference on analytical results. Spikes of analytes are added to aliquots of sample matrix in the manner specified in the ASP. Selected samples are spiked to determine accuracy as a percentage recovery of the analyte from the sample matrix and precision as RPD between the MS and MSD samples. A matrix duplicate is prepared in the same manner as the matrix spike sample.

Analytical Duplicate Samples - Replicate samples are aliquots of a single sample that are split on arrival at the laboratory, or upon analysis. Significant differences between two replicates, split in a controlled laboratory environment, will result in flagging the affected analytical results.

Surrogate Spike Analyses - Surrogate spike analyses are used to determine the efficiency of recovery of organic analytes in the sample preparations and analyses. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method.

Laboratory Control Sample/ (Spike Blank) - For each method which requires a laboratory control sample (LCS) or spike blank, a LCS spike blank will be prepared with each quality control batch and analyzed according to criteria specified in the ASP. These samples support an assessment of the ability of the analytical procedure to generate a correct result without matrix effects or interference affecting the analysis.

11.0 QUALITY ASSURANCE PERFORMANCE AUDITS AND SYSTEM AUDITS

Quality assurance audits may be performed by the Project Quality Assurance Manager (PQAM) or personnel designated by the PQAM. The PQAM and his or her designees function as an independent body and report directly to Engineering Consultant's quality assurance management. The PQAM may plan, schedule, and approve system and performance audits based upon the Engineering Consultant's procedure customized to the project requirements. These audits may be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). At times, the PQAM may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits.

Formal audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that quality assurance requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Audit reports will be written by lead auditors after gathering and evaluating all resultant data. Items, activities, and documents determined by lead auditors to be in noncompliance will be identified at exit interviews conducted with the involved management. Noncompliances will be logged, documented, and controlled through audit findings which are attached to and are a part of the integral audit report. These audit finding forms will then be directed to management to satisfactorily resolve the noncompliance in a specified and timely manner. All audit checklists, audit reports, audit findings, and acceptable resolutions must be approved by the PQAM prior to issue. QA verification of acceptable resolutions will be determined by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the PQAM will close out the audit report and findings.

It is the Engineering Consultant's Project Manager's overall responsibility to verify that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Engineering Consultant's Project Manager within 15 days of completion of the audit. Serious deficiencies must be reported to the Engineering Consultant's Project Manager within 24 hours.

Serious deficiencies identified during an audit will be reported to NM and NYSDEC as part of the DUSR or Site investigation and/or RI Reports.

11.1 System Audits

System audits, performed by the PQAM or designated auditors, may encompass evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Engineering Consultant's Project Manager requests the PQAM to perform unscheduled audits, these activities will be instituted.

11.2 Performance Audits

In accordance with the requirements for NYSDOH ELAP CLP certification, the laboratory will participate in all performance evaluation testing.

Also, one field audit may be performed by the PQAM or designated auditor during collection of the field samples to verify that field samplers are following established sampling procedures. Performance of a field audit will be based on the type of investigation activities being performed, the length of the field project, and any available information concerning prior inspections of the project or sampling team. The Site-Specific Work Plan will provide details on the performance of a field audit.

12.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

12.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators. Analytical instruments will be serviced at intervals recommended by the manufacturer. An instrument repair/maintenance log book will be kept for each instrument, and this log will be available on-site during field activities and, at the completion of the investigation, be placed in the project files. Entries include the date of service, type of problem encountered, corrective action taken, and initials and affiliation of the person providing the service.

The instrument use log book will be monitored by the analysts to detect any degradation of instrument performance. Changes in response factors or sensitivity are used as indications of potential problems. These are brought to the attention of the laboratory supervisor and preventive maintenance or service is scheduled to minimize down time. Back-up instrumentation and an inventory of critical spare parts are maintained to minimize delays in completion of analyses.

Use of equipment in need of repair will not be allowed, and field work will be terminated until the malfunction is repaired or the instrument replaced.

12.2 Schedules

Written procedures, where applicable, will identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule and to arrange any necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. shall be performed by qualified personnel.

12.3 Records

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories and by the data and sample control personnel when and if equipment, instruments, tools, and gauges are used at the sites. The Engineering Consultant's Project Manager or the PQAM may audit these records to verify complete adherence to these procedures.

12.4 Spare Parts

Where appropriate, a list of critical spare parts will be identified by the operator in consultation with the equipment manufacturer. These spare parts will be stored for availability and use in order to reduce the downtime. In lieu of maintaining an inventory of spare parts, a service contract for rapid instrument repair or backup instruments will be available.

13.0 ASSESSMENT PROCEDURES FOR DATA ACCEPTABILITY

Procedures used to assess data precision and accuracy will be in accordance with the appropriate laboratory method, and as periodically updated.

13.1 Accuracy

The percent recovery is calculated as below:

$$\% = \frac{Ss - So}{S} \times 100$$

So = The background value, i.e.; the value obtained by analyzing the sample

S = Concentration of the spike added to the sample

Ss = Value obtained by analyzing the sample with the spike added

% = Percent Recovery

13.2 Precision

The relative percent difference (RPD) is calculated as below:

$$RPD = \frac{|V1 - V2|}{0.5\ (V1 + V2)} \times 100$$

V1, V2 = The two values obtained by analyzing the duplicate samples

13.3 Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system compared to the total amount expected to be obtained under ideal conditions. A target of 100 percent completeness, calculated for each analysis method, has been established as the overall project objective.

$$PC = \frac{NA}{NI} \times 100$$

where:

PC = Percent completeness
NA = Actual number of valid analytical results obtained
NI = Theoretical number of results obtainable under ideal conditions

14.0 CORRECTIVE ACTION

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

When a significant condition adverse to quality is noted on-site, at the laboratory, or at a subcontractor location, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the FOL, Engineering Consultant's Project Manager, and involved subcontractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action. All project personnel have the responsibility, as part of the normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality.

At a minimum, corrective actions may be initiated:

- When predetermined acceptance standards are not attained
- When procedure or data compiled are determined deficient
- When equipment or instrumentation is found faulty
- When samples and test results are questionably traceable
- When quality assurance requirements have been violated
- When designated approvals have been circumvented
- As a result of system and performance audits
- As a result of a management assessment
- As a result of laboratory/inter-field comparison studies
- As required by NM
- As required by NYSDEC ASP, 2001

Procedure Description

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor on-going work performance in the normal course of daily responsibilities.

Work may be audited at Engineering Consultant's office, Site, laboratory, and subcontractor locations by the PQAM and/or designated auditor. Items, activities, or documents ascertained to be in noncompliance with quality assurance requirements will be documented and corrective actions mandated through audit finding sheets attached to the audit report. Audit findings are logged,

maintained, and controlled by the PQAM (Section 11.0).

Technicians assigned quality assurance functions will also control noncompliance corrective actions by having the responsibility of issuing and controlling the appropriate Corrective Action Request Form (Figure 5). All project personnel may identify a noncompliance; however, the technician is responsible for documenting, numbering, logging, and verifying the closeout action. It is the Engineering Consultant's Project Manager's responsibility to verify that all recommended corrective actions are produced, accepted, and received in a timely manner.

The Corrective Action Request (CAR) identifies the adverse condition, reference document(s), and recommended corrective action(s) to be administered. The issued CAR is directed to the responsible manager in charge of the item or activity for action. The individual to whom the CAR is addressed returns the requested response promptly to the technician in charge, affixing his signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The technician maintains the log for status control of CARs and responses, confirms the adequacy of the intended corrective action, and verifies its implementation. The technician will issue and distribute CARs to specified personnel, including the originator, responsible project management involved with the condition, the Engineering Consultant's Project Manager, involved subcontractor, and the FOL, at a minimum. CARs are transmitted to the project file for the records.

15.0 QUALITY ASSURANCE REPORTS

Quality assurance reports to management may consist of the reports on audits, reports on correction of deficiencies found in audits, a final QA report on field sampling activities, and the data validation report.

At the end of the project, the PQAM may submit a lessons leaned report to the Engineering Consultant's Project Manager which will discuss the QA activities. That report may include discussions of any conditions adverse or potentially adverse to quality, such as responses to the findings of any field or laboratory audits; any field, laboratory, or sample conditions which necessitated a departure from the methods or procedures specified in this QAPP; field sampling errors; and any missed holding times or problems with laboratory QC acceptance criteria; and the associated corrective actions undertaken. This report shall not preclude immediate notification to project management of such problems when timely notice can reduce the loss or potential loss of quality, time, effort, or expense.

These reports, if prepared, shall be reviewed by the Engineering Consultant's Project Manager for completeness and the appropriateness of any corrective actions, and they shall be retained in the project files.

In the final investigative report, laboratory and field QC data will be presented, including a summary of QA activities and any problems and/or comments associated with the analytical and sampling effort. Any corrective actions taken in the field, results of any audits, and any modifications to laboratory protocols will be discussed.

Attachment 1

NYSDEC ASP Methods 4035 (PAHs) and 4020 (PCBs)

Attachment 2

Field PAH and PCB Soil Test Technical Guides and Test Kit Instructions

TABLE 3
TARGET ANALYTES AND CONTRACT REQUIRED QUANTITATION (CRQ) LIMITS[1]

	Contract Required Quantitation Limit Water Samples (ug/L)	Contract Required Quantitation Limit Soil Samples (ug/kg)
NYSDEC ASP TCL Volatile Organic Compounds (by 2001-1)		
Acetone	10	10
Benzene	10	10
Bromodichloromethane	10	10
Bromoform	10	10
Bromomethane	10	10
2-Butanone	10	10
Carbon disulfide	10	10
Carbon tetrachloride	10	10
Chlorobenzene	10	10
Chloroethane	10	10
Chloroform	10	10
Chloromethane	10	10
Dibromochloromethane	10	10
1,1-Dichloroethane	10	10
1,2-Dichloroethane	10	10
1,1-Dichloroethene	10	10
1,2-Dichloroethene (cis and trans)	10	10
1,2-Dichloropropane	10	10
cis-1,3-Dichloropropene	10	10
trans-1,3-Dichloropropene	10	10
Ethylbenzene	10	10
2-Hexanone	10	10
4-Methyl-2-pentanone	10	10
Methylene chloride	10	10
Styrene	10	10
1,1,2,2-Tetrachloroethane	10	10
Tetrachloroethene	10	10
Toluene	10	10
1,1,1-Trichloroethane	10	10
1,1,2-Trichloroethane	10	10
Trichloroethene	10	10
Vinyl chloride	10	10
Total Xylenes	10	10

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TCL - Semivolatile Organic Compounds (by 2001-2)		
Base/Neutral Extractables		
Acenaphthene	10	330
Acenaphthylene	10	330
Anthracene	10	330
Benzo(a)anthracene	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(g,h,i)perylene	10	330
Benzo(a)pyrene	10	330
bis(2-Chloroethoxy)methane	10	330
bis(2-Chloroethyl)ether	10	330
bis(2-ethylhexyl)phthalate	10	330
4-Bromophenyl phenyl ether	10	330
Butyl benzyl phthalate	10	330
Carbazole	10	330
4-Chloroaniline	10	330
2-Chloronaphthalene	10	330
4-Chlorophenyl phenyl ether	10	330
Chrysene	10	330
Dibenz(a,h)anthracene	10	330
Dibenzofuran	10	330
Di-n-butylphthalate	10	330
1,2-Dichlorobenzene	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
3,3'-Dichlorobenzidine	10	330
Diethyl phthalate	10	330
Dimethyl phthalate	10	330
2,4-Dinitrotoluene	10	330

NOTES

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2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TCL - Semivolatile Organic Compounds (by 2001-2, Cont.)		
2,6-Dinitrotoluene	10	330
Di-n-octylphthalate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorobutadiene	10	330
Hexachlorocyclopentadiene	10	330
Hexachloroethane	10	330
Indeno(1,2,3-cd)pyrene	10	330
Isophorone	10	330
2-methyl Naphthalene	10	330
Naphthalene	10	330
2-Nitroaniline	25	800
3-Nitroaniline	25	800
4-Nitroaniline	25	800
Nitrobenzene	10	330
N-Nitroso-diphenylamine	10	330
N-Nitroso-dipropylamine	10	330
2,2' Oxybis(1-chloropropane)	10	330
Phenanthrene	10	330
Pyrene	10	330
1,2,4-Trichlorobenzene	10	330

NOTES

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2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TCL - Semivolatile Organic Compounds (by 2001-2, Cont.) **Acid Extractables (cont.)**		
4-Chloro-3-methylphenol	10	330
2-Chlorophenol	10	330
2,4-Dichlorophenol	10	330
2,4-Dimethylphenol	10	330
4,6-Dinitro-2-methylphenol	25	800
2,4-Dinitrophenol	25	800
2-Methylphenol	10	330
4-Methylphenol	10	330
2-Nitrophenol	10	330
4-Nitrophenol	25	800
Pentachlorophenol	25	800
Phenol	10	330
2,4,5-Trichlorophenol	25	800
2,4,6-Trichlorophenol	10	330
NYSDEC ASP TCL Pesticides and PCBs (by 2001-3)		
Aldrin	0.05	1.7
alpha-BHC	0.05	1.7
beta-BHC	0.05	1.7
delta-BHC	0.05	1.7
gamma-BHC (Lindane)	0.05	1.7
Chlordane (alpha &/or gamma)	0.05	1.7
4,4'-DDD	0.10	3.3
4,4'-DDE	0.10	3.3
4,4'-DDT	0.10	3.3
Dieldrin	0.10	3.3
Endosulfan I	0.05	1.7
Endosulfan II	0.10	3.3
Endosulfan sulfate	0.10	3.3

NOTES

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2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TCL - Pesticides and PCBs (by 2001-3, Cont.)		
Endrin	0.10	3.3
Endrin Aldehyde	0.10	3.3
Endrin Ketone	0.10	3.3
Heptachlor	0.05	1.7
Heptachlor Epoxide	0.05	1.7
Methoxychlor	0.50	17.0
Toxaphene	5.0	170.0
Aroclor-1016	1.0	33.0
Aroclor-1221	2.0	67.0
Aroclor-1232	1.0	33.0
Aroclor-1242	1.0	33.0
Aroclor-1248	1.0	33.0
Aroclor-1254	1.0	33.0
Aroclor-1260	1.0	33.0
NYSDEC ASP TAL Metals and Cyanide (by CLP-M)		
Aluminum	200	
Antimony	60	
Arsenic	10	
Barium	200	
Beryllium	5	
Cadmium	5	
Calcium	5000	
Chromium	10	
Cobalt	50	
Copper	25	
Iron	100	
Lead	3	
Magnesium	5000	

NOTES

1. Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable. Quantitation limits listed for soil are based on wet weight.
2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

TABLE 3 (Cont'd.)
TARGET ANALYTES AND CRQ LIMITS[1]

	Contract Required Quantitation Limit Water Samples(ug/L)	Contract Required Quantitation Limit Soil Samples(ug/kg)
NYSDEC ASP TAL Metals and Cyanide (by CLP-M) (Cont.)		
Manganese	15	
Mercury	0.2	
Nickel	40	
Potassium	5000	
Selenium	5	
Silver	10	
Sodium	5000	
Thallium	10	
Vanadium	50	
Zinc	20	
Cyanide	10	

NOTES

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2. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in quantitation limits, the Site-Specific Work Plan (which will include this information) will take precedence.

These CRQLs are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The quantitation limits for samples may be considerably higher depending on the sample matrix.

TABLE 1
SAMPLE CONTAINERIZATION

Analysis	Bottle Type	Preservation[1]	Holding Time[2]
Aqueous Samples			
Volatile Organics (BTEX)	40 ml glass vial with Teflon-lined septa	Cool to 4°C	7 days
PCBs/Pesticides	1000 ml amber glass	Cool to 4°C	5 days*
Semivolatile Organics (PAHs)	1000 ml amber glass	Cool to 4°C	5 days*
Metals	1000 ml polyethene	HNO_3 to pH <2	6 months (Mercury 26 days)
Cyanide	1000 ml polyethene	NaOH to pH >12	12 days
Soil & Sediment Samples			
Volatile Organics (BTEX)	Wide-mouth glass w/ teflon-lined septa [3]	Cool to 4°C	7 days
Semivolatile Organics (PAHs)	Wide-mouth glass w/ teflon cap [3]	Cool to 4°C	5 days*
Pesticide/PCBs	Wide-mouth glass w/ teflon cap [3]	Cool to 4°C	5 days*
Metals, Cyanide	Wide mouth glass w/ teflon cap [3]	Cool to 4°C	Metals - 6 months Mercury - 26 days Cyanide - 12 days

NOTES

1. All samples to be preserved in ice at 4°C during collection and transport.
2. Days from verified time of sample receipt (VTSR) by the laboratory.
3. Sized appropriately for the analytical method.
4. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in containerization requirements, the Site-Specific Work Plan (which will include this information) will take precedence.

* Extraction of water samples for pesticides/PCB analysis by separating funnel must be completed within five days of VTSR. Continuous liquid-liquid extraction is the required extraction for water samples for semivolatiles. Continuous liquid-liquid extraction of water samples, or sonication or soxhlet procedures for semivolatile and pesticides/PCB analyses, shall be started within five days. If a re-extraction and reanalysis must be performed, the extraction must start within 10 days and completed within 12 days of VTSR. Extracts of either water or soil/sediment samples must be analyzed within 40 days of VTSR.

TABLE 2
LABORATORY ANALYSIS PROGRAM

Matrix	Parameter [1]	Analytical Method [2]
Water	BTEX	Method 8260B*
	VOC	2001-1
	SVOC	2001-2
	PAHs	Method 8270C*
	PCBs and Pesticides	2001-3
	Metals	CLP-M (various for individual metals)
	Cyanide	CLP-M
Soil & Sediments	BTEX	Method 8260B*
	VOC	2001-1
	SVOC	2001-2
	PAHs	Method 8270C*
	Pesticides and PCBs	2001-3
	Metals	CLP-M (various for individual metals)
	Cyanide	CLP-M
	TCLP	Method 1311; Method Series 7000, 8000
Waste Characteristics		Methods 1010/1020A; 9040B/9041A; Section 7.3

NOTES

1. Abbreviations: BTEX = Benzene, Toluene, Ethylbenzene, Xylene; VOCs = Volatile organic compounds; SVOCs = Semivolatile organic compounds; PAHs = Polycyclic aromatic Hydrocarbons; TCLP = Toxicity Characteristic Leaching Procedure; PCBs = Polychlorinated Biphenyls; CLP = Contract Laboratory Program.
2. NYSDEC Analytical Services Protocol, 2001, Category B deliverables.
   Analyses must meet NYSDEC ASP holding time specified for Methods in Exhibit I Part II.
3. If the information provided in this table differs from the most recent version of the ASP (2001), the ASP requirements will take precedence. In addition, if site-specific requirements dictate a change in analytical requirements, the Site-Specific Work Plan (which will include this information) will take precedence

* BTEX and PAH analyses must meet NYSDEC ASP holding time specified for Methods 2001-1 and 2001-2, respectively.

FIGURE 1

DATA REDUCTION, VALIDATION AND REPORTING

Figure 1

DATA REDUCTION, VALIDATION & REPORTING SCHEME

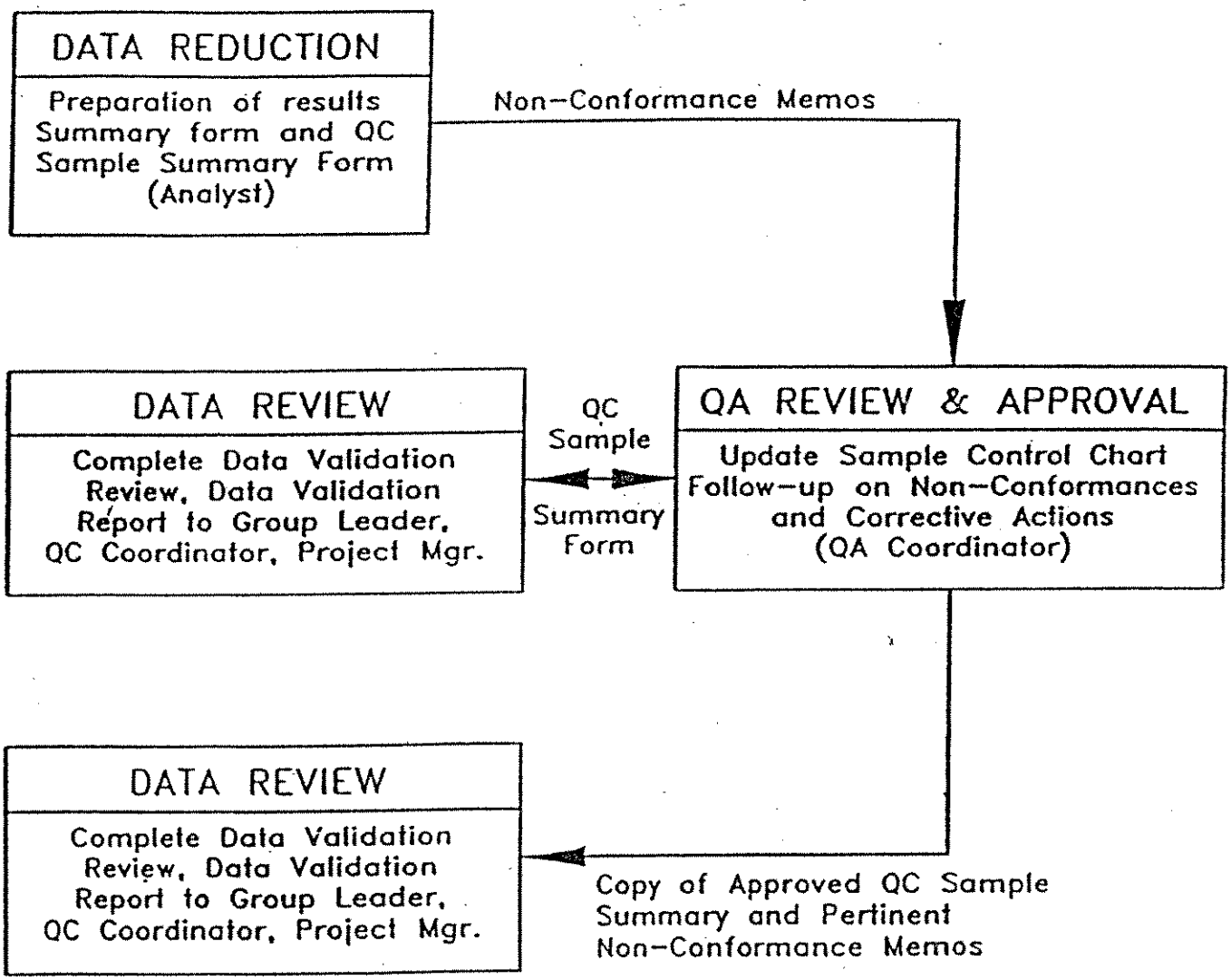
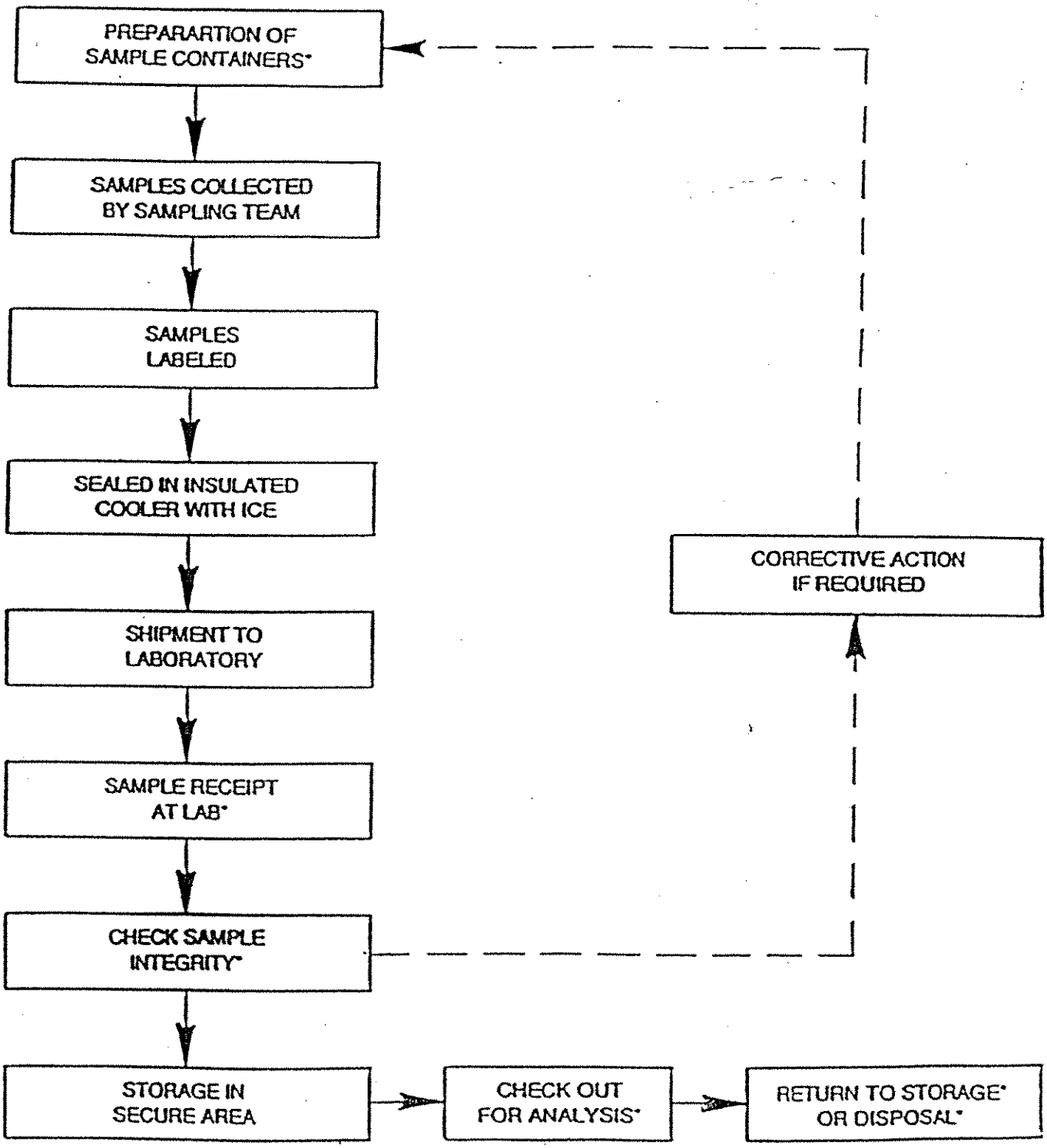


FIGURE 2

SAMPLE CUSTODY

Figure 2

SAMPLE CUSTODY



* Requires sign-off on Chain of Custody Form.

FIGURE 3

CHAIN-OF-CUSTODY RECORD

Severn Trent Laboratories
200 Monroe Turnpike
Monroe CT 06468
Tel: (203) 261-4458
Fax: (203) 268-5346

Committed To *Your* Success

CHAIN OF CUSTODY RECORD

PAGE OF NO.

STL JOB #:

CLIENT:

PROJECT ID:

STL PROJECT MGR:

RUSH ☐ YES ☐ NO DUE DATE

BOTTLE SET #	CLIENT SAMPLE ID.	DATE / TIME SAMPLED	MATRIX	LAB (STL)	QC (Y / N)	TESTS / METHOD / BOTTLE TYPE AND PRESERVATION								SAMPLE REMARKS
						FIELD FILTERED / CIRCLE Y or N								
						Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	

MATRIX CODES

A - AIR
AQ - AQUEOUS
C - COMPLEX
D - DRUM WASTE
OI - OIL
S - SOIL
SL - SLUDGE
W - WIPE
O - OTHER
FB - FIELD BLANK
TB - TRIP BLANK

BOTTLES PREPARED BY	DATE / TIME	BOTTLES REC'D BY	DATE / TIME
SIGNATURE		SIGNATURE	
SAMPLES COLLECTED BY	DATE / TIME	RECEIVED IN LAB BY	DATE / TIME
SIGNATURE		SIGNATURE	

REMARKS ON SAMPLE RECEIPT

☐ BOTTLES INTACT ☐ CUSTODY SEALS
☐ PRESERVED ☐ SEALS INTACT
☐ CHILLED ☐ SEE REMARKS

LABORATORY COPY

FIGURE 4

DAILY STATUS AND MONITORING REPORT

DAILY STATUS & MONITORING REPORT
Niagara Mohawk SIR & MSA Programs

Date:_____ Site Name:_____

Project Manager:_____ Project Field Operations Lead:_____

Description of Field Work Performed:

_____

_____

_____

_____

Media	Sample Number	Types of Analyses	Sample Sent to Lab? (Y/N)	Comments

Means of Sample Shipment to Laboratory? Name and Location of Laboratory:

_____

_____

_____

_____

Issues/Concerns Raised:

_____

_____

_____

_____

Work to be Performed Tommorrow:

_____

_____

_____

_____

Name of Preparer:_____

FIGURE 5

CORRECTIVE ACTION REQUEST FORM

Figure 5

CORRECTIVE ACTION REQUEST	CAR NO. _____ DATE _____
PROJECT NO./TITLE _____ _____ _____ TASK NO./TITLE _____ _____	REFERENCE(S) _____ _____ REPLY DUE DATE _____
SUBJECT _____ _____	PREPARED BY _____
DESCRIPTION OF CONDITION	APPROVED BY _____ PROJECT MANAGER
_____ _____ _____ _____ _____	
CAUSE AND CORRECTIVE ACTION (Include Effective Date) _____ _____ _____ _____ _____ _____ _____ _____	
_____ TASK MANAGER DATE	_____ PROJECT QA OFFICER DATE	_____ PROJECT MANAGER DATE
CLOSEOUT ACTION _____ _____ _____ _____ _____ _____ _____ _____	
_____ PROJECT QA OFFICER DATE	_____ PROJECT MANAGER DATE	SEE REVERSE SIDE FOR INSTRUCTIONS

ATTACHMENT 1

ENSYS FIELD PAH AND PCB SOIL TEST TECHNICAL GUIDES AND TEST KIT INSTRUCTIONS

STRATEGIC DIAGNOSTICS INC.

PAHEnSys® 12T SOIL TEST SYSTEM 70613

RAPID IMMUNOASSAY SCREEN

User's Guide

This method correctly identifies 95% of samples that are PAH-free and those containing 1ppm or greater of PAHs. A sample that develops less color than the standard is interpreted as positive. It contains PAHs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PAHs.

IMPORTANT NOTICE

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of PAHs. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLE SHOOTING GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

Wash Step - Lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. *Solution*: Make sure that the operator washes four times vigorously.

Pipette Calibration - An out-of-calibration pipette may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*: Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipette is out of calibration is if the gold barrel is loose and will turn. (When set on 30 µl there should be about 1/4 of an inch between the white plunger and the end of the clear pipette tip.)

Air bubbles in the pipette - the presence of air bubbles in the pipette tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*: quickly examine the pipette tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

Mixing - Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*: observe the mixing times in the instructions and to mix with sufficient force to ensure that the liquid is homogeneous.

Timing - it is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the test. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

Addition of Drops - it is important to carefully count the drops added to color development steps. The addition of ±1 drop to the instructed 5 drops can cause variability in the results RIGHT AROUND THE DETECTION LEVELS OF INTEREST. One drop less could result in a darker color (a less dilute solution) and result in a false negative. One drop more could result in a lighter color (a more dilute solution) and result in a false positive

Wiping the Tubes - wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

Mixing Lot #'s - never mix lots! Each kit's components are QC'd together for optimal performance and may give inaccurate results with components from other kits, that are not of the same lot #. Also, the user must NEVER mix components from different types of kits (ex: Petro kit buffer tubes can't be used with a PAH kit).

Storage and Operating Temperatures - temperature requirements are very important and should be strictly adhered to. This information can be found in the kit User's Guide.

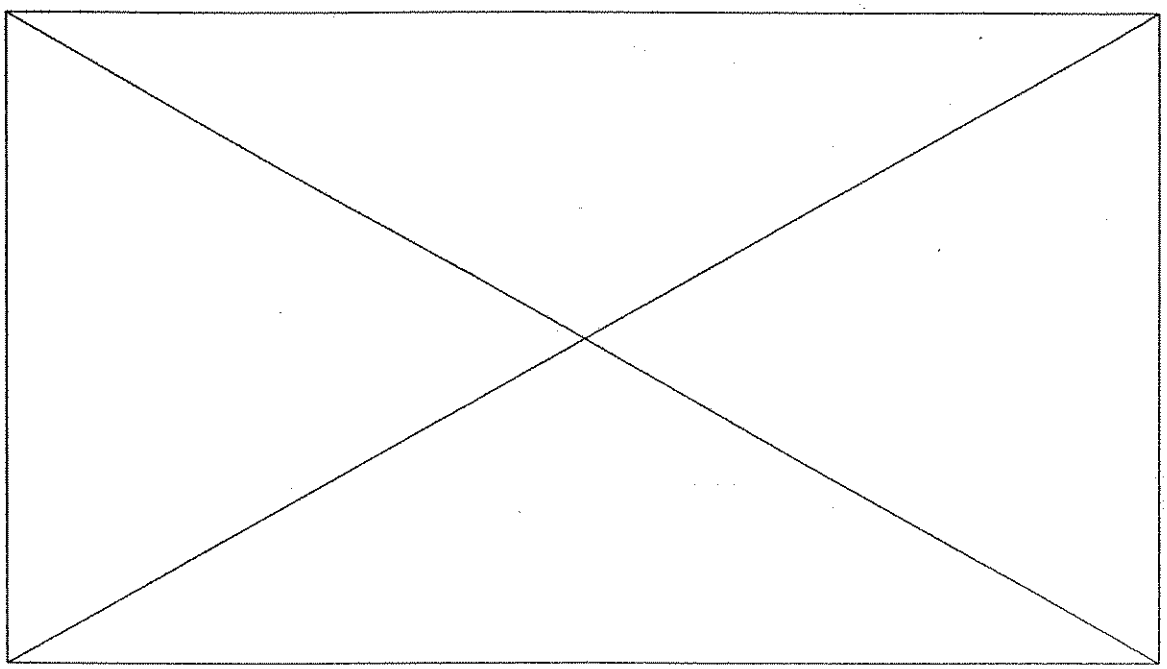
Shelf-life - each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- **Mechanical pipette tips**
- **Stop solution**
- **Standard vial**
- **4 antibody coated tubes**
- **Substrate A**
- **Filtration barrel & plunger**
- **1 and 10 ppm**
- **dilution ampules**
- **Substrate B**
- **Bulb pipette**
- **4 blue buffer tubes**
- **4 conjugate tubes**



READ BEFORE PROCEEDING

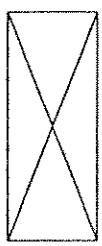
- Follow diagram above to setup workstation.
- Items that you will need that are not provided in the test kit include:
  a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PAHs at 1 and 10 ppm.

PAH Standard

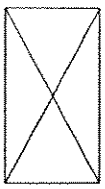
Ampule Cracker

TEST PREPARATION

- Label amber vial "PAH standard" and the current date; Standard is usable for up to 2 weeks from this date. Open PAH Standard ampule by slipping ampule cracker over top, and then breaking top at scored neck. Transfer to empty amber vial with bulb pipette. Always cap tightly when finished using Standard.



Bulb Pipette

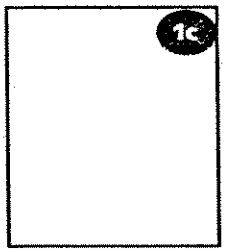


Amber Vial

PHASE 1 SAMPLE EXTRACTION & PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WEIGH SAMPLE

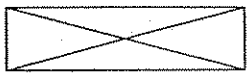


1a Place unused weigh boat on pan balance.

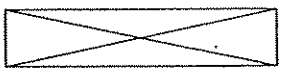
1b Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c Weigh out 10 + / - 0.1 grams of soil.

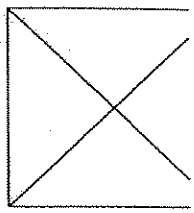
1d If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Pan balance

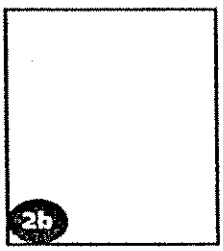


Wooden spatula



Weigh Boat

EXTRACT PAHS

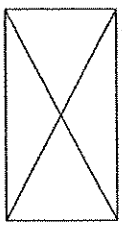


2a Uncap extraction jar and place on flat surface. Without contacting solvent, puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

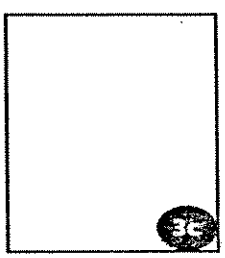
2c Recap extraction jar tightly and shake **vigorously** for one minute.

2d Allow to settle for one minute. Repeat steps **1a -2c** for each sample to be tested.



Sample extraction jar

FILTER SAMPLE

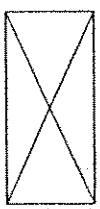


3a Remove lid from extraction jar.

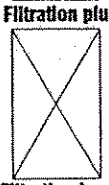
3b Disassemble filtration plunger from filtration barrel.

3c Insert bulb pipette into top (liquid) layer in extraction jar and draw up sample. Transfer **at least** 1/2 bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3d Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).



Filtration plunger



Filtration barrel

Bulb pipette

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM FOR DETECTION LEVELS OTHER THAN 1 & 10PPM

1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.

2. At your request, your kit may include extra dilution ampules to reach high detection levels.

3. **EVERY AMPULE PROVIDED MUST BE USED!**

If there are any questions concerning the dilution procedure please call Technical Services before running the samples to help avoid costly mistakes.
1-800-544-8881.

EXAMPLE:

Lowest ppm	Intermediate ppm	Highest ppm	Dilution Ampules

NOTE: Your order may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.

PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Label the glass conjugate and plastic antibody coated tubes with a permanent marking pen.
- When using the mechanical pipette always withdraw and dispense below the liquid level. Instructions for operating the Mechanical Pipette are found on page 13.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE AND BUFFER SAMPLE FOR 1 PPM AND 10 PPM DETECTION LEVELS

4a Uncap enough blue buffer, conjugate, and antibody coated tubes for Samples and Standards.

4b Empty a blue buffer tube into each conjugate tube.

4c Assemble new tip onto mechanical pipette.

4d Open 1 and 10 ppm dilution ampules by slipping ampule cracker over tip, and then breaking top at scored neck.

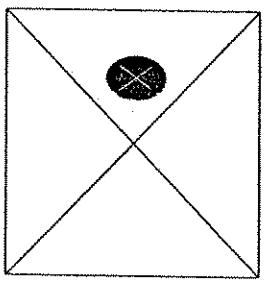
PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

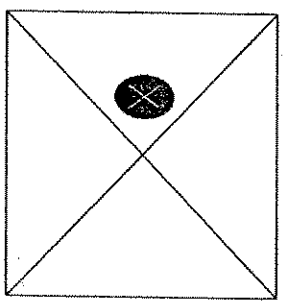
DILUTE AND BUFFER SAMPLE

4e Withdraw 75 µL of filtered sample using mechanical pipette and dispense below the liquid level in 1 ppm dilution ampule. Gently shake ampule for 5 seconds.

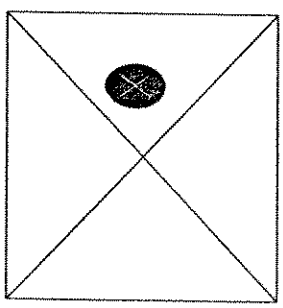
4f Withdraw 75 µL of diluted sample from the 1 ppm dilution ampule and dispense below the liquid level in the 10 ppm dilution ampule. Gently shake ampule for 5 seconds.



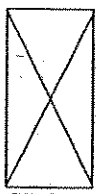
4g Withdraw 75 µL of diluted sample from 10 ppm dilution ampule and dispense below the liquid level in corresponding conjugate tube. Always wipe tip after dispensing into conjugate tube. Withdraw 75µL of 1ppm sample and dispense into corresponding conjugate tube.



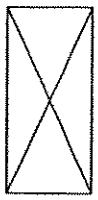
4h Assemble new tip onto mechanical pipette and withdraw 75µl of PAH Standard and dispense below the liquid level in two conjugate tubes. Immediately replace cap on PAH Standard vial.



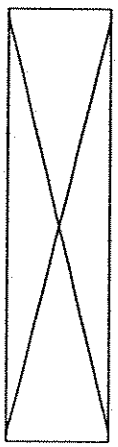
4i Gently shake conjugate tubes for 5 seconds.



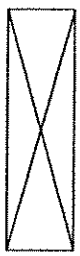
Dilution ampules (1 & 10 ppm)



Plastic Safety Sleeve



Mechanical pipette



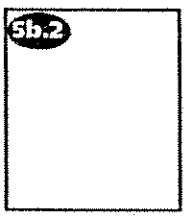
Mechanical pipette tip

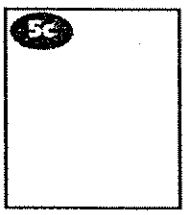
READ BEFORE PROCEEDING

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM CONJUGATE TUBE TO ANTIBODY COATED TUBE





5a. Set timer for 10 minutes.

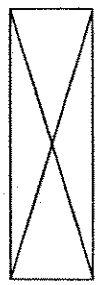
5b. Working left to right in the workstation:

1. Fit all antibody coated tubes firmly on top of all corresponding conjugate tubes.

2. **Start timer and immediately** invert **all** connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

5d. Disconnect and discard the smaller glass conjugate tubes. [It is not important to worry about drops of liquid adhering to lips of tubes].



Antibody coated tubes (contained in resealable "zip-seal" aluminized pouch)

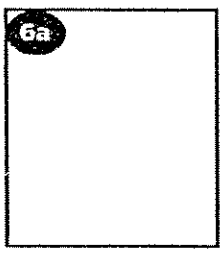
PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

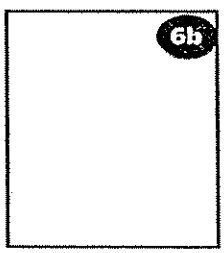
DILUTE AND BUFFER SAMPLE

4e Withdraw 75 µL of filtered sample using mechanical pipette and dispense below the liquid level in 1 ppm dilution ampule. Gently shake ampule for 5 seconds.

4f Withdraw 75 µL of diluted sample from the 1 ppm dilution ampule and dispense below the liquid level in the 10 ppm dilution ampule. Gently shake ampule for 5 seconds.



4g Withdraw 75 µL of diluted sample from 10 ppm dilution ampule and dispense below the liquid level in corresponding conjugate tube. Always wipe tip after dispensing into conjugate tube. Withdraw 75µL of 1ppm sample and dispense into corresponding conjugate tube.



Wash bottle

4h Assemble new tip onto mechanical pipette and withdraw 75µl of PAH Standard and dispense below the liquid level in two conjugate tubes. Immediately replace cap on PAH Standard vial.

4i Gently shake conjugate tubes for 5 seconds.

PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

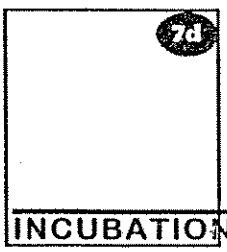
READ BEFORE PROCEEDING

- This phase of the procedure requires critical timing and care in handling the antibody coated tubes.

ADD ENZYME

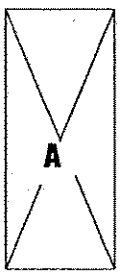
6a Dispense first drop from enzyme dropper into liquid waste container.

Note: before dispensing drops, tap capped tip on hard surface to avoid dispensing air bubbles.

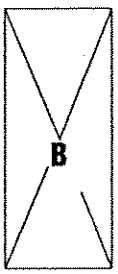


6b Dispense 3 drops of enzyme into each blue buffer tube by squeezing the dropper.

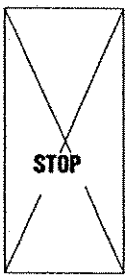
6c Shake buffer tubes for 5 seconds.



Substrate A



Substrate B



Stop

INCUBATION

7a Set timer for 10 minutes.

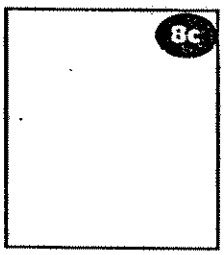
7b Start timing and immediately pour solution from each blue buffer tube into appropriate antibody coated tube.

7c When pouring is complete, gently shake all 4 tubes for 5 seconds.

PHASE 4 INTERPRETATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD



8a Wipe outside of all antibody coated tubes.

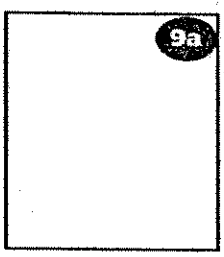
8b Place both Standard tubes in photometer.

8c Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude , results are outside QC limits. Retest the sample(s).

8d Remove and discard tube in right well. The tube in the left well is the more conservative standard and should be used.

MEASURE SAMPLE



9a Place 1 ppm tube in right well of photometer and record reading shown on display.

If photometer reading is negative or zero, PAHs are present.

If photometer reading is positive, concentration of PAHs are less than 1 ppm.

9b Place 10 ppm tube in right well of photometer and record reading shown on display.

If photometer reading is negative or zero, PAHs are present.

If photometer reading is positive, concentration of PAHs are less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

How It Works

Standards, Samples, and color-change reagents are added to test tubes coated with a chemical specific to PAHs. The concentration of PAHs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard.**

Note: PAHs concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PAHs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after its expiration date.
- Each analysis must include 2 **Standards,** with no more than a total of 12 antibody coated tubes.
- Do not exceed incubation periods prescribed by the specific steps.
- Results may not be valid if photometer reading for **Standards** exceed 0.3 in magnitude.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If liquid from the extraction jar, or PAH Standard comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Operate test at temperatures greater than 40° F/4 °C and less than 90° F/32° C.
- After use, dispose of kit components in accordance with applicable federal and local regulations.

System Description

Each PAH RISc Soil Test System contains enough material to perform four complete tests, each at 1 and 10 ppm.

The PAH RISc Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free:

1-800-544-8881.

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PAH-free soil and soil containing 1 ppm and 10 ppm of PAHs were tested with the EnSys® PAH analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PAHs. Either a 1 ppm or a 10 ppm sample that has developed more color than the standard is interpreted as negative. It contains less than the indicated level of PAHs (1 ppm or 10 ppm).

The company does not guarantee that the results with the EnSys® PAH Soil Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

Strategic Diagnostics Inc. warrants that this product conforms to the descriptions contained herein. No other warranties, whether expressed or implied, including warranties of merchantability and of fitness for a particular purpose shall apply to this product.

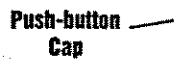
SDI neither assumes nor authorizes any representative or other person to assume for it any obligation or liability other than such as is expressly set forth herein.

Under no circumstances shall SDI be liable for incidental or consequential damages resulting from the use or handling of this product.

MECHANICAL PIPETTE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE MECHANICAL PIPETTE



To Set Or Adjust Volume

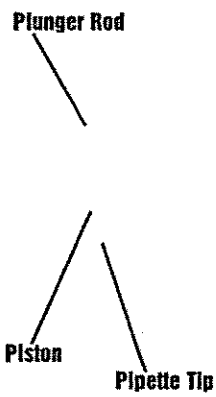
Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "075". Tighten volume lock screw and replace push-button cap.

To Assemble Pipette Tip

Slide larger mounting end of pipette tip onto end of pipette. Holding tip in place, press push-button until plunger rod enters pipette tip. Ensure no gap exists between piston and plunger rod (see illustration).

To Withdraw Sample

With tip mounted in position on pipette, press push-button to first stop and hold it. Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.



To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipette, please refer to your pipette manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS SDI EnSys® TEST SYSTEM

Please read the following before proceeding with field testing.

SAMPLING

The result of your screening test is only as valid as the sample that was analyzed. Samples should be homogenized thoroughly to ensure that the 10 grams you remove for field testing is representative of the sample as a whole. All other applicable sample handling procedures should be followed as well.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of field analysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of EnSys RIS® immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. 1-800-544-8881.

Data for PAH EnSys® Soil Test

Operator: _____ Date: _____ Location: _____

Sample ID	ΔOD	OD sample	Interpretation	OD sample	Interpretation	N O T E S
	Standards	_____ ppm		_____ ppm		

STRATEGIC DIAGNOSTICS INC.

PCB EnSys® 12T SOIL TEST SYSTEM

70203

RAPID IMMUNOASSAY SCREEN

User's Guide

IMPORTANT NOTICE

This method correctly identifies 95% of samples that are PCB-free and those containing 1 ppm or greater of PCBs. A sample that develops less color than the standard is interpreted as positive. It contains PCBs. A sample that develops more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

This test system should be used only under the supervision of a technically qualified individual who is capable of understanding any potential health and environmental risks of this product as identified in the product literature. The components must only be used for the analysis of soil samples for the presence of polychlorinated biphenyls. After use, the kits must be disposed of in accordance with applicable federal and local regulations.

TROUBLESHOOTING GUIDE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WASH STEP

Lack of vigorous washing may result in false positives or negatives depending on whether the wash error was committed on standard or sample tubes. Solution: Make sure to wash four times vigorously, washing the whole set of 12 tubes at once.

PIPET CALIBRATION

An out-of-calibration pipet may result in false positives or negatives depending on whether the amount is greater or less than the specified transfer volume. *Solution*Check the calibration at least daily and after any extreme mechanical shock (such as dropping). An indication that the pipet is out of calibration is if the gold barrel is loose and will turn. (When set on 30 µl there should be about a 1/4 of an inch between the white plunger and the end of the clear pipet tip.)

AIR BUBBLES IN THE PIPET

The presence of air bubbles in the pipet tip when transferring extracts may result in false positives or negatives depending on whether the error was committed on standard or sample tubes. *Solution*Quickly examine the pipet tip each time an aliquot is withdrawn and go back to the source and take another aliquot to displace the bubble if necessary.

MIXING

Lack of thorough mixing, when instructed, can cause inconsistent results. *Solution*Observe the times in the instructions and mix with sufficient force to ensure that the liquid is homogenous.

TIMING

It is important to follow the timing steps in the instructions carefully. The incubation step in the antibody tubes can vary a bit without harm to the tests. The color development step timing is critical and should be no less than 2 minutes and no greater than 3 minutes.

WIPING THE TUBES

Wiping of the tubes should be done before they are read in the spectrophotometer because smudges and fingerprints on the tubes can give potentially false negative readings.

MIXING LOT #'S

Never mix lots! Each kit's components are matched for optimal performance and may give inaccurate results with the components from other kits with different lot #'s. Also, NEVER mix components from different types of kits (ex: Petro kit buffer can not be used with a PAH kit).

STORAGE AND OPERATING TEMPERATURES

Temperature requirements are very important and should be strictly adhered to. This test kit should be stored at less than 80°F/27°C and operated between 40°F/4°C and 90°F/32°C.

SHELF-LIFE

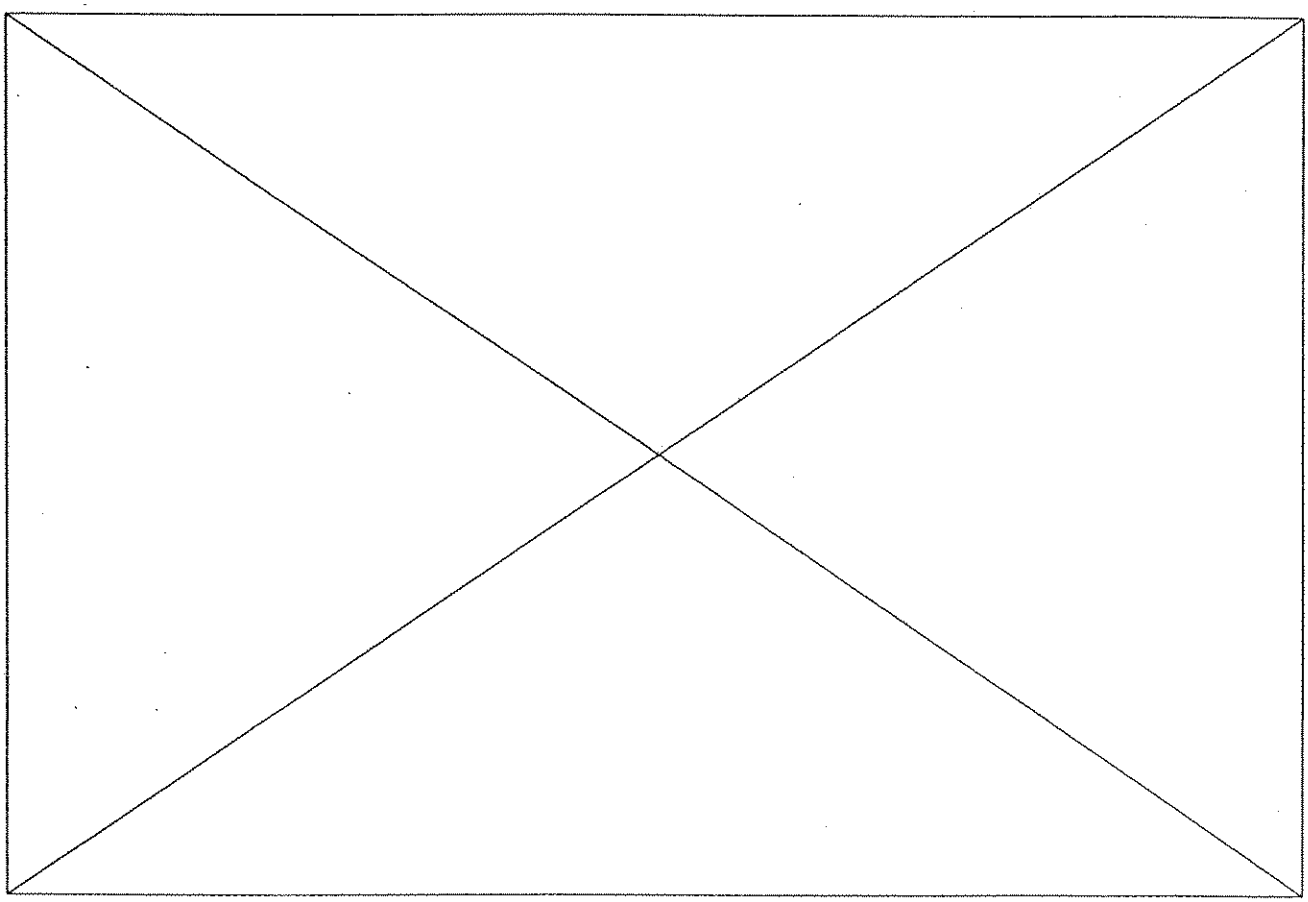
Each kit label contains the kit expiration date. To achieve accurate results, kits must be used prior to expiration.

WORKSTATION SET-UP

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

WORKSTATION SET-UP

- Mechanical pipet tips
- Filter barrels & plungers
- Ampule cracker
- Glass PCB buffer tubes
- Substrate A
- Eppendorf pipet tips
- Bulb pipets
- PCB standard
- Antibody coated tubes
- Substrate B
- Extraction jars
- 1 & 10 ppm dilution ampules
- Stop Solution



Workstation shows components for 3 samples tested at 2 levels

TEST PREPARATION

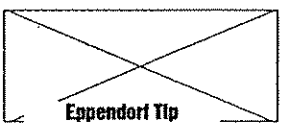
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Do not attempt to run more than 12 tubes, two of which must be standards.
- Items that you will need that are not provided in the test kit include: a permanent marking pen, laboratory tissue (or paper towels), a liquid waste container, and disposable gloves.
- This User's Guide was written for analyzing soil samples for PCBs at 1 and 10 ppm. See table on page 10 for sensitivity to various Aroclors.

TEST PREPARATION

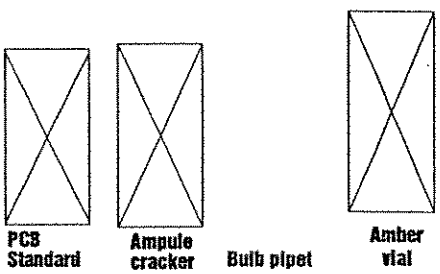
- Label all Eppendorf repeater tips. Tips can be reused for future analyses. Label the first 5mL tip "A", the second 5mL tip "B" and the third 5mL tip "Stop".



- Label the 12.5 mL tip "Buffer".

STANDARD PREPARATION

- Open PCB Standard ampule by slipping ampule cracker over top, and then breaking tip at scored neck. Transfer solution to empty vial with Bulb Pipets.



- Label vial with current date. Standard is usable for 2 weeks. Always cap tightly when finished using standard.

PHASE 1 EXTRACTION & PREPARATION OF THE SAMPLE

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

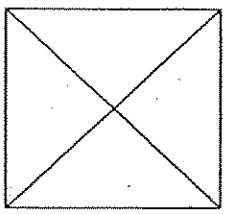
WEIGH SAMPLE

1a. Place unused weigh boat on pan balance.

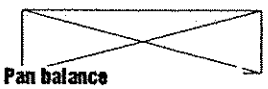
1b. Press ON/MEMORY button on pan balance. Balance will beep and display 0.0.

1c. Weigh out 10 ⁄ 0.1 grams of soil.

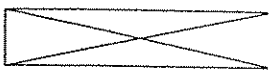
1d. If balance turns off prior to completing weighing, use empty weigh boat to retare, then continue.



Weigh Boat



Pan balance



Wooden spatula

EXTRACT PCBS

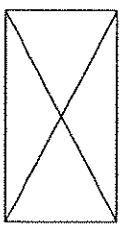
2a. Uncap extraction jar and place on a flat surface. Without contacting solvent puncture foil seal with ampule cracker or sharp object. Peel the remainder of the seal off extraction jar.

2b. Using wooden spatula, transfer 10 grams of soil from weigh boat into extraction jar.

2c. Recap extraction jar tightly and shake **vigorously** for one minute.

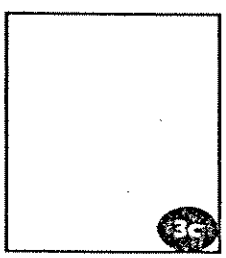
2d. Allow to settle for one minute.

Repeat steps 1a - 2c for each sample to be tested.



Extraction Jar

FILTER SAMPLE

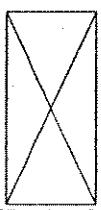


3a. Disassemble filtration plunger from filtration barrel.

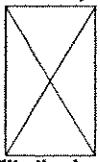
3b. Insert bulb pipet into top (liquid) layer in extraction jar and draw up sample. Transfer **at least ½** bulb capacity into filtration barrel. **Do not use more than one full bulb.**

3c. Press plunger firmly into barrel until adequate filtered sample is available (place on table and press if necessary).

Repeat steps **3a - 3c** for each sample to be tested.



Filtration plunger



Filtration barrel

Bulb pipet

READ TO AVOID COSTLY MISTAKES

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SAMPLE DILUTION PROGRAM

1. The sample dilution procedure on the next page is for standard detection levels. The following diagram represents the sample dilution procedure for all other detection levels.

2. Your kit may include extra dilution ampules to reach high detection levels.

3. **EVERY AMPULE PROVIDED MUST BE USED!**

   If there are any questions concerning the dilution procedure please call SDI Technical Services before running the samples to help avoid costly mistakes. (1-800-544-8881)

EXAMPLE:

NOTE: Your Kit may include additional ampules in order to achieve your test levels. Always transfer filtered sample to the dilution ampule labeled with the lowest PPM level and then transfer from this ampule to the next higher level dilution tube.

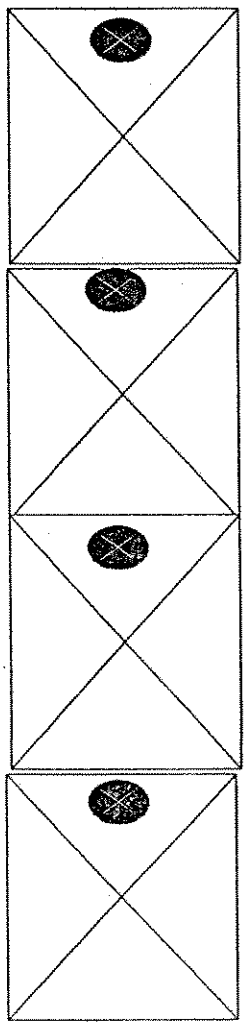
PHASE 2 SAMPLE & STANDARD PREPARATION

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING

- Label the plastic antibody coated tubes with a permament marking pen.
- When using the mechanical pipet always withdraw and dispense below the liquid level.
- "Shake tubes" means to thoroughly mix the contents with special care not to spill or splash.

DILUTE SAMPLES AND STANDARDS



4a. Set the Eppendorf Repeater on 4, assemble the "Buffer" tip and fill with Buffer.

4b. Dispense 1 mL of Buffer into each glass buffer tube.

4c. Open 1 and 10 ppm dilution ampules by slipping ampule cracker over top, and then breaking top at scored neck.

4d. Withdraw 60 µL of filtered sample using mechanical pipet and dispense below the liquid level in "1 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

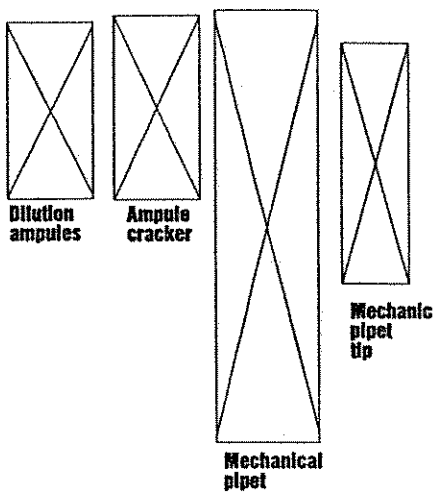
4e. Withdraw 60 µL from the "1 ppm" dilution ampule using mechanical pipet and dispense below the liquid level in "10 ppm" dilution ampule. Gently shake ampule from side to side for 5 seconds to mix thoroughly.

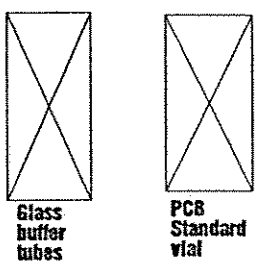
4f. Transfer 60 µL from each dilution ampule into glass buffer tubes. Always wipe tip after dispensing into buffer tube.

4g. Change pipet tip and repeat 4d - 4f for each sample.

4h. Assemble new pipet tip on mechanical pipet and transfer 60 µL from Standard vial into two glass buffer tubes. Immediately replace cap on PCB Standard vial.

4i. Shake all glass buffer tubes for 5 seconds.

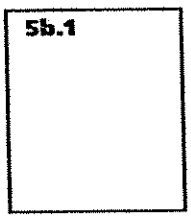


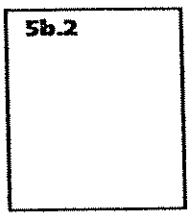


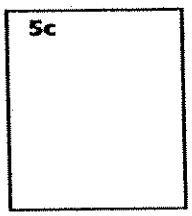
PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

TRANSFER FROM DILUTION TUBE TO ANTIBODY COATED TUBE







5a. Set timer for 10 minutes

5b. Working left to right in the workstation:

1. Fit all antibody coated tubes firmly on top of all corresponding glass buffer tubes.

2. Start timer and immediately invert all connected tube pairs so that the liquid is poured into the antibody coated tubes. Return the tube pairs to the appropriate workstation row making sure the larger (antibody coated) tube is on the bottom.

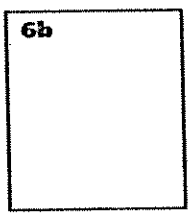
5c. Invert all tube pairs several more times making sure the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

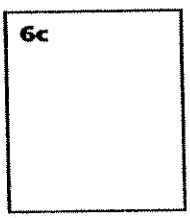
5d. Disconnect and discard the smaller (dilution) tubes. It is not important to worry about drops of liquid adhering to lips of tubes.

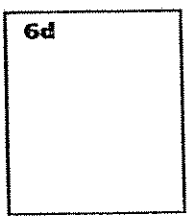
5e. Place conjugate tubes behind antibody tubes in workstation. Remove grey caps and discard.

TRANSFER OF CONJUGATE TO ANTIBODY COATED TUBES

AFTER 10 MINUTES, IMMEDIATELY:







6a. Set timer for 5 minutes.

6b. Working left to right in the workstation:

Start timer and immediately:

Dissolve the conjugate pellets by horizontally connecting the antibody coated tubes and conjugate tubes and **tilt the liquid up to pour it onto the conjugate.**

6c. Return the connected tubes to the appropriate workstation row making sure **the larger (antibody coated) tube is on the bottom. It is important that this step is completed within one minute for all tubes.**

6d. In order to adequately mix solution, **invert** all connected tube pairs **several more times** making sure that the pair is returned to the workstation with the larger (antibody coated) tube on the bottom.

6e. Disconnect and discard the conjugate tubes. It is not important to worry about the loss of liquid adhering to lip of tubes.

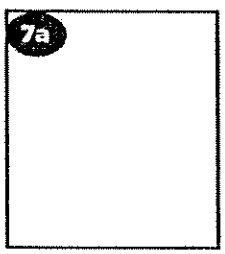
PHASE 3 THE IMMUNOASSAY

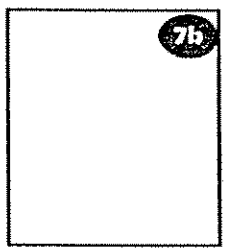
READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

READ BEFORE PROCEEDING
WASH PROCEDURE

- An accurate test requires a vigorous wash accomplished by directing a strong stream into the antibody coated tubes.
- The wash solution is a harmless, dilute solution of detergent.

WASH



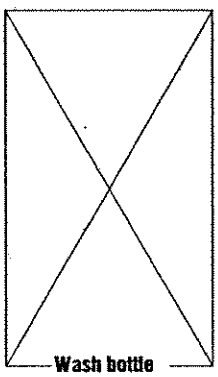


7a After the 5 minute incubation, empty antibody coated tubes into liquid waste container.

7b Wash antibody coated tubes by vigorously filling and emptying a total of 4 times.

7c Tap antibody coated tubes upside down on paper towels to remove excess liquid. Residual foam in the tubes will not interfere with test results.

Note: When running up to 12 antibody coated tubes, tubes can be washed in two groups - one group immediately following the other group.



PHASE 3 THE IMMUNOASSAY

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

COLOR DEVELOPMENT

8a. Set the Eppendorf Repeater on 2, assemble the "A" tip and fill with Substrate A (TMB, yellow label).

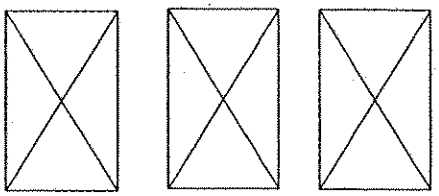
8b. Dispense once (200 µL) into each antibody coated tube.

8c. Set timer for exactly 2 1/2 minutes.

8d. Assemble "B" tip, fill with Substrate B, start timer, and dispense once (200 µL H_2O_2, green label) into each antibody coated tube.

8e. Shake all tubes for 5 seconds. Solution will turn blue in some or all antibody coated tubes.

8f. Assemble "Stop" tip, fill with Stop Solution (red label), and stop reaction at end of 2 1/2 minutes by dispensing once (200 µL) into each antibody coated tube.



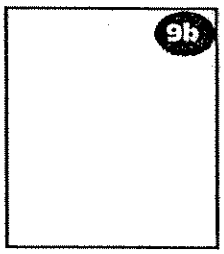
AROCLOR SENSITIVITY

Aroclor	Lowest Detection Level
1248	1.0 ppm
1254	0.5 ppm
1260	0.5 ppm
1242	2.0 ppm
1232	4.0 ppm
1016	4.0 ppm

PHASE 4 ANALYSIS OF RESULTS

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

SELECT STANDARD



9a. Wipe outside of all antibody coated tubes.

9b. Place both Standard tubes in photometer.

9c. Switch tubes until the photometer reading is negative or zero. Record reading.

If reading is greater than - 0.3 in magnitude (reading is less than or lower than - 0.3), results are outside QC limits. Retest the sample(s). (See QC Example)

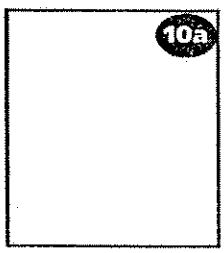
9d. Remove and discard tube in right well. The tube in the left well is the conservative standard.

QC Check Example:

If the photometer reading (with both Standard tubes) is **-0.34 or 0.34**, results are outside the QC limits, and the samples should be retested.

If the photometer reading (with both Standard tubes) is **-0.27 or 0.27**, results are within the QClimits, and testing may proceed.

MEASURE SAMPLE



10a. Place 1 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 1 ppm.

10b. Place 10 ppm tube in right well of photometer and record reading.

If photometer reading is negative or zero, PCBs are present.

If photometer reading is positive, concentration of PCBs is less than 10 ppm.

QUALITY CONTROL

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

System Description

Each SDI PCB Ensys® Soil 12 Test Case contains enough material to perform 12 test samples, each at two detection levels.

The SDI PCB EnSys Soil Test is divided into four phases. The instructions and notes should be reviewed before proceeding with each phase.

Hotline Assistance

If you need assistance or are missing necessary Test System materials, call toll free: 1-800-544-8881.

Validation and Warranty Information

Product claims are based on validation studies carried out under controlled conditions. Data has been collected in accordance with valid statistical methods and the product has undergone quality control tests of each manufactured lot.

PCB-free soil and soil containing 1 ppm or greater of PCBs were tested with the SDI EnSys PCB analytical method. The method correctly identified 95% of these samples. A sample that has developed less color than the standard is interpreted as positive. It contains PCBs. A sample that has developed more color than the standard is interpreted as negative. It contains less than 1 ppm PCBs.

SDI does not guarantee that the results with the PCB EnSys Soil 12 Test System will always agree with instrument-based analytical laboratory methods. All analytical methods, both field and laboratory, need to be subject to the appropriate quality control procedures.

How It Works

Standards, Samples, and color-change reagents are added to test tubes, coated with a chemical specific to PCBs. The concentration of PCBs in an unknown **Sample** is determined by comparing its color intensity with that of a **Standard**.

Note: PCB concentration is inversely proportional to color intensity; the lighter the color development of the sample, the higher the concentration of PCBs.

Quality Control

Standard precautions for maintaining quality control:

- Do not use reagents or test tubes from one Test System with reagents or test tubes from another Test System.
- Do not use the Test System after any portion has passed its expiration date.
- Do not attempt the test using more than 12 antibody coated tubes (two of which are Standards) at the same time.
- Do not exceed incubation periods prescribed by the specific steps.
- Always follow the procedure in this user's guide.
- Use EPA Method 8080 or Code of Federal Regulations Title 40, Part 136, Appendix A, Method 680 to confirm results.

Storage and Handling Precautions

- Wear protective gloves and eyewear.
- Store kit at room temperature and out of direct sunlight (less than 80°F).
- Keep aluminized pouch (containing unused antibody coated tubes) sealed when not in use.
- If Stop Solution or liquid from the extraction jar comes into contact with eyes, wash thoroughly with cold water and seek immediate medical attention.
- Standard Solution contains PCBs. Test samples may contain PCBs. Handle with care.

REPEATER PIPET & MECHANICAL PIPET

READ ALL INSTRUCTIONS BEFORE PROCEEDING WITH THE TEST

HOW TO OPERATE THE REPEATER PIPET

To Set Or Adjust Volume

To determine the pipetting volume, the dial setting (1-5) is multiplied by the minimum pipetting volume of the tip.

To Assemble Pipet Tip

Slide filling lever down until it stops. Then raise the locking clamp and insert the tip until it clicks into position. Be sure the tip plunger is fully inserted into the barrel before lowering the locking clamp to affix the tip in place.

To Fill Tip

With tip mounted in position on pipet, immerse end of tip into solution. Slide filling lever upward slowly.

To Dispense Sample

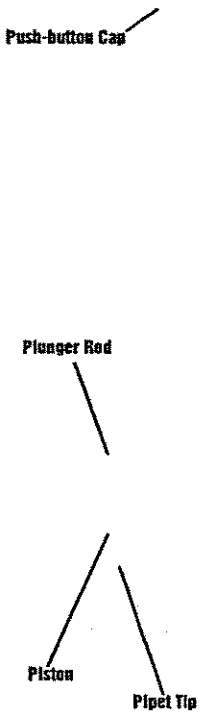
Check the volume selection dial to ensure pipetting volume. Place tip inside test tube so that tip touches the inner wall of tube. Completely depress the pipetting lever.

To Eject Tip

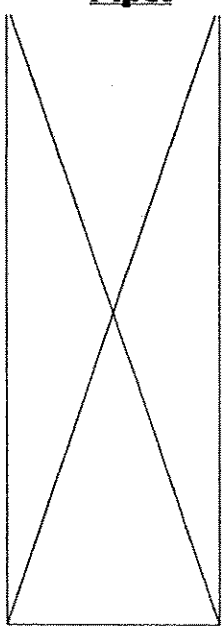
Empty tip of any remaining solution into appropriate container. Raise locking clamp upward, and remove the tip.

For additional information regarding operation and use of repeater, please refer to your Repeater pipet manual.

Mechanical Pipet



Repeater Pipet



HOW TO OPERATE THE MECHANICAL PIPET

To Set Or Adjust Volume

Remove push-button cap and use it to loosen volume lock screw. Turn lower part of push-button to adjust volume up or down. Meter should read "060". Tighten volume lock screw and replace push-button cap.

To Assemble Pipet Tip

Slide larger mounting end of pipet tip onto end of pipet. Holding tip in place, press push-button until plunger rod enters pipet tip. **Ensure no gap exists between piston and plunger rod.**

To Withdraw Sample

With tip mounted in position on pipet, press push-button to first stop and hold it.

Place tip at bottom of liquid sample and slowly release push-button to withdraw measured sample. Ensure that no bubbles exist in liquid portion of sample. If bubbles exist, dispense sample and re-withdraw sample.

To Dispense Sample

Place tip into dispensing vessel (immersing end of the tip if vessel contains liquid) and slowly press push-button to first stop. (Do not push to second stop or tip will eject).

Remove tip from vessel and release push-button.

To Eject Tip

Press push-button to second stop. Tip is ejected.

For additional information regarding operation and use of pipet, please refer to your pipet manual.

ON-SITE QUALITY CONTROL/QUALITY ASSURANCE RECOMMENDATIONS SDI EnSys® 12 TEST SYSTEM

Please read the following before proceeding with field testing.

PRIOR TO TESTING SAMPLES

Carefully follow the instructions in the User's Guide included with every test kit. This is the key element in obtaining accurate results. In addition, store your unused test kits at room temperature and do not use them past their expiration date (see label on each test kit).

INTERNAL TEST QC

Two standards are analyzed with each sample to provide internal test system quality control. With both standards inserted in the photometer, a valid test is indicated when the magnitude of the displayed number (irrespective of the sign, + or -) is less than the value given in the User's Guide. Test runs resulting in a greater number should be repeated to ensure valid conclusions.

QA/QC

The validity of field test results can be substantially enhanced by employing a modest, but effective QA/QC plan. SDI recommends that you structure your QA/QC plan with the elements detailed below. These have been developed based on the data quality principles established by the U.S. Environmental Protection Agency.

A. **Sample Documentation**
   1. Location, depth
   2. Time and date of collection and field analysis

B. **Field analysis documentation** - provide raw data, calibration, any calculations, and final results of fieldanalysis for all samples screened (including QC samples)

C. **Method calibration** - this is an integral part of SDI's EnSys immunoassay tests; a duplicate calibration is performed for each set of samples tested (see the instructions in the User's Guide)

D. **Method blank** - analyze methanol from the extraction jar.

E. **Site-specific matrix background field analysis** - collect and field analyze uncontaminated sample from site matrix to document matrix effect

F. **Duplicate sample field analysis** - field analyze duplicate sample to document method repeatability; at least one of every 20 samples should be analyzed in duplicate

G. **Confirmation of field analysis** - provide confirmation of the quantitation of the analyte via an EPA-approved method different from the field method on at least 10% of the samples; choose at least two representative samples testing above the action level; provide chain of custody and documentation such as gas chromatograms, mass spectra, etc.

H. **Performance evaluation sample field analysis (optional, but strongly recommended)** - field analyze performance evaluation sample daily to document method/operator performance

I. **Matrix spike field analysis (optional)** - field analyze matrix spike to document matrix effect on analyte measurement

FURTHER QUESTIONS?

SDI's technical support personnel are always prepared to discuss your quality needs to help you meet your data quality objectives. (1-800-544-8881)

Data for SDI PCB EnSys® 12T Soil Test

Operator: _____ Date: _____ Location: _____

Sample ID	ΔOD	OD sample	Interpretation	OD sample	Interpretation	Comments
	Standards	_____ ppm		_____ ppm		

APPENDIX I

SITE MANAGEMENT FORMS

ENVIRONMENTAL EASEMENT AND ENGINEERING CONTROL INSPECTION FORM
Patchogue Former Manufactured Gas Plant

A. General Information:

Inspector:_____ Inspection Date:_____ Last Inspection Date:_____

Title:_____ Affiliation (employer):_____

Street Address: _____ City:_____

State: _____ Zip Code: _____ Telephone: _____Email: _____

B. Site Location:

Site Street Address: _____ Municipality: _____

County: _____ State:_____ Block(s): _____ Lot(s):_____

D. Institutional Controls:

1. Is the current land use consistent with Environmental Easement? Yes _____ No _____ If no, explain below.

_____

_____

2. Do the institutional and engineering controls continue as designed and intended to protect the public health and safety and the environment? Yes _____ No _____ If no, explain below.

_____

_____

3. Was each alteration or disturbance (e.g., penetration) of the engineering control, if any, performed expediently and appropriately to maintain the integrity of the engineering control? Yes ____ No _____ If no, explain below.

_____

_____

4. Do any new standards, regulations, or laws apply to the site that might necessitate the implementation of additional procedures, apart from those specified in the Environmental Easement, to evaluate the protectiveness of the engineering control? Yes _____ No _____ If yes, explain below.

_____

_____

ENVIRONMENTAL EASEMENT AND ENGINEERING CONTROL INSPECTION FORM
Patchogue Former Manufactured Gas Plant

C. Engineering Control Conditions (Use extra sheet provided, if needed):

1(a) Engineering Control Type: _____

(b) Condition of the Engineering Control surface (describe any cracks, disturbances, etc.):

_____

_____

_____

_____

_____

_____

(c) Describe maintenance activities performed, if any, during reporting period:

_____

_____

(d) Are repairs needed? Yes _____ No _____ If yes, describe type, location, and size of repair area. (Mark locations on attached site map. Attach pre-and post- repair photographs on the "Photograph Log". Use additional sheets if necessary.)

_____

_____

_____

_____

2 (a) Engineering Control Type: _____

(b) Condition of the Engineering Control surface (describe any cracks, disturbances, etc.):

_____

_____

_____

(c) Describe maintenance activities, if any, performed during reporting period:

_____

_____

_____

(d) Are repairs needed? Yes _____ No _____ If yes, describe type, location, and size of repair area. (Mark locations on attached site map. Attach pre-and post- repair photographs on the "Photographic Log". (Use additional sheets if necessary.)

_____

_____

ENVIRONMENTAL EASEMENT AND ENGINEERING CONTROL INSPECTION FORM
Patchogue Former Manufactured Gas Plant

I, hereby, certify that the engineering controls were inspected and maintained and its integrity remains so that the remedial action continues to be protective of the public health and safety and of the environment.

Inspector's Name (print or Type):_____ Title: _____
Inspector's Signature: _____ Date: _____

FIGURE 1

SITE NAME:

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

MONITORING WELL FIELD INSPECTION LOG
NYSDEC WELL DECOMMISSIONING PROGRAM

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

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

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

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

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

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

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

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

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

REMARKS:

Brown AND Caldwell

Upper Saddle River, NJ Office

LOW-FLOW GROUNDWATER SAMPLING FIELD DATA

Well Number:
Sample I.D.: (if different from well no.)

Project:
Personnel:

Date: _____ Time: _____
Weather: _____ Air Temp.: _____

WELL DATA:

Casing Diameter: _____ ❑ Stainless Steel ❑ Steel ❑ PVC ❑ Teflon® ❑ Other: _____
Intake Diameter: _____ ❑ Stainless Steel ❑ Galv. Steel ❑ PVC ❑ Teflon® ❑ Open rock
DEPTH TO : Static Water Level: _____ ft Bottom of Well:_____ft
DATUM: ❑ Top of Protective Casing ❑ Top of Well Casing ❑ Other:
CONDITION: Is Well clearly labeled? ❑ Yes ❑ No Is well clean to bottom? ❑ Yes ❑ No
Is Prot. Casing/Surface Mount in Good Cond.? (not bent or corroded) ❑ Yes ❑ No
Does Weep Hole adequately drain well head? ❑ Yes ❑ No
Is Concrete Pad Intact? (not cracked or frost heaved) ❑ Yes ❑ No
Is Padlock Functional? ❑ Yes ❑ No ❑ NA Is Inner Casing Intact? ❑ Yes ❑ No
Is Inner Casing Properly Capped and Vented? ❑ Yes ❑ No
VOLUME OF WATER: Standing in well: _____ To be purged: _____

PURGE DATA:

METHOD: □ Bailer, Size: ____ ❑ Bladder Pump ❑ 2" Submersible Pump ❑ 4" Submersible Pump
❑ Centrifugal Pump ❑ Peristaltic Pump ❑ Inertial Lift Pump ❑ Other: _____

MATERIALS: Pump/Bailer: ❑ Teflon® ❑ Stainless Steel ❑ PVC ❑ Other: _____
Tubing/Rope: ❑ Teflon® ❑ Polyethylene ❑ Polypropylene ❑ Other: _____

Pumping Rate: _____ Elapsed Time: _____ Volume Pumped: _____
Was well Evacuated? ❑ Yes ❑ No Number of Well Volumes Removed: _____
PURGING EQUIPMENT: ❑ Dedicated ❑ Prepared Off-Site ❑ Field Cleaned

SAMPLING DATA:

METHOD: ❑ Bailer, Size: ____ ❑ Bladder Pump ❑ 2" Submersible Pump ❑ 4" Submersible Pump
❑ Syringe Sampler ❑ Peristaltic Pump ❑ Inertial Lift Pump ❑ Other: _____

MATERIALS: Pump/Bailer: ❑ Teflon® ❑ Stainless Steel
Tubing/Rope: ❑ Teflon® ❑ Polyethylene

SAMPLING EQUIPMENT: ❑ Dedicated ❑ Prepared Off-Site ❑ Field Cleaned
Metals samples field filtered? ❑ Yes ❑ No Method: _____
APPEARANCE: ❑ Clear ❑ Turbid ❑ Color: _____ ❑ Contains Immiscible Liquid
FIELD DETERMINATIONS: See attached form for field parameter data.

DUP : ❑ No ❑ Yes Name: _____
MS/MSD : ❑ No ❑ Yes Name: _____

I certify that this sample was collected and handled in accordance with applicable regulatory and project protocols.

Signature: _____ Date: _____

Brown AND Caldwell

2 Park Way, Upper Saddle River, NJ 07458
Phone: (201) 574-4700 Fax: (201) 236-1607

NJ FIELD LAB ID# 02023
LOW-FLOW GROUNDWATER FIELD DATA SHEET

Project Name: _____ Project Number: _____
Client: _____ Date: _____
Personnel: _____ Well ID: _____
Purge/Sample Depth: _____ Sample ID: _____

Actual Time	Certified Parameters					ORP (mV)	DTW (ft)	Pumping Rate (mL/min)	Comments
	pH	Temp (ºC)	Cond ( )	DO (mg/L)	Turbidity (NTU)				

Certified Sample Information:
Time of Sample: _____ Analyst Signature: _____
Instrument Data:
Manufacturer/Model: _____
Serial No. Unit: _____ Serial No. Handheld: _____
Calibration Date/Time: _____

Are low-flow parameters subject to field lab certification? ☐ Yes ☐ No (not required for CERCLA sites or sites outside of NJ)

If yes, low-flow data must be accompanied by a completed "Field Calibration Record, Horiba U-52" form or equivalent.

APPENDIX J

GENERIC FIELD SAMPLING PLAN

GENERIC
FIELD SAMPLING PLAN

FOR

SITE INVESTIGATIONS

AT

NON-OWNED FORMER MGP SITES

Prepared for:

Niagara Mohawk, A National Grid Company
300 Erie Boulevard West
Syracuse, New York

Prepared by:

Foster Wheeler Environmental Corporation
One Park Place
300 South State Street, Suite 620
Syracuse, New York

NOVEMBER 2002

Site Specific
Revisions Attached: Supplement No. ___ Date ___

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1.0 INTRODUCTION

This generic Field Sampling Plan (GFSP) has been prepared for Niagara Mohawk, a National Grid Company (NM) in response to the Voluntary Cleanup Order (VCO) (Index No. DO 0001 0011) between NM and the New York State Department of Environmental Conservation (NYSDEC). This document is intended to provide guidance for implementation of various types of environmental sampling activities that may be utilized during Site Investigation and/or Remedial Investigations, Interim Remedial Measures, Feasibility Studies, Remedial Designs, and/or Remedial Actions at Non-owned Former MGP sites. The numbers and types of environmental samples to be collected are identified in the detailed respective Site-Specific Work Plans, to which this document is appended. If any discrepancy occurs between the Site-Specific Work Plan and the Generic Work Plan/Field Sampling Plan then the Site-Specific Work Plan will govern.

During the performance of any investigation, references in all work products to dense nonaqueous phase liquids (DNAPL) and/or other MGP impacted media (i.e. soil, water, sediments, etc.) will be made using the terminology and descriptions presented in the U.S.EPA documents entitled ***Ground Water Issue - Dense Nonaqueous Phase Liquids*** (Huling and Weaver; March 1991) and included as Attachment B.

2.0 GENERAL FIELD GUIDELINES

2.1 Underground Utilities

All underground utilities, including electric, telephone, cable TV, sewers, water, natural gas, etc., will be identified prior to any drilling and subsurface sampling. Underground Facilities Protective Organization (UFPO) will be contacted by phone at least 72 hours prior to field activities so their underground utilities can be marked at the Site. Other potential on-site hazards such as sharp objects, known subsurface structures, overhead power lines, and building hazards will be identified during the Site reconnaissance visit.

2.2 Sample Identification

Each sample will be given a unique identification as shown in Table 1. With this type of identification, no two samples will have the same label. Labels or tags identified as shown in Table 1 will be attached to each sample container. Labels or tags will be rendered waterproof by either covering the label with clear plastic wrapping tape or utilizing waterproof material for the tag or label.

2.3 Sampling Equipment

The following is a general list of equipment, which may be necessary for sample collection:

- Stainless steel spoons and bowls for mixing soil and sediment samples;
- Appropriate sample containers (and coolers) provided by the laboratory;
- Sample bottles (kept closed and in the laboratory-shipped coolers until the samples are collected);
- Reagent-grade preservatives and pH paper or meter (or pre-preserved sample containers) for aqueous samples;
- Chain-of-Custody labels, tags, seals, and record forms;
- Logbook, field sampling records, and indelible ink markers;
- Laboratory grade decontamination detergents (such as Alconox, Liquinox, etc.), reagent-grade solvents, and deionized, organic-free water to be used for decontaminating equipment between sampling stations;
- Squirt Bottles;
- Ruler and measuring tape;
- Garbage bags;
- Paper towels and/or baby wipes;
- Buckets, wash basins, and scrub brushes to be used for decontaminating equipment;

- Digital camera or camera and film to document sampling procedures and sample locations;
- Stakes and flagging tape and/or spray paint to identify sampling locations;
- Shipping labels and forms;
- Knife;
- Vermiculite or other packing/shipping material for sample bottles;
- Strapping tape;
- Clear plastic tape;
- Duct tape;
- Aluminum Foil;
- Reclosable plastic bags;
- Ice;
- Portable field instruments, which may include but not be limited to a pH meter, conductivity meter, turbidity meter, dissolved oxygen (DO) meter or multi-parameter flow through cell, photoionization detector (PID), and water level indicator;
- Combustible gas indicator (CGI);
- Poly-sheeting;
- Driller's jars (for archiving samples);
- Polypropylene or stainless steel bailers;
- Poly propylene rope and/or Teflon line; and
- Submersible, peristaltic and/or centrifugal pump and associated tubing.

Other sampling materials and equipment may be utilized as warranted by field conditions encountered at time of sampling and media to be sampled. Appropriate health and safety equipment and PPE, as per the Generic Environmental Health and Safety (EHS) Plan (Volume II) will be used.

2.4 Field Records

The Project Manager will control all field logbooks. Each field logbook will receive a serialized number and be issued to the field operations leader (FOL). Field logbooks will be maintained by the FOL and other team members while in the field to provide a daily record of significant events, observations, and measurements during the field investigation. All entries will be signed and dated at the bottom of each page.

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

- Name and title of author, date and time of entry, and physical/environmental/weather conditions during field activity;
- Purpose of sampling activity;
- Location of sampling activity;
- Name and address of field contact;
- Name and title of field crew members;
- Name and title of any Site visitors;
- Sample media (soil, sediment, groundwater, etc.);
- Sample collection method;
- Number and volume of sample(s) collected;
- Description of sampling point(s);
- Volume of groundwater removed before sampling;
- Preservatives used;
- Date and time of collection;
- Sample identification number(s);
- Sample distribution (e.g., laboratory);
- Field observations;
- Any field measurements made, such as pH, temperature, turbidity, conductivity, water level, etc.;
- References for all maps and photographs of the sampling site(s);
- Information pertaining to sample documentation such as:
    - Bottle lot numbers
    - Dates and method of sample shipments
    - Chain-of-Custody Record numbers
    - Overnight Shipping Air Bill Number

All original data recorded in Field Logbooks, Sample Tags, and Chain-of-Custody records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed.

If an error is made on an accountable document assigned to one individual, that individual will make all corrections simply by crossing a single line through the error, placing the initials of the individual making the correction and date next to the crossed out information and entering the correct information. The erroneous information will not be erased. All field personnel will be instructed as to the proper field logging techniques for maintaining the integrity of the documentation.

3.0 EQUIPMENT DECONTAMINATION

3.1 Drill Rig and Backhoe Decontamination

A decontamination pad will be constructed of high-density polyethylene sheeting, no less than 10-millimeters thick, on a prepared surface sloped to a sump. The sump must also be lined and of sufficient volume to contain at least 20 gallons of decontamination water. The size of the pad shall be of sufficient size to contain the fluids generated during the decontamination of on-site equipment. The decontamination pad will be no larger than the back of the drill rig, since the back of the drill rig will be the largest piece of equipment anticipated on-site. Sides of the pad will be bermed so that all decontamination water is contained. Upon completion of all field activities, the decontamination pad will be properly decommissioned. To accomplish decommissioning, all free liquids will be removed from the surface of the High Density Polyethylene (HDPE) sheeting, including the sump area, and allowed to air dry. The HDPE sheeting will then be cut to manageable size, folded or rolled, and placed in the waste container (usually a roll-off container or 55-gallon drum). The earthen material or wood timbers used to construct the containment berm will be inspected to ascertain if the material has come in contact with decontamination liquids during use. If they have, the materials will be disposed in the waste container for subsequent disposal at an appropriate facility. If the materials have not been in contact with decontamination liquids, they may be reused.

All equipment used in intrusive work including backhoe, drilling rig, augers, bits, tools, split-spoon samplers and tremie pipe will be cleaned with a high-pressure hot water or steam cleaning unit and scrubbed with a wire brush to remove dirt, grease, and oil before beginning field work and before leaving the project Site upon completion of the last sampling activity. All tools, drill rods, and augers will be placed on sawhorses or polyethylene plastic sheets following steam cleaning. Direct contact with the ground will be avoided. The back of the drill rig and all augers, rods, and tools will be decontaminated between each drilling location according to the above procedures. The backhoe bucket, arm, and any other part of the equipment, which may have contacted excavated soil, will be decontaminated between each test pit location. Tools, augers, and rods will be decontaminated between drilling monitoring wells.

Decontamination water collected in the sump of the decontamination pad will be at a minimum removed from the sump at intervals less than 90% of its capacity and prior to rain events. The liquids will be pumped to a 55-gallon drum and stored in an appropriate satellite storage area. All waste handling will be performed in accordance with waste handling regulations.

Unless sealed in manufacturers packaging, monitoring well casing and screens will be steam cleaned immediately before installation. The screen and casing shall then be wrapped in polyethylene plastic and transported from the designated decontamination area to the well location.

3.2 Sampling Equipment Decontamination

Prior to sampling, all non-dedicated/non-disposable equipment (i.e., bowls, spoons, and bailers) will be washed with potable water and a laboratory grade detergent (such as Alconox). Decontamination may take place at the sampling location as long as all liquids are contained in pails, buckets, 55-gallon drums, etc. The sampling equipment will then be rinsed with potable water followed by a reagent-grade isopropanol rinse and finally a deionized water rinse. Additionally, all equipment used to collect samples for metals analysis will receive a nitric acid rinse followed by a deionized water rinse. Between rinses, equipment will be placed on polyethylene sheeting. At no time will decontaminated equipment be placed directly on the ground. Equipment will be wrapped in polyethylene plastic or aluminum foil for storage or transportation from the designated decontamination area to the sampling location, where appropriate.

4.0 SITE RECONNAISSANCE AND SCREENING

The following practices, procedures and methods will be utilized in carrying out all field activities if specified in the Site-Specific Work Plan.

4.1 Site Reconnaissance

Following the contact with UFPO and markout of subsurface utilities at the Site, Site reconnaissance will be performed. The Site reconnaissance will be attended by the NM Project Manager, the Consultant Project Manager and/or the FOL, and representatives of the NYSDEC and/or the NYSDOH. During this task, the NYSDEC-approved sampling locations, as outlined in the Site-Specific Work Plan, will be marked in the field with a wooden stake and/or spray paint. Conflicts with the NYSDEC-approved sampling locations, based on the utility markout, will be modified during this visit.

Prior to this Site visit, the property owner and/or company representative will be contacted by the NM Project Manager to meet at the Site. The property owner and/or company representative will be asked if subsurface structures exist on the property and will be asked to identify their locations. Subsurface structures will consist, but are not limited to the following: septic tanks, cesspools, underground irrigation lines, water supply wells, vaults, leaching fields, propane, oil, and/or fuel tanks, underground utilities installed by the owner, drainage lines, etc.

4.2 Metal Detector Survey

A metal detector survey may be conducted using the magnetic cable locator model MAC-51B (or equivalent); to locate unidentified underground utilities and possible buried drums or tanks. The area around each proposed subsurface investigation point may be checked with the MAC-51B (or equivalent) prior to any subsurface investigation. Initially, the locator will be tested on known locations of underground utilities to verify that it is functioning properly.

If there is no indication of buried utilities, drums, or tanks, then subsurface sampling will proceed. However, if the locator indicates the presence of a buried object, activities will not proceed in that location until the type of buried object is determined. If the object cannot be identified from surface or shallow digging, a test pit may be required to determine the identity of the buried object. If a test pit is required, the procedure and scope will be reviewed with the NM Project Manager prior to conducting the work.

The NM Project Manager will keep the property owner or company representative informed of planned Site activities.

4.3 PAH Field Screening

PAH screening of soil samples may be used to determine the extent of PAHs in soil and to optimize the location of samples for confirmatory laboratory analysis.

If PAH field screening is conducted at any Site, then adequate facilities will be provided for proper use of the PAH-specific immunoassay test. The individual responsible for conducting the immunoassay test in the field shall receive instruction in the proper use and storage of the test kit. The instructions for the PAH Field Screening Kit are provided as Attachment A of the Generic Quality Assurance Project Plan (QAPP) (Volume II). The test is a simple procedure designed to test any type of soil sample for PAHs. The test uses a semi-quantitative, colorimetric method that incorporates immunoassay technology. The test is performed using tubes, which are coated with a chemical that specifically reacts with PAHs. To perform the test, the standards, samples and reagents are added in a step-wise manner to the coated tubes. The procedure results in a color change within each tube inversely proportional to the concentration of PAHs. The color in the tubes is read by inserting the tubes in a standardized color photometer. The test consists of the following three steps:

1. Sample Preparation: First, PAHs are extracted from the soil using a solvent. The extract is clarified using a disposable 0.45-micron filter tip.

2. Testing: After sample preparation, the PAH standards and the sample and the enzyme are added to the coated tubes. After 10 minutes incubation, the tubes are rinsed and color-developing reagents are added. Within a few minutes, color development occurs in the tubes.

3. Results Interpretation: The color of the sample tube is compared against the color of the standard tube using a photometer to determine if PAHs are present in the sample. The result will indicate concentrations in three ranges; less than 1 ppm, between 1 and 100 ppm, and over 100 ppm.

4.4 PCB Field Screening

Polychlorinated biphenyls (PCBs) screening of soil samples may be used to determine the extent of possible PCBs in soil and to optimize the location of samples for confirmatory laboratory analysis. The field screening may be conducted using a PCB-specific immunoassay test. The individual responsible for conducting the immunoassay test in the field shall receive instruction in the proper use and storage of the test kit. The instructions for the PCB Field Screening Kit are provided as Attachment A of the Generic Quality Assurance Project Plan (QAPP) (Volume II). The test is a simple procedure designed to test any type of soil sample for PCBs. The test uses a semi-quantitative, colorimetric method that incorporates immunoassay technology. The test is performed using tubes, which are coated with a chemical that specifically reacts with PCBs. To perform the test, the standards, samples and reagents are added in a step-wise manner to the coated tubes. The procedure results in a color change within each tube proportional to the concentration of PCB. The color in the tubes is read by inserting the tubes in a comparative photometer. The test consists of the following three steps:

1. Sample Preparation: First, PCBs are extracted from the soil using a solvent. The

extract is clarified using a disposable 0.45-micron filter tip.

2. Testing: After sample preparation, the PCB standards and the sample are added to the coated tubes using dropper bottles. After 10 minutes incubation, the tubes are rinsed and color-developing reagents are added. Within a few minutes, color development occurs in the tubes.

3. Results Interpretation: The color of the sample tube is compared against the color of the standard tube using a photometer to determine the concentration of the sample. The result will indicate concentrations in 3 ranges; less than 5 ppm, between 5 and 50 ppm, and over 50 ppm. Also, with a dilution samples can be tested for over 500 ppm.

PCB specific screening with the eminase test kits will be utilized on-sites, which have historically been associated with either electrical equipment from a certain time period that employed the use of PCB oils or when records may reflect the use of PCBs at that facility. The test kits will be used as part of an overall analytical program, which will include laboratory analysis of on-site soils.

4.5 Private Water Supply Inventory

If off-site groundwater impacts are detected through the sampling program, or if specifically requested by the NYSDEC, than an inventory of private water supply sources within a one-half mile radius around the project Site will be researched. The research will be conducted by contacting the municipal Water Department (if one exists), the municipal engineer, the NYS Department of Health and consulting the *Atlas of Community Water System Sources*, and/or the United States Geologic Society (USGS).

5.0 SUBSURFACE BORING PROTOCOL

5.1 Drilling Methods and Sample Collection

Overburden

Soil borings, in general, will be drilled with hollow-stem augers or flush-joint casing. When advancing a soil boring, re-entry of the split-spoon sampler into the previously sampled interval shall not be permitted. Hollow-stem augers with center plug will be advanced at two-foot intervals, consistent with the split-spoon sampling pace. Alternative methods may be used at the geologist's discretion with the authorization of NM and NYSDEC. Split-spoon sampling will be conducted in accordance with ASTM Specification D-1586-84 for standard penetration test and split barrel sampling, unless otherwise authorized by the field geologist. Split-spoons will be decontaminated after each sample is collected.

A plywood sheet or other suitable basin (during mud or water rotary drilling) will be placed around the augers during drilling to contain soil cuttings/mud drilling and prevent them from contacting the ground surface. Soil cuttings will be placed in a 55-gallon steel drum or a roll-off container for subsequent sampling and disposal. Decontamination water and drilling mud/water will be placed in tanks and/or 55-gallon steel drums for proper disposal.

Boring Completion Methods

All soil borings will be completed by adding cement/bentonite grout, via tremie pipe, from the bottom of the borehole up to the ground surface as the augers are withdrawn. The grout will be mixed in the following relative proportions: 30 gallons of water to three 94-pound bags of cement to 25 pounds granular bentonite.

Geoprobe® Coring

If prescribed in the Site-Specific Work Plan, Geoprobe® coring will be performed in accordance with the manufacturer's specifications. An assembled Geoprobe Macro-Core® open-tube soil sampler, with a one use dedicated liner, will be driven one sampling interval (approximately 4 feet) into the subsurface then retrieved using a Geoprobe® soil probing machine. The collected soil core will be removed from the sampler along with the liner. The field geologist will classify and sample the soil located within the liner. Upon completion, the excess soil will be placed into a 55-gallon drum for disposal and the inner liner properly disposed. After decontamination, the Macro-Core sampler will be reassembled using a new liner. The clean sampler will then be advanced back down the same borehole to collect the next soil core interval.

Upon completion of sampling, the borehole will be grouted from the base of the borehole to ground surface. As the Geoprobe ® piping is removed from the borehole, grout will be place in the Geoprobe ® piping and allowed to flow out, via gravity, into the void left by the piping.

Procedures for geologic logging and field classification will be as presented in Section 5.2.

Shelby Tube Sampling

Shelby tube samples will be collected in accordance with the latest revision of ASTM D/587. When the desired sampling depth is reached, the hollow-stem auger or casing will be cleaned out using whatever method is preferred so as not to disturb the material to be sampled. The Shelby tube will be lowered to the bottom of the borehole, then advanced (pushed) via pressure without rotation by a continuous relatively rapid motion until 24 inches of penetration is achieved. At the discretion of the field geologist, a period of approximately 10 minutes, measured from the time of insertion, will be allowed to provide for sample adhesion to the tube walls. Prior to removal, the tube may be rotated two complete revolutions to shear the bottom of the sample from the native material.

Upon removal, the field geologist will log the tops and bottoms of the sample for soil classification. Samples recovered via Shelby tube will be preserved in conformance with the latest revision of ASTM D 4220. To preserve the natural moisture content of the samples, the tube ends will be sealed with a minimum of 0.50 inch of paraffin wax. Plastic slip caps will be applied at the ends of the sample tube, taped, then dipped and sealed in wax.

Rock Coring

Conventional or wire-line HX or NX coring will be used if rock drilling is specified in the Site-Specific Work Plan. Prior to drilling at such locations, a minimum 4-inch diameter, temporary steel casing or equivalent will be placed or locked into the top of bedrock. Rock coring will be conducted in accordance with the latest version of ASTM D2113. Upon retrieval, the core will be placed in a core box labeled as follows:

Outer Core Box and/or End Panels

1) Project/Site name
2) Site location
3) Boring/well number
4) Box number
5) Core run number and footage interval
6) Date

Inside Core Box Cover (in columns)

1) Boring/well number
2) Run number
3) Depth interval
4) Actual recovery
5) Rock quality degree (RQD) in percent
6) PID screening results where applicable

7) Comments

In addition, a geologist will be on-site during the drilling operations to fully describe each core, including:

1) Color
2) Thickness of bedding
3) Rock type
4) Additional petrographic information
5) Texture
6) Weathering state
7) Structure
8) Detailed description of discontinuities and fillings
9) Formation name
10) Detailed description of visible impacts
11) Miscellaneous observations

Sample descriptions, PID readings, and drilling locations will be recorded in the field logbook.

5.2 Geologic Logging, Soil Classification and Documentation

The field geologist will log borehole geology in the field logbook and on field forms. All samples collected from the borehole will be classified in accordance with ASTM standards D2487 Standard Method for Classification of Soils for Engineering Purposes and D2488 Standard Practice for Description and Identification of Soils or using the Burmeister Method and classifying the soils using the Unified Soil Classification System. The field geologist will be on-site during the drilling operations to classify/log each sample in the field logbook and/or field forms including:

- Site;
- Boring number;
- Interval sampled;
- Date;
- Initials of sampling personnel;
- Drilling Company's Name;
- Soil type;
- Color;
- Feet of recovery;
- Moisture content;
- Texture;

- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations (including organic vapor readings).

If no recovery, or limited recovery, is observed in the sample, then a description regarding the lack of sample recovery should be provided on the log of boring, if evidence of an obstruction or equivalent can be identified. If no observable evidence is identified then no opinion or guess should be entered on the log of boring.

Figure 1 presents an example of a log of boring form to be completed. If this form is not utilized, the form used should be approved by the Consultant's Project Manager as well as NM's project manger.

Photo documentation

Photo documentation of the Site activities will be conducted consistently throughout the implementation of the field program. A photographic log will be created and maintained as part of the overall field program. Visually impact materials and/or distinct stratigraphic changes in the soil column will be included in the photographic documentation for the individual Sites.

6.0 MONITORING WELL INSTALLATION AND DEVELOPMENT

Monitoring wells will be installed at the locations identified in the Site-Specific Work Plan. After the completion of drilling and monitoring well installation, all wells will be developed prior to the collection of groundwater samples. The following procedures will be used to install and develop all monitoring wells.

6.1 Monitoring Well Specifications

Monitoring wells installed in unconsolidated deposits that do not penetrate a presumed confining layer will be constructed according to the following specifications:

- PVC or stainless steel 2-inch diameter threaded, flush-joint casing and screens with O-rings will be installed.
- Wells will be screened in the unconsolidated deposits. Screens will be approximately 10 feet in length, and slot openings will be 0.020 inch. Alternatives may be used at the discretion of the field geologist, based on Site-specific geologic conditions.
- A sump, up to 2 feet in length, may be attached to the bottom of the screen to collect dense nonaqueous phase liquids (DNAPLs), if appropriate. A sump will not be installed if DNAPL is not observed in the boring.
- The top of the casing will extend to approximately 2 to 3 feet above ground surface where possible, given Site-specific considerations. Otherwise, flush-mount casings will be used.
- Where appropriate, the annulus around the screens will be backfilled with silica sand (#1 Morie or equivalent), based on Site-specific geologic conditions and screen slot size, to a minimum height of 2 feet above the top of the screen.
- A bentonite pellet/chip seal or slurry (30 gallons water to 25 to 30 lbs. bentonite, or relative proportions) will be placed above the sand pack. The bentonite pellet/chip seal will be installed via gravity and allowed to hydrate for at least 1 hour before placement of grout above the seal. If the bentonite slurry method is used for installation of the seal, then a side discharging tremie pipe will be utilized for the installation of the bentonite seal. Where possible, the bentonite seal will be a minimum of 24-inches in depth, except in those instances where the top of the well screen is in close proximity to the ground surface. In these instances, the well will be completed in accordance with specifications provided by the field geologist, which will incorporate an adequate surface seal into the well design.
- A fine sand pack (Morie 00 or equivalent) approximately 1 foot thick will be placed above and below the bentonite seal to isolate it and to prevent mixing of components.
- The remainder of the annular space will be filled with a cement-bentonite grout up to the ground surface. The grout will be pumped from the bottom up. The grout will be

mixed in the following relative proportions: 30 gallons of water to three 94-pound bags of cement to 25 pounds granular bentonite. The grout will be allowed to set for a minimum of 48 hours before wells are developed.

- Each monitoring well will have an expansion plug or plumbers plug and a 4-inch diameter, steel casing with a hinged, locking cap placed over the monitoring well. The protective casing will extend approximately 2 feet below ground surface and be cemented in place. In some areas, it may be necessary to provide flush mounted casings. All wells will have keyed-alike locks and the keys will be maintained by the NM project manager.
- A concrete surface pad (2 ft x 2 ft x 6-inch) will be sloped to channel water away from the well casing.
- A weep hole will be drilled at the base of the protective standpipe casing to allow any water between the inner and outer casing to drain. If a flush mounted protective casing is installed then a small diameter drainage tube will be installed in the side of the casing discharging to the surrounding subsurface soils.
- The flush mounted monitoring well protective casing will be a minimum 8-inch diameter box or equivalent. All flush mounted well risers will be capped with an expansion plug or plumbers plug.
- The top of the PVC well casing will be permanently marked/notched and surveyed to 0.01 foot, and elevations will be determined relative to a fixed benchmark or datum. The measuring point on all wells, the permanent mark/notch will be on the innermost PVC casing.
- Each outer casing will be permanently labeled using a steel hand stamp or equivalent (i.e. MW-4).

Modification of the above installation procedure will be subject to changes in the field. All field-executed changes will be communicated to the NYSDEC for their discussion and approval, if appropriate.

Based on field conditions and evaluation of the best methodology to ensure the integrity of the seal, the field geologist will select the best method (i.e. bentonite pellet via gravity or bentonite slurry via tremie) to install the bentonite seal above the sand pack.

Figure 3 shows details of an overburden monitoring well construction diagram for wells installed in unconsolidated material. Figure 2 shows details of a monitoring well installed with a flush mounted protective casing.

Figure 4 shows details of a typical double-cased monitoring well construction diagram for wells installed in unconsolidated soils that do penetrate a presumed confining layer. The decision to install double-cased wells will be made on a boring-specific basis by the field geologist. Double-cased wells will be installed when the boring for the monitoring well penetrates a presumed confining layer. The

confining layer shall be defined as a minimum five (5) foot thick, predominantly clay unit which has been shown to be laterally continuous across the Site. In the event the field geologist and NM and NYSDEC Project Managers decide a reasonable possibility exists for contamination to be deposited in deeper, clean zones during the drilling and installation of a monitoring well, the well will be double-cased. The purpose of the steel protective casing will be to minimize the possibility that residual contamination is deposited at the depth of the screened interval during the drilling process.

Monitoring wells that penetrate confining layers will be installed according to the following specifications:

- 6-inch inside diameter (ID) steel outer casings will be installed to a depth of at least 2 feet below the lower limit of observed or measured contamination and/or the confining layer. This casing will be grouted in place with cement to inhibit downward migration of contamination.
- The 6-inch casing will be installed through 6.25-inch ID hollow-stem augers. The augers will be filled with grout prior to their removal to ensure the integrity of the borehole and the grout seal. Then, the 6-inch casing will be installed into the grout and hydraulically pushed approximately 1-foot beyond the bottom of the boring. A 3-foot thick grout plug will be installed at the base of the 6-inch diameter pipe through which the borehole will be advanced. Potable water will be tremied to the bottom of the inside of the casing to dilute the grout, thereby allowing the grout to be more easily pumped out of the casing. The grout, pumped out of the casing, will be drummed and staged with other investigation-derived waste (IDW).
- The cement-bentonite grout remaining in the annulus between the casing and the formation will be allowed to set for at least 24 hours before drilling is continued. The drilling will then continue using 4-inch diameter flush-joint spin casing and potable water. All lubricant water will be containerized.
- The well will be constructed of 2-inch diameter PVC or stainless steel riser pipe and screen, sand pack, bentonite seal, grout, and surface casing as specified for single cased monitoring wells discussed above and in accordance with NYSDEC requirements. The bentonite seal may consist of pellets or a bentonite slurry mixture in proportions relative to 30 gallons of water to 25-30 pounds of bentonite. The grout mix will consist of 30 gallons water to three 94-pound bags of cement and 25 pounds of granular bentonite.

Monitoring wells to be installed as open holes in bedrock will be installed according to the following specifications:

- Advance each boring to the top of the bedrock surface. Borehole advancement will be conducted using 6¼-inch inner diameter (ID) continuous flight hollow-stem augers in 2-foot intervals, to permit the continuous collection of subsurface soil samples with carbon steel split-spoon samplers in accordance with Section 5.1. Confirmation of the

bedrock surface depth will be based upon split-spoon and hollow stem auger refusal.

- Overbore the borehole to a 12-inch diameter borehole, in which to install a temporary 10-inch carbon steel overburden casing to bedrock, utilizing an appropriately sized tri-cone roller bit or thin wall bit. A 3–foot thick grout plug will be installed at the base of the 10-inch diameter pipe through which the borehole will be advanced, if appropriate.
- Subsequent to temporary casing installation, continue borehole advancement into the bedrock to a depth of 5 feet below the bedrock surface, first using the rock coring method for logging (see Section 5.1) and then overboring with a 9-inch outer diameter (OD) tri-cone roller bit via the water rotary method.
- Set a permanent 6-inch carbon steel casing 5-feet into the competent bedrock by the spin casing method.
- Backfill the annular space around the well casing with bentonite/cement slurry to the surface. The ratio of cement to bentonite for grouting will be approximately 30 gallons of water to three 94-pound bags of cement to every 25 pounds of granular bentonite.
- Remove the 10-inch temporary casing during pressure grouting. Allow grout to cure for at least 24 hours.
- Continue coring and then drilling in the borehole to the maximum anticipated total depth (i.e. 10 feet below the point where groundwater was encountered) and/or the depth where fracture zones indicate sufficient yield, first using the rock coring method and then overboring utilizing the water rotary method and a 5-inch OD tri-cone roller bit or equivalent.
- Complete the open hole monitoring well with a protective locking stick-up or flushmount box installed in a concrete pad as per Section 6.1.
- If the borehole extends to a depth greater than 25 feet below the bottom of the surface casing (due to depth and/or yield of groundwater), construct the monitoring well using 10 feet of 2-inch diameter Schedule 40 PVC or Schedule 5 stainless steel wire wound screen (0.010-inch slot or a slot size appropriate to the formation) and 2-inch diameter Schedule 40 PVC or Schedule 5 stainless steel riser pipe. For non-flushmounted wells, at least 2 to 3 feet of riser pipe must extend above the ground surface. Flushmounted wells will only be installed in high traffic areas, such as roadways, sidewalks, etc.
- Backfill the annular space to a minimum height of 2 feet above the top of screen with a sand pack. The sand pack shall be Morie #1 silica sand or equivalent (based on Site-specific geologic conditions and screen slot size). The remaining annular space will be filled with bentonite/cement grout up to the ground surface. The ratio of cement to bentonite for grouting will be approximately 30 gallons of water to three 94-pound bags of cement to every 25 pounds of granular bentonite.

- Complete the constructed monitoring well as described with a protective locking stickup or flushmount box installed in a concrete pad as per Section 6.1.

Modification of the above installation procedure will be subject to changes in the field. All field-executed changes will be communicated to the NYSDEC for their discussion and approval, if appropriate.

Characteristics of each newly installed well will be recorded on the appropriate well construction diagram. Each well will be identified with a well number placed on the inside of the well cap and on the outside of the protective casing or outside flush-mount cover. Each separate source of potable water used for the drilling process will be sampled once for TCL/TAL compounds.

6.2 Monitoring Well Development

After a minimum of 24 hours after completion, the monitoring wells will be developed by one or a combination of the following techniques:

- Surging;
- Bailing;
- Using a centrifugal pump and dedicated polyethylene tubing;
- Positive displacement pumps and dedicated polyethylene tubing, and/or
- Other methods recommended by the field geologist and approved by the NM and NYSDEC Project Managers.

Development water will initially be monitored for organic vapors with a PID. In addition, the development water will be observed for the presence of non-aqueous phase liquids (NAPLs) or sheens. The development water will be contained in a tank and/or 55-gallon steel drums on-site. The purge water will be disposed of in accordance with NYSDEC requirements. The wells will be developed until the water in the well is reasonably free of visible sediment (<50 NTU if possible) or until pH, temperature and specific conductivity stabilize, assuming a minimum of 10 well volumes of water has been removed from the monitoring well during development. In no case will well development exceed 8 hours per well. Following development, wells will be allowed to recover for at least one week before groundwater is purged and sampled. All monitoring well development will be overseen by a field geologist and recorded in the field logbook.

6.3 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing may be performed on selected monitoring wells as indicated in the Site-Specific Work Plan to obtain estimates of groundwater velocities and potential groundwater recovery rates for the aquifer. The objective of the hydrogeologic testing is to determine the hydraulic properties of the aquifer in the vicinity of the Site.

Slug tests may be conducted in selected monitoring wells utilizing the rising or falling head slug test technique. Rising head tests can be performed in unconfined and confined aquifers. Falling head tests

should only be performed in confined aquifers. The slug tests will be performed by subjecting water-bearing units in the screened interval to a stress caused by the sudden displacement of the water level within the well. The rising head tests will be conducted as follows:

- Slugs and other downhole equipment will be decontaminated before and after each test by methods described in Section 3.2.
- Prior to conducting each slug test, the static water level in the well will be measured to the nearest 0.01 foot. Water levels will be measured during the test with an electric sounder (water level indicator) and with pressure transducers attached to a data logger, thereby providing water level measurements by two independent devices.
- A weighted slug of known volume will be inserted gently into the well below the water table. The water level will be measured until the water level returns to static conditions.
- The slug will be suddenly withdrawn from the well and the water level recovery will be monitored at appropriate intervals until recovery is complete and stabilized.
- Wells, which were bailed dry during development, may not be able to provide meaningful data through slug tests. Tests will be terminated in wells which do not recover significantly (>80% of static level) within a certain amount of time, at the discretion of the field geologist. These wells will be bailed dry and their recovery measured with an electronic water level indicator.

The falling head tests will be conducted as follows:

- Slugs and other downhole equipment will be decontaminated before and after each test by methods described in Section 3.2.
- Prior to conducting each slug test, the static water level in the well will be measured to the nearest 0.01 foot. Water levels will be measured during the test with an electronic sounder (water level indicator) and with pressure transducers attached to a data logger, thereby providing water level measurements by two independent devices.
- A weighted slug of known volume will be quickly inserted into the well below the water table. The water level will be measured until the water level returns to static conditions.
- The test will be terminated in wells which do not recover significantly (>80% of static level) within an unspecified time, at the discretion of the field geologist.

The slug test data will be analyzed using the Cooper, Bredehoeft, and Papadopulos (1967) type curve method or the Bouwer and Rice (1976, 1989) method. The Cooper et al. analysis assumes that the well penetrates a confined aquifer, and the Bouwer and Rice method applies where unconfined conditions are prevalent.

6.4 Well Abandonment

Monitoring wells installed in unconsolidated material will be abandoned in the following manner:

- Remove the protective casing and concrete pad.
- Over drill the well casing 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.
- Remove the well casing from the hole. If the casing cannot be removed while the augers are in place, cutoff the casing at least two feet, and if possible five feet, below the ground surface.
- Add cement/bentonite grout via tremie pipe from the bottom of the augers as the augers are withdrawn.
- If the well casing cannot be overdrilled and removed, the well casing will be filled with cement/bentonite grout from the bottom up using a tremie pipe. The grout mixture will be as specified for the well installation (see Section 6.1).
- Add grout to the point where the casing was cut off. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

Monitoring wells installed in Consolidated (bedrock) or open holes will be abandoned in the following manner:

- Remove the protective casing and concrete pad.
- Add cement/bentonite grout via tremie pipe from the bottom of the well up to the ground surface. The grout mixture will be as specified for the well installation (see Section 6.1).□
- Add grout to the point where the casing was cut off. From that point up to ground surface, backfill with native soil material surrounding the boring/well.

6.5 Packer Testing

Attachment A presents the packer test procedures to be used in the event the hydraulic conductivity of a discrete bedrock zone is required for the purpose of determining the well screen interval of bedrock wells. Down-hole packer equipment will be decontaminated following the procedures in the FSP (see Section 3.1) prior to use at each location and prior to demobilization.

7.0 TEST PIT EXCAVATIONS

When specified in the Site-Specific Work Plan, test pits will be excavated using a rubber-tired or track backhoe. In the event deep excavations are anticipated, a track hoe will be utilized. Locations of test pits, if proposed in the Site-Specific Work Plan, will be finalized in the field, based on the location of potential source areas and existing underground utilities. If the prospective test pit location is covered by asphalt or concrete, the area will be saw cut prior to excavation. During excavation activities, personnel will stand upwind of the excavation area to the extent possible. Air monitoring will be conducted in accordance with the Generic EHS Plan (Volume II). Test pit materials will be logged, as well as photographed for future reference. Material removed from the test pit will be placed on polyethylene sheeting. Should sampling of excavated material be performed, samples will be collected with a decontaminated or a new disposable sampling tool, or equivalent, from the center of the backhoe bucket. Upon completion, the material from the test pit will be placed back in the excavation in the reverse order in which it was excavated. The location and size of the test pit will be measured and described in the field logbook.

Visually clean soils, such as surface soils, will be segregated from soils that may be impacted. The visually clean soils will be used to cover the impacted soils/source materials when placed back in the excavation. At a minimum, the top two feet of back filled soil will be visually clean. If the original (top) two feet of soil is impacted or some portion of it is impacted then the soil will be replaced and/or supplemented with certified clean fill. Test pits will be backfilled as soon as possible after completion and in general prior to the cessation of activities at the end of the day. The closure of individual test pits, prior to work cessation at the end of the day, will be performed on a case by case basis utilizing criteria for the maintenance of safe working and overall Site conditions. For gravel roadways and parking areas, the backfill will be tamped down in 18-inch lifts. A 6-inch layer of clean run-of-crush gravel will be tamped in-placed as the final lift. For test pits located in asphalt-covered areas, the surface will be replaced with cold or hot asphalt mix, compacted by rolling, and trimmed flush with the adjoining surface. Test pits located in grass covered areas will be returned to original grade and reseeded. Following restoration of the excavation, the test pit will be staked/marked to facilitate subsequent location by surveying crews.

7.1 Underground Utilities

Potential for encountering underground utilities is part of any subsurface investigation, where test pitting will be utilized as part of the investigation. When performing test pitting in areas of suspected live underground utilities, the test pits will be advanced by hand digging to a depth of five (5) feet below ground surface to confirm the location of the live utility. If investigation of abandoned underground utilities is required, then the parameters of the investigation will be specified in the Site-Specific Work Plan.

If an abandoned under ground pipe/structure, associated historically with the former MGP operations, is encountered during the test pitting operation, then excavation activity will cease until the pipe or underground structure can be adequately investigated. The investigation of the piping will include the

description of the pipe/structure construction, material, condition, orientation, dimension, and contents of the pipe/structure, if possible. If the piping/structure interior can not be readily accessed then penetration of the underground utility may be necessary. Penetration of any underground utility should be conducted with the utmost care and consideration given for the utilization of proper tools (spark proof, beryllium coated, etc) for the task at hand. Once the interior of the pipe is accessible then a sample will be taken of the pipe contents, and sent to a laboratory for analysis.

If prior to initiation of test pitting activities, a live underground utility is identified in the area of anticipated test pitting, then the live underground line, if feasible, will be shut down. Consideration must be given to impacts to the facility operations prior to shutting down any active utility. (See the lockout tag out procedure section of the Generic HSP).

If during test pitting activities an unexpected live underground utility is encountered, excavation will cease, the orientation and dimensions of the underground utility will be recorded, and if possible, the live utility will be shielded from damage and test pitting will continue. If shielding is not possible then the test pit will be back filled and a new test pit attempted in the general vicinity of the initial location. When performing excavation activities next to a live underground utility, care will be taken not to undermine or impact the operation of the live underground utility. If a pipe or underground utility is accidentally severed, the owner of the utility, then NM, will immediately be notified. Liquid flows or electricity will be shut off immediately and appropriate repairs initiated as soon as possible. If a release of liquid occurs, the Consultant PM will notify NM who will then notify NYSDEC. All appropriate response actions will be implemented.

8.0 GROUNDWATER SAMPLING

The following is a step-by-step sampling procedure to be used to collect groundwater samples from the monitoring wells. Well sampling procedures will be recorded on the form shown in Figure 5. Sample management is detailed in the Generic QAPP (Volume II).

- Groundwater samples will not be collected until, at minimum, one week following well development.
- Prior to sampling, measure the static water level from the surveyed well elevation mark on the top of the PVC or stainless steel casing with a decontaminated water level probe. The elevation of nearby surface water bodies will also be recorded using bulkheads, culverts, or other convenient structures as reference points in which the elevation is known. These relative measurements will be used to aid with interpreting the relationship between observed surface water and groundwater fluctuations. Record time, date, and measurement to nearest 0.01 foot and record in the field logbook.
- Decontaminate all field test equipment and meter probes prior to use on-site.
- Prior to collecting a round of groundwater elevations an oil/water interface probe will be used to determine the presence of LNAPL and DNAPL in the well.
- A round of groundwater elevations will be collected prior to the start of sample collection. The measurement at each well location will be made from the top of the PVC or stainless steel casing with a water level probe. The measurements will be made in as short a time frame as practical to minimize temporal fluctuations in hydraulic conditions.
- Place a plastic sheet on the ground to prevent contamination of the bailer rope and/or the tubing associated with the purging (pump) equipment.
- Purge the well by removing a minimum of 3 well volumes or at least one volume of saturated sand pack, whichever is greater or use the low flow sampling procedures below. Purging will be conducted with a teflon, stainless steel or disposable polyethylene bailer, or a centrifugal, submersible, peristaltic, or whale pump and dedicated polyethylene tubing, or other methods at the discretion of the field geologist, and with the prior approval of NM and NYSDEC. Purging of the well to stabilized parameters may be performed at between 100 to 500ml/min. If the well goes dry before the required volumes are removed, the well may be sampled when it recovers sufficiently.
- Collect volatile organic analyte (VOA) or BTEX samples with Teflon, stainless steel or dedicated polyethylene bailers lowered by a dedicated polypropylene and/or Teflon line or other methods as indicated. TCL SVOCs, PAHs, pesticide/PCBs, TAL metals, natural attenuation parameters, and other non-conventional parameters may be collected with Teflon, stainless steel, or dedicated polyethylene bailer or a

submersible, or peristaltic pump using the low-flow sampling technique. Low flow well sampling will be at a rate less than or equal to 100ml/min.

Low-flow sampling procedures may be utilized to collect samples for metals analysis if sample turbidity is excessive. Low flow sampling will be performed according to USEPA (1998) guidance. The pump should be capable of throttling to a low flow rate suitable for sampling.

- Measure temperature, pH, turbidity, DO, and conductivity, at 5 to 10 minute intervals. When the parameters stabilize over 3 consecutive readings, sampling may commence. Record results in the field logbook prior to sample collection.
- Fill sample containers for VOCs or BTEX first. Sample containers for SVOCs and other analytes are then filled.
- After all samples are collected, dispose of polypropylene line and bailer, or other dedicated disposable sampling equipment.

9.0 SURFACE WATER SAMPLING

Surface water samples will be collected at the locations indicated in the Site-Specific Work Plan. Sample management is detailed in the Generic QAPP (Volume II). A decontaminated stainless steel or glass cup may be used to collect the water for these samples or the sample bottles may be directly dipped into the water. At no time will a sample jar, which contains preservative, be submerged in the sampling media. The sample should be collected from mid-depth by submersing the sampling device or sample container to a mid-depth position and opening the container and allowing it to fill. If this methodology does not work effectively then an alternative sampling device (i.e. bacon bomb etc) can be utilized. The stainless steel or glass cup will be decontaminated following the procedures outlined in Section 3.2. Surface water samples will be collected downstream first, and then progressing in an upstream direction. If sediment sampling is to be performed in conjunction with surface water sampling at corresponding locations, the surface water sample will be collected prior to the sediment sample.

Surface water flow measuring techniques will vary greatly based upon the existing field conditions. A discussion regarding the investigative techniques for collection of surface water flow measurements will be discussed in detail in the Site-Specific Work Plan.

All Field data will be recorded in the logbook and on the sample log sheet (Figure 6).

10.0 SURFACE SOIL SAMPLING

Surface soil samples will be collected at the locations indicated in the Site-Specific Work Plan. Sample management is detailed in the Generic QAPP (Volume II). Samples will be collected using decontaminated stainless steel equipment or disposable sampling equipment. If the selected sampling location is in a vegetated area, the vegetation will be removed over a one square foot area prior to sample collection. The sample will be collected from within the top 2-inches of the exposed ground surface. Samples will be collected by hand digging into the soil with a pre-cleaned stainless steel trowel or a disposable sampling tool. All samples selected for laboratory analysis will be placed in the appropriate containers provided by the laboratory. Sample containers for volatile organic analysis will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel bowl with a decontaminated steel trowel or disposable scoop. This composite sample will be analyzed for all remaining parameters identified in the Site-Specific Work Plan.

All samples collected for analysis will be placed immediately into laboratory sample jars and properly stored in a cooler with ice to 4°C before transport to the laboratory.

Duplicate samples will be collected at the frequency detailed in the Generic QAPP by alternately filling two sets of sample containers. Composite samples may be required to obtain a sufficient soil volume.

In addition, surface soil samples will be described by including:

- Site;
- Location number;
- Interval sampled;
- Date;
- Initials of sampling personnel;
- Soil type;
- Color;
- Moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations (including organic vapor readings).

11.0 SUBSURFACE SOIL SAMPLING

11.1 Samples for Laboratory Analysis

Subsurface soil samples selected for laboratory analysis will be obtained from a standard 2-foot split-spoon or Geoprobe ® samplers and placed in the appropriate containers provided by the laboratory. The soil samples will be collected from the 2-foot sampling interval (assuming full recovery) of the split-spoon. Additionally, the Geoprobe ® methodology will utilize the standard 2-foot sampling interval. Sample containers for volatile organic analysis will be filled first. Samples for volatile analysis will be collected or biased toward the collection of that portion of the sample that exhibits the highest PID reading or as otherwise detailed in the Site-Specific Work Plan. Next, a sufficient amount of the remaining soil will be homogenized by mixing the sample in a decontaminated stainless steel bowl with a decontaminated stainless steel trowel or disposable scoop.

All samples collected for analysis will be placed immediately into sampling containers provided by the laboratory and properly stored on ice to 4°C before transport to the laboratory. Sample management is detailed in the Generic QAPP (Volume II). In addition, a geologist will be on-site during the drilling operations to fully describe each sample including:

- Soil type and sorting;
- Color;
- Feet of recovery;
- Moisture content;
- Texture;
- Grain size and shape;
- Relative density;
- Consistency;
- Visible evidence of residues; and
- Miscellaneous observations.

Duplicate samples will be collected at the frequency detailed in the Generic QAPP by alternately filling two sets of sample containers.

11.2 Geotechnical Testing

When identified in the Site-Specific Work Plan, laboratory geotechnical testing will be performed on selected soil samples in accordance with appropriate ASTM standards. Geotechnical analysis will be performed on soil samples collected in Shelby tubes or in glass sampling containers including, but not limited to, the following tests: grain size and sieve analysis, total organic carbon, permeability, specific gravity, Atterberg Limits, porosity, moisture content, and bulk density.

12.0 SEDIMENT SAMPLING

Proposed sediment sampling locations are identified in the Site-Specific Work Plan. Sample management is detailed in the Generic QAPP (Volume II). Sample locations in surface waterways will be marked along the bank prior to sampling. For all sample locations, the distance from the waterline to the sample location will be measured and recorded in the field logbook. Sediment samples will be collected from the furthest downstream point, progressing toward the furthest upstream sampling location. Following the completion of sampling the sediment locations will be marked along the shoreline for subsequent location by a survey crew.

12.1 Shallow Sediment Samples

Shallow sediment samples collected in shallow water will be collected with a Wildco core sampler, clam shell, lexane tubes, hand auger, vibracore or split-spoon sampler. Where possible, rocks and vegetative material will be discarded, and care will be taken to retain fine materials, which tend to disperse when disturbed. Sampling personnel will stand downstream of the sampling point to minimize disturbance of the bottom sediments during collection. Equipment will be decontaminated between samples following procedures outlined in Section 3.2. Field data will be recorded on the field sampling records. Surface sediment samples will be collected from a depth interval of 0 to 6 inches (0 to 15 cm) using these same procedures as outlined above. Sediments, which are located near shore and are not submerged, will be collected with a decontaminated trowel or disposable sampling tool.

12.2 Deep Water Sediment Samples

Sediment sampling in deeper water and samples requiring retrieval from deeper depths will be obtained using a barge-mounted drilling system or similar watercraft. Either a tripod and cat-head assembly or a Vibracore system will be used on the barge to advance the sampling apparatus into the bottom sediments. The tripod and cat-head assembly will be equipped either with a five-foot long "California" split-spoon sampler or a standard 2-foot long split-spoon sampler for sample collection. Split spoon samplers can be fitted with a sediment sampling head or shoe to ensure adequate recovery of the sample. To keep the hole open for subsequent samples and to minimize cross-contamination, 3-inch spin casing will be advanced, with plug, into the sediment. The spin casing will be advanced in 2-foot increments prior to sampling. The sediment sampler will then be pushed ahead or below the base of the 3-inch spin casing. The spin casing will be pumped free of sediment after each sample is collected. When the casing is free of sediment, it will be advanced 2 additional feet in preparation for the next sample collection.

The Vibracore uses a vibrating motion to advance a barrel and flexible plastic liner to achieve sample collection. A "core catcher" retains the sediment sample upon retrieval. Samples will be obtained by cutting the plastic liner longitudinally using a knife, then the sediment samples will be placed in sampling jars, based on sampling interval compensating for compression.

Sediment samples will be visually classified for texture and screened for the evolution of organic vapors with a PID. Samples will be collected or biased toward the collection of that portion of the sample that exhibits the highest PID reading or as otherwise detailed in the Site-Specific Work Plan. The sediment samples will be collected from the 2-foot sampling interval (assuming full recovery) of the split-spoon. Visible staining or contamination will be noted in the field logbook.

12.3 Sediment Probing

When identified in the Site-Specific Work Plan, sediment probing will be utilized to evaluate the presence of NAPL in the stream bedding. The near-shore sediment probing will be performed on a Site by Site basis. The use of standard visual observance techniques to evaluate the possible presence of sheens on the adjacent water bodies, with out disturbance of the sediments, will be conducted as part of the initial Site Investigation. The Sediment probing activities can be used to supplement the information collected during the initial Site investigation by focusing the probing activities in the area of the observed sheens.

Implementation of a sediment probing investigation will involve the use of multiple sections of 3/8-inch to ½-inch threaded rod and associated threaded female couplings. The threaded rod will be pushed into the sediment at multiple locations in an attempt to disturb the near surface sediments as well as deeper sediments. Upon detection of any sheen a stake will be located along the shoreline to provide a marker for the subsequent location by a survey crew, if require by the Site-Specific Work Plan. Sediment probing can also be used to provide information on the depth of competent material below the soft surface sediments.

Personnel will stand downstream of the sampling point to minimize disturbance of the bottom sediments prior to utilizing the probe. Equipment will be decontaminated prior to use in the stream and post use, following procedures outlined in Section 3.2. Field data regarding the location, depth, odor, and description of the sheen will be recorded on the field logbook.

Sediment probing in deeper water and samples requiring retrieval from deeper depths will be obtained by utilizing a rowboat or similar watercraft.

13.0 AIR MONITORING

13.1 Ambient Air Monitoring

Air monitoring will be conducted with a photoionization detector (PID) and combustible gas indicator (CGI) during all drilling and intrusive activities. The PID will be used to monitor for organic vapors in the breathing zone, borehole, and along the Site's perimeter and to screen samples for analysis. The CGI measures the concentration of combustible gas or vapor in air, indicating the results as a percentage of the lower explosive limit (LEL) of the calibration gas. Action levels are identified in the Generic EHS Plan (Volume II).

PID and CGI readings will be recorded in the field logbook and on the soil-boring log during drilling activities. The PID and CGI are calibrated at least once each day and more frequently if needed with the manufacturer specified calibration gas. The detailed procedures for the PID and CGI operation and calibration are included in the Generic EHS Plan (Volume II).

13.2 Perimeter Air Sampling

Perimeter air sampling may be required during field activities at the Site. Air sampling may be required during test pit excavation and/or during soil excavation/removal associated with an IRM. The basis for such sampling will be outlined in the Site-Specific Work Plan.

Prior to the collection of air samples, air-sampling stations, commonly one (1) upgradient and two (2) downgradient, will be set up at the Site perimeter. The location of these stations is based on daily wind direction during the field activities. A sample station would be setup so that the sample media (Summa canister, high volume sampler, whole air sampler or absorbent tube, etc.) would draw in air from approximately 2 to 4 feet above the ground surface. The sampling media would remain in place a maximum 24-hour period before it is shipped overnight to a laboratory for testing. Air samples are commonly analyzed for BTEX via Method TO-15 (summa canister using a whole air sampler) or TO-17 (using an absorbent tube) and PAHs via Method TO-13 (using a high volume sampler).

13.3 Building Interior Air Sampling for Volatile Organic Compounds (VOC)

When identified in the Site-Specific Work Plan, building air sampling will be performed in the on-site buildings during follow up investigations. Interior air sample collection will be performed in the basement and on the first floor of buildings potentially impacted by on-site contaminants. Various collection techniques will be used based on the type of contamination anticipated and the requirements set forth in the USEPA ERT SOP # 1704, #2121, and # 2119. Interior air sampling will also conform with NYSDOH indoor Air and Analysis guidance and the off-site Laboratory will have the New York State Environmental Laboratory Approval Program (ELAP) certification.

The following procedure will be used for air sampling of VOCs, based on USEPA ERT SOP

#1704:

I. Subatmospheric Pressure Sampling Using a Fixed Orifice, Capillary, or Adjustable Micrometering Valve

- Complete the appropriate information on the Canister Sampling Data Field Sheet.
- A canister, which is evacuated to 0.05 mm Hg and fitted with a flow restricting device, is opened to the atmosphere which contains the VOCs for sampling. The pressure differential causes the sample to flow into the canister.
- This technique can be used to collect grab samples having a duration of 10 to 30 seconds or time-integrated samples having a duration of 12 to 24 hours. The sampling duration is depends on the degree to which the flow is restricted.
- As the pressure approaches atmospheric pressure, a critical orifice flow regulator will cause a decrease in the flow rate.
- Record data on an appropriate data sheet and/or in the field logbook.

The following procedure will be used for air sampling of VOCs, and is based on USEPA ERT SOP #1704:

ii. Subatmospheric Pressure Sampling or Pressurized Sampling Using a Mass Flow Controller/Vacuum Pump Arrangement (Andersen Sampler Model 87-100)

- Complete the appropriate information on the Canister Sampling Data Field Sheet.
- Open a canister, which is evacuated to 0.05 mm Hg and connected in line with the sampler, to the atmosphere, which contains the VOCs for sampling.
- A whole air sample will be drawn into the system through a stainless steel inlet tube by a direct drive blower motor assembly. A small portion of this whole air sample is drawn from the inlet tube by a specially modified inert vacuum pump in conjunction with a mass flow controller.
- The initially evacuated canister is filled by the action of the flow controlled pump to near atmospheric pressure (subatmosphereic pressure sampling) or a positive pressure

not to exceed 25 psig (pressurized sampling).

- A digital time program is used to pre-select sample duration and start and stop times.
- Record data on an appropriate data sheet and/or in the field logbook.

The following procedure will be used for air sampling of SVOCs and/or pesticides/PCBs, and is based on USEPA ERT SOP #2121:

- Using a calibrated sampler, place the sampler in the desired location. The polyurethane foam (PUF) sampler should be in the breathing zone in order to prevent elevated results. It should be located in an unobstructed area, at a distance of twice the height of any obstruction to air flow but no closer than two meters to the obstacle.
- Assemble the sampling system by attaching the legs and magnehelic panel to the platform. Connect the motor to the platform, making sure that the gasket is placed between the motor and the platform. Plug the motor into the timer located on the magnehelic panel. Connect the magnehelic to the venturi with tubing. Adjust the exhaust hose to face downwind of the sampler.
- Put on clean surgical gloves.
- Place the loaded sampling module into the quick release fitting and engage by locking the two levers down securely. Remove the metal cover.
- Record the pump number, location, sample start time, time/counter at the start, and other pertinent information on an appropriate data sheet and/or in the field logbook.
- Plug in the unit. If necessary, adjust the magnehelic gauge by turning the ball valve in order to achieve the reading required to reach the target flow rate. Wait approximately two minutes for the magnehelic reading to stabilize.
- Allow the sampling system to operate for the predetermined duration. If the sampling system is in use for more than 24 hours, the initial calibration should be audited every 24 hours. If the resultant value for the check is +/- 7 percent of the initial calibration, the sampling system must be recalibrated.

The following procedure will be used for air sampling of metals, and is based on USEPA ERT SOP #2119:

- Assemble the sampling trains with clean filter cassettes. Verify the pump calibration by removing the inlet plug from the cassette, attaching a rotameter with Tygon tubing and turning on the sampling pump. Check to make sure all the connections are tight.

- Record the actual flow rate on an appropriate data sheet and/or in the field logbook. Replace the inlet plug until ready to sample.

- Set the sampling pump timer (low volume pumps) for the predetermined sampling time, or record the elapsed timer on the data sheet/logbook. This will be determined based on the type of pump being used.

- Deploy sampling pumps at sampling locations. Remove the cassette cap or inlet plug from the cassette. Sampling for elements can be conducted with the cassettes open-faced (cassette cap removed) or closed-faced (only inlet port plug removed). Open-faced is preferred because it allows even loading of the filter cassette and should be used whenever high particulate concentrations are expected in order to allow greater particulate loading of the filter. Closed-faced sampling is performed when there is a possibility that the sample may be shaken and particulates may be lost.

- Turn on the sampling pump and let it run for the predetermined sampling period.

- After the sampling period is over, verify the sampling period by reading the sample run time (low volume pumps) or by checking the elapsed time on the counter (medium volume pumps). Record the length of sampling time on the data sheet and/or in the field logbook. Turn off the pump.

- Verify the pump calibration by attaching a rotameter with Tygon tubing and turning on the sampling the inlet plug.

- Remove the sampling cassette from the sampling train and insert the outlet plug. Calculate sample volume.

14.0 GEOPHYSICAL AND SOIL GAS SURVEYS

When specified in the Site-Specific Work Plan, geophysical and soil gas surveys will be carried out at the site with the primary objective being to delineate areas of possible subsurface impacts from former MGP operations. Delineation of impacted areas will allow for a more focused and efficient sampling program during subsequent phases. Sampling locations may be located downgradient of potential historical MGP operations areas to determine if these areas act as contaminant sources. Also, boring locations can be adjusted to avoid large subsurface metallic bodies, thereby minimizing the potential for release of hazardous material from buried containers, and avoiding the expense associated with multiple boring attempts due to subsurface refusal. Furthermore, additional valuable subsurface information may be derived from this study, including:

- Delineation of underground structures(i.e. holder, and tar well);
- Mapping of existing site utilities and former MGP utilities; and,
- Detection of underground storage tanks (USTs) and/or other potential contaminant source areas.

If potential historical MGP operations areas prove to act as contaminant sources, the results of the geophysical investigation may also provide important information necessary for an Interim Removal action.

14.1 Geophysical Survey GPR and TDEMI

Two geophysical methods can be used for the geophysical survey: Time-domain Electromagnetic Induction (TDEMI) and ground penetrating radar (GPR). TDEMI can detect ferrous and non-ferrous metallic objects, such as a single 55-gallon drum, at a depth of up to 3 m (10 ft) bgs; GPR can detect both metallic and non-metallic subsurface targets at depths varying from several centimeters up to 20 m (65 ft bgs) or more, dependent upon frequency of induced waves, soil conductivity, and presence of extremely reflective interfaces. GPR can also be utilized to locate void spaces, detect disturbed soil or differential fill, and map Site Stratigraphy.

The TDEMI system utilized at the site will be the Geonics EM61 High Sensitivity Metal Detector or similar equipment. The EM61 is a one-person portable system designed primarily for industrial site assessment. The EM61 is relatively insensitive to nearby surface cultural interferences such as buildings, powerlines, and fences, and has the ability to record digital data at 0.17 second intervals, which translates to a spatial sample density of approximately 0.17 m (0.55 ft) along the ground surface.

The GPR system utilized at the site will be the Geophysical Survey Systems, Inc. (GSSI) SIR-2, or equivalent and will be equipped with both 200 and 500 MHZ antennas. The GSSI SIR-2 is a

monostatic GPR system, in which a single antenna is used as the transmitter and receiver. The antennas are shielded to ensure a high proportion of the energy produced is focused into the subsurface, decreasing noise from surrounding fences, buildings, and other features. The GPR reflection section is displayed in real time as data is acquired, and an analog record is output by an in-the-field printer. Data is also digitally logged to a high-capacity drive at a rate of 32 scans/second, which translates to a spatial sample density of approximately 0.03 m (0.1 ft) along the ground surface.

Geophysical Survey Ground Penetrating Radar (GPR) and Time-Domain Electromagnetic Induction (TDEMI)

The geophysical investigation will encompass all areas suspected of former MGP operations. The survey area will be run over both paved and vegetative cover and will be divided into four (4) subplots ranging in size from 0.2 to 0.5 acres. The EM61 data will be acquired using a Leica system 530 Global Positioning System (GPS), or equivalent equipment, for navigational control. GPS data will be captured in one second intervals, utilizing the real-time kinematic (RTK) mode, which provides centimeter-grade positional accuracy. GPR data will be acquired along a pre-established orthogonal grid system, with line and station spacing appropriate for detection of targets of interest.

Concurrent with geophysical data acquisition, cultural features maps will be developed which will detail the location of potential interferences such as buildings, fences, utilities, etc. These maps will be utilized in the interpretation stage to more accurately assess the significance of geophysical anomalies observed in the data.

TDEMI data will be processed and interpreted using manufacturer-supplied software. TDEMI data will be interpolated to accurate State Name Planar coordinates with appropriate shifts and filters applied, and data extrapolated to a regularly spaced grid system using accepted mathematical methods. These data will then be displayed as high-resolution color maps. Proprietary software will then be utilized to isolate and characterize subsurface anomalies potentially related to steel structures or buried drums.

GPR data will be processed and interpreted using WINRAD and/or GRADIX software packages or equivalent. Processing may include "rubber sheeting" of data to appropriate coordinates, application of appropriate gains and filters, display of color-coded GPR sections, and advanced processing techniques, such as migration and deconvolution. Diffraction hyperbolas or other discrete anomalies will be identified and characterized and compared with locations of EM61 anomalies. GPR anomalies, which occur in areas free of EM61 anomalies can be attributed to non-metallic targets, and may be associated with plastic barrels.

A final report including description of data collected, maps of the geophysical data, and interpretation of these data will be included in the Final Report.

Geophysical Survey Ground Penetrating Radar (GPR) and Time-Domain Electromagnetic Induction (TDEMI) Procedure

The geophysical survey will be conducted using the following procedure:

1. Clear the surface of the area to be surveyed (performed by clearing and grubbing subcontractor). This may include cutting underbrush to a height less than 0.3m (1 foot), removing trees less than 7.5 cm (3 inches) in diameter, removing brush, and mowing grasses greater than 0.6m (2 feet) in height. A sweep for metal objects on the ground surface will be conducted, and surficial metal identified will be noted and removed from the area of investigation.

2. Establish survey control within the investigation area. Survey markers will be installed both within and around the boundary of the survey area, and these points will be utilized to establish and calibrate the GPS base station.

3. Acquire data from each instrument from a test line prior to commencement of each day's activities. This test line will be performed over a known subsurface object or over a pre-placed object (such as a steel pipe).

4. Obtain GPS reading at a known survey point.

5. Begin survey at the southwest corner of the investigation area (or a subdivision of the investigation area) and progress northward (or eastward) until the area boundary or a major obstruction is encountered. TDEMI data will be acquired at a sampling rate of approximately 6 samples per second, which translates to a sample density of 1 sample every 0.17 meters (0.55 feet) based on an average walking pace. GPS data will be acquired concurrently with TDEMI data, at a rate of [1 sample] per second. GPR readings will be acquired at a sampling rate of approximately 32 scans per second, which translates to a sample density of 1 sample every 0.03 meters (0.1 feet) based on an average walking pace.

6. After reaching the grid boundary or obstruction, reverse direction, and acquire survey data in the opposite direction along a parallel line at the following line spacing: 1 meter (3 ft) for TDEMI readings and 2-meters (6 ft) for GPR readings.

7. Continue acquiring data in opposing directions, until the entire investigation area has been covered.

8. Acquire several lines of TDEMI data over a known linear metallic object placed upon the

ground surface. This procedure will allow for accurate time shifting of geophysical data necessary for merging the geophysical and GPS data.

9. Acquire data from the test line subsequent to each day's activities, for quality assurance comparison.

10. Obtain GPS reading at known survey point for QA comparison.

14. 2 Geophysical Survey Magnetometer and FDEMI

A geophysical investigation to delineate areas of possible subsurface impacts can be performed by utilizing two geophysical methods: magnetometry and frequency-domain electromagnetic induction (FDEMI).

Geophysical data will be collected using two instruments: a Geometrics G-858G magnetometer (configured as a vertical gradiometer and including a continuous-recording base station) and a Geonics EM31-MK2 ground conductivity meter or equivalent equipment. Positional data will be verified by utilizing a Leica System 530 GPS system, or equivalent, for navigational control. GPS data will be captured at one second intervals, utilizing the real-time kinematic (RTK) mode, which provides centimeter-grad positional accuracy.

Geophysical Survey Magnetometry and Frequency-Domain Electromagnetic Induction (FDEMI) Procedure

The geophysical survey will be conducted using the following data collection procedure:

1. Clear the surface of the area to be surveyed (performed by clearing and grubbing subcontractor). This may include cutting underbrush to a height less than 1 foot, removing trees less than 3 inches in diameter, removing brush, and mowing grasses greater than 2 feet in height. A sweep for metal objects on the ground surface will be conducted, and surficial metal identified will be noted and removed from the area of investigation.

2. Establish survey control within the investigation area. Survey markers will be installed both within and around the boundary of the survey area, and these points will be utilized to establish positional control, as well as calibrate the GPS base station.

3. Acquire data from a test line prior to commencement of each day's activities. This test line will be performed over a known subsurface object or over a pre-placed object (such as a steel pipe).

4. Set up magnetometer base station.

5. Begin survey at the southwest corner of the investigation area (or a subdivision of the investigation area) and progress northward (or eastward) until the area boundary or a major obstruction is encountered. Magnetometry data will be acquired at a sampling rate of approximately 10 samples per second, which translates to a sample density of 1 sample every 0.1 meters (0.33 feet) based on an average walking pace. FDEMI conductivity readings will be acquired at a sampling rate of approximately 2.5 samples per second, which translates to a sample density of 1 sample every 0.4 meters (1.3 feet) based on an average walking pace. GPS data will be acquired concurrently with geophysical data, at a rate of 1 sample per second.

6. After reaching the boundary or obstruction, reverse direction, and acquire survey data in the opposite direction along a parallel line at the following line spacing: 1 meter for magnetometer readings and 2 meters for conductivity readings.

7. Continue acquiring data in opposing directions, until the entire investigation area has been covered.

8. Acquire several lines of geophysical data for a known linear metallic object placed upon the ground surface. This procedure will allow for accurate time shifting of geophysical data necessary for merging the geophysical and GPS data.

9. Repeatedly (at least 3 times per day) revisit a calibration station and collect data with the EM31, in order to provide for an instrument drift correction.

10. Acquire data from the test line subsequent to each day's activities, for quality assurance comparison.

The geophysical data will be processed and interpreted using manufacturer-supplied software. Data will be interpolated to NYS State Plane coordinates, filtered as appropriate, extrapolated to a grid system, and displayed on maps of the Site.

14.3 Downhole Geophysics

Downhole gamma-ray geophysical logging, if required in the Site Specific Work Plan, will be conducted by a utilizing existing wells or soil borings as they are completed. Gamma-ray logging may be conducted in cased as well as uncased boreholes, and, because clays typically contain a higher

percentage of gamma emitting minerals, can be useful for identification and correlation of clayey zones. The gamma-ray log can provide information on stratigraphic changes in the subsurface soils.

1. Be certain that the well has ample clearance for the gamma probe to pass without obstruction or binding. A dummy cylinder with the same diameter as the gamma log tool may be lowered downhole as a test for obstructions. Downhole may be performed if significant uncertainty exists. Wear appropriate health and safety equipment.

2. Set the tripod over the wellhead and park the mobile unit at a convenient location.

3. Slowly and carefully lower the probe to the bottom of the well with the logger recording the counts per second (cps) of gamma radiation. The descent is a "dry" run until the well bottom is attained.

4. Set the plotter so the gamma-ray logging is recorded on a graph. Set the upward speed at a constant rate. Bring the probe to the surface.

5. If the graph is successfully plotted, perform appropriate decontamination on the probe and the line and proceed to the next logging location.

14.4 Soil Gas Survey

A soil gas survey, if required by the Site-Specific Work Plan, will be performed around the Site to delineate areas of possible subsurface impacts and potential source areas. A sampling grid of approximately 100 feet by 100 feet or depending on the size of the investigation area, will be utilized across a majority of the Site, with soil gas samples collected at the grid nodes. Additional soil gas samples will be collected at 25 foot by 25 foot grid nodes in the vicinity of the potential test pit locations, and at any other additional areas determined during the field investigation (e.g., elevated levels present during real-time sampling, etc.). Actual sampling locations will be adjusted in the field to ensure sample targeting of all suspected areas of subsurface impacts. A field gas chromatograph (GC) will be used to determine sample screening concentrations of volatile organic compounds (VOCs). Water table, barometric, and temperature changes can vary the results.

The FOL or his designee, will be present on-site during active soil gas collection activities. The following soil gas survey activities will occur:

- Location of the soil gas survey locations;
- Comparison of the field GC data with applicable quality assurance data to determine acceptability of results;

- Determination of the need for additional or a reduction in the number of soil gas survey points;
- Supervision of the topographic surveying to locate the sampling points;
- Review of the data analysis and evaluation from the soil gas survey report; and
- Recommendation for movement of the proposed field investigation sampling locations based on the soil gas survey results.

Soil Gas Survey Procedure

1. Record ambient air temperature and barometric pressure.

2. Drill a hole into the soil either by hand auger, rotary hammer, or driven rod (as conditions dictate), to roughly 4 to 5 feet in depth. The depth may be reduced based upon conditions at the Site at the time of sampling; all changes will be noted on Field Change Requests (see Section 13.0 of the QAPP).

3. Insert a probe, slightly smaller in diameter than the borehole, into the hole, and the hole will be sealed by packing soil around the expansion bulb at the probe top. The probe assembly will be selected by the soil gas crew and FOL, to provide the best probe assembly for the Site conditions. A typical assembly would consist of a 1/4-inch O.D. stainless steel probe, approximately 5-feet in length, and Teflon tubing, with a reducing tee and cap attached to the fitting.

4. Ensure/test vacuum with a gauge attached to the probe.

5. Extract soil gas through the probe via a vacuum pump connected to the tubing. Purge approximately 3 to 5 sample volumes prior to sampling to remove any introduced ambient contamination.

6. Remove the soil gas sample with a 500 uL gas-tight syringe or equivalent device, inserted into the tubing in front of the pump. This volume is adequate for achieving the required detection limit of 25 ug/L. If necessary, due to field conditions, the sample can be stored in a pressurized container.

7. Immediately inject the sample into the calibrated GC (see Step 8), and plot the chromatogram. Identify and quantify, based on standard peaks, any contaminants present in the soil gas

sample.

8. Calibrate the GC prior to sample analysis. Initial instrument calibration should consist of a minimum of 3 concentration points (5 points are preferred), to demonstrate the working range and linearity. Linearity will be assumed if the ratio of the area response to the amount injected is constant over the working range (i.e., less than 20 percent Relative Standard Deviation). In addition, an initial verification of a less than 25 ug/L detection limit shall be run.

9. Check the sample probe for contamination between each sample location, by drawing ambient air through the probe via the pump, and checking that the response is not greater than background levels. If necessary, decontaminate the probes using methanol and deionized water, and then air drying.

Calibration standards will be run at the beginning and end of each sampling day, and a method blank shall be analyzed every 12 hours and after any highly contaminated samples to check for carry-over. In addition, an environmental field duplicate will be chosen and analyzed every 20 samples.

15.0 FIELD INSTRUMENTS

All field analytical equipment will be calibrated immediately prior to each day's use and more frequently if required. A calibration log will be created on which all equipment calibration will be

recorded. Further details on calibration, precision, accuracy, etc. are provided in the Generic QAPP (Volume II). The calibration procedures will conform to manufacturer's standard instructions. This calibration will ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. If an equipment malfunction is identified during calibration then the malfunctioning equipment will be replaced or repaired within 24-hours or applicable fieldwork will be terminated as necessary until the malfunctioning equipment is repaired or replaced. Records of all instrument calibration will be maintained by the Field Operations Leader (FOL) and will be subject to audit by the Project Quality Assurance Manager (PQAM). Copies of all of the instrument manuals will be maintained on-site by the FOL.

15.1 Portable Photoionization Detector

The photoionization detector (PID) will be equipped with a minimum 10.6 eV lamp. The PID should be capable of ionizing and detecting compounds with an ionization potential of less than 10.6 eV. This accounts for up to 73% of the volatile organic compounds on the NYSDEC ASP Target Compound List. Calibration will be performed at the beginning and end of each day of use with a standard calibration gas specified by the manufacturer. If the unit experiences abnormal perturbation or erratic readings, additional calibration will be required. All calibration data will be recorded in field logbooks and on calibration log sheets to be maintained on-site by the FOL.

A battery check will be completed at the beginning and end of each working day. If erratic readings are experienced, the battery will be checked for proper voltage. This information will also be recorded in field logbooks and on the calibration log sheets.

15.2 pH Meter

Calibration of the pH meter will be performed at the start of each day of use, and after very high or very low readings. National Institute of Standards and Technology - traceable standard buffer solutions, which bracket the expected pH range, will be used. The standards will most likely be pH of 7.0 and 10.0 standard units. The use of the pH calibration and slope knobs will be used to set the meter to display the value of the standard being checked. The pH meter readings during calibration must be within 0.1 of the reference solution. The calibration data will be recorded on calibration sheets maintained on-site by the FOL.

15.3 Specific Conductivity Meter

Calibration checks using the conductivity standard will be performed at the start of each day of use, after five to ten readings or after very high or low readings. The portable conductivity meter will be calibrated on a daily basis using a reference solution specified by the manufacturer. Readings must be within 5 percent to be acceptable. The thermometer of the meter will be calibrated against the field laboratory thermometer on a weekly basis.

15.4 Turbidity Meter

Calibration using a turbidity standard will be performed at the start of each day of use and after very high or low readings. The portable turbidity meter will be calibrated using a reference solution specified by the manufacturer. The turbidity reading must be within ±2 NTU of the standard to be acceptable.

15.5 DO Meter

Calibration using a DO standard will be performed at the start of each day of use. The portable DO meter will be calibrated using a calibration solution specified by the manufacturer. The DO reading must be within 5% of the standard to be acceptable.

15.6 Combustible Gas Indicator

Calibration of the CGI will conform to the procedures prescribed in the Generic Environmental Health and Safety Plan (Volume II). Calibration will occur at the start of each day of use.

16.0 MANAGEMENT OF INVESTIGATION DERIVED WASTE

During the implementation of field activities, investigation derived wastes (IDW) will be generated at the Site. These IDWs will include the following: soil drilling mud/water, development and purge water, decontamination wash water, PPE, polysheeting, spent decontamination fluids, etc. Following the generation of these IDWs, they will be properly containerized in 55-gallon drums, frac tanks, agricultural poly tanks, and/or roll-off containers. PPE will be bagged and placed in 55-gallon drums. The containers will be properly labeled with the date of generation, the Site name, client name and address, contents of the containers, etc. Upon generation the IDW will be immediately containerized. The containers will be secured at the end of each day at the Site. The containers will be segregated on-site in a temporary fenced area and signs stating "Do Not Enter" will be posted on the fencing. Upon completion of the field activities, the containers will be sampled for disposal characteristics. IDW materials will be removed from the Site and shipped to an approved facility. Waste handling procedures and regulations will be strictly adhered to during all phases of waste handling.

17.0 REFERENCES:

Atlas of Community Water System Sources

Bouwer and Rice, 1976: A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, v. 12, pp. 423-428.

Cooper, Bredehoeft, and Papadopulos, 1967: Response of a Finite Diameter Well to an Instantaneous Charge of Water. Water Resources Research, vol. 3, no. 1, pp. 263-269.

Haling and Weaver, 1991: Dense Nonaqueous Phase Liquids, EPA Groundwater Issue. March, 1991.

Leupold & Stevens, Inc. 1978: Stevens Water Resources Data Book, 3rd Edition.

USEPA, 1998: Low-Flow (Minimal Drawdown) Ground Water Sampling Procedures. 540/5-95/504.

TABLES

Table 1
METHOD FOR IDENTIFYING AND LABELING SAMPLES

LLLL*	LL*	NN*	NN/NNNN*
Site	Sample Type	Sample Location	Depth/Time

Site :

Sample Type: Monitoring Well (MW), Surface Soil (SS), Subsurface Soil (SB), Sediment (SD), Surface Water (SW), Waste Water (WW), Solid Waste (WA)

Sample Number: Number referenced to a sample location map illustrated in the Site-Specific Work Plan.

* L = Letter
* N = Number

FIGURES

Figure 1

LOG OF BORING

(Page 1 of 1)

PROJECT:
PROJECT NO.:
LOCATION:

DATE STARTED: :
DATE COMPLETED: :
GEOLOGIST: :
DRILLER: :
DRILLING METHOD: :

GW DEPTH: :
ELEVATION: :

Depth in feet	RECOVERY	USCS	GRAPHIC	DESCRIPTION	TIME	DATE	PID (ppm)	Sample I.D.	COMMENTS
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									

LOG OF BORING

PROJECT:
PROJECT NO.:
LOCATION:

DATE STARTED: :
DATE COMPLETED: :
GEOLOGIST: :
DRILLER: :
DRILLING METHOD: :

GW DEPTH: :
ELEVATION: :

Depth in feet	RECOVERY	USCS	GRAPHIC	DESCRIPTION	TIME	DATE	PID (ppm)	Sample I.D.	COMMENTS
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									

Notes:

FOSTER WHEELER

10-18-2001 P:\Front Street\Boring Logs\Blank BOR

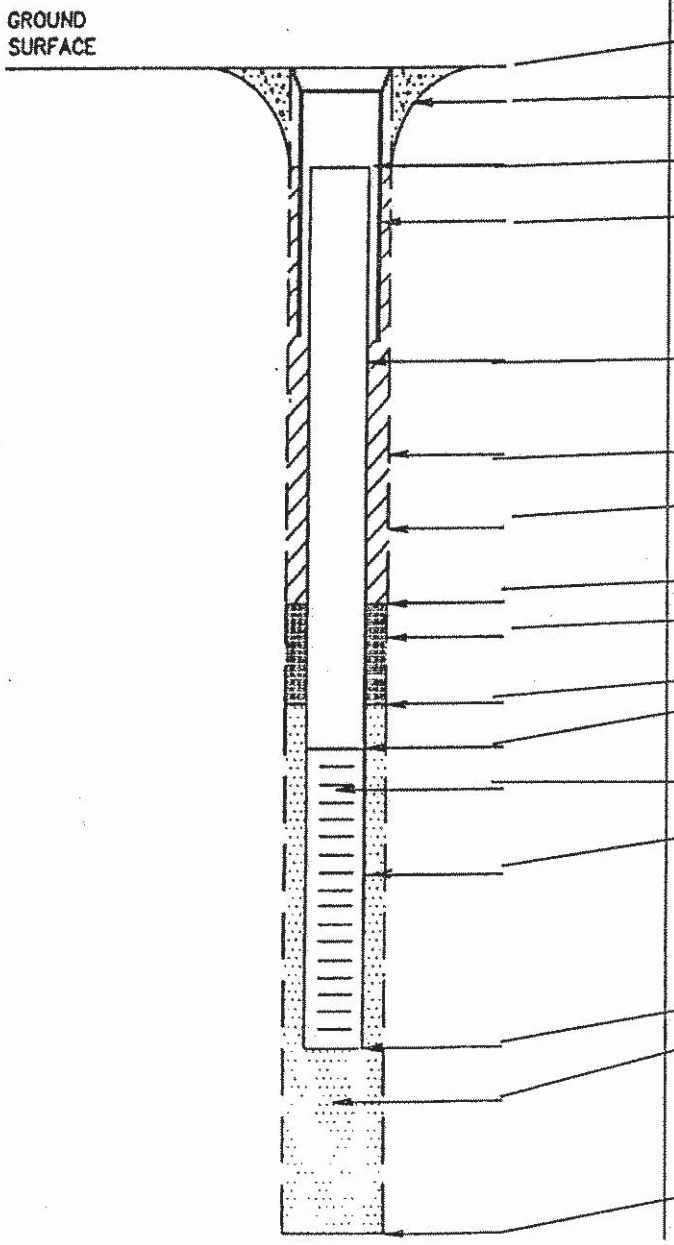
Figure 2

UNCONSOLIDATED
MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO. _____

PROJECT _____
PROJECT NO. _____
DATE _____ BORING NO.: _____
ELEVATION _____
LOGGED BY: _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____
TYPE OF SURFACE SEAL: _____
GROUND SURFACE ELEVATION: _____
ELEVATION OF TOP OF RISER: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF BACKFILL: _____

ELEVATION/DEPTH TOP OF SEAL: _____
TYPE OF SEAL: _____

ELEVATION/DEPTH TOP OF SAND PACK: _____
ELEVATION/DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____
SLOT SIZE X LENGTH: _____
TYPE OF SAND PACK: _____

ELEVATION/DEPTH BOTTOM OF SCREEN: _____

ELEVATION/DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION/DEPTH OF HOLE:

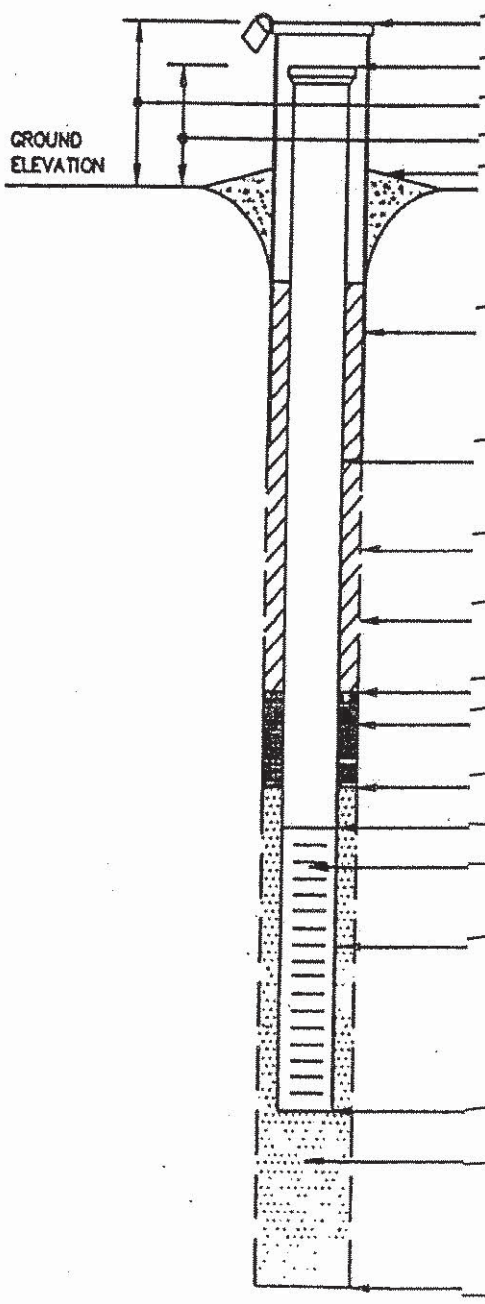
Figure 3

OVERBURDEN
MONITORING WELL
CONSTRUCTION DIAGRAM

WELL NO. _____

PROJECT _____
PROJECT NO. _____
DATE _____ BORING NO.: _____
ELEVATION _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____
ELEVATION OF TOP OF RISER PIPE: _____
STICK-UP TOP OF SURFACE CASING: _____
STICK-UP RISER PIPE: _____
TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF BACKFILL: _____

ELEVATION/DEPTH TOP OF SEAL: _____
TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION/DEPTH TOP OF SCREEN: _____
TYPE OF SCREEN: _____
SLOT SIZE X LENGTH: _____
TYPE OF SAND PACK: _____

ELEVATION/DEPTH BOTTOM OF SCREEN: _____
ELEVATION/DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION/DEPTH OF HOLE: _____

NOT TO SCALE

NOT TO SCALE

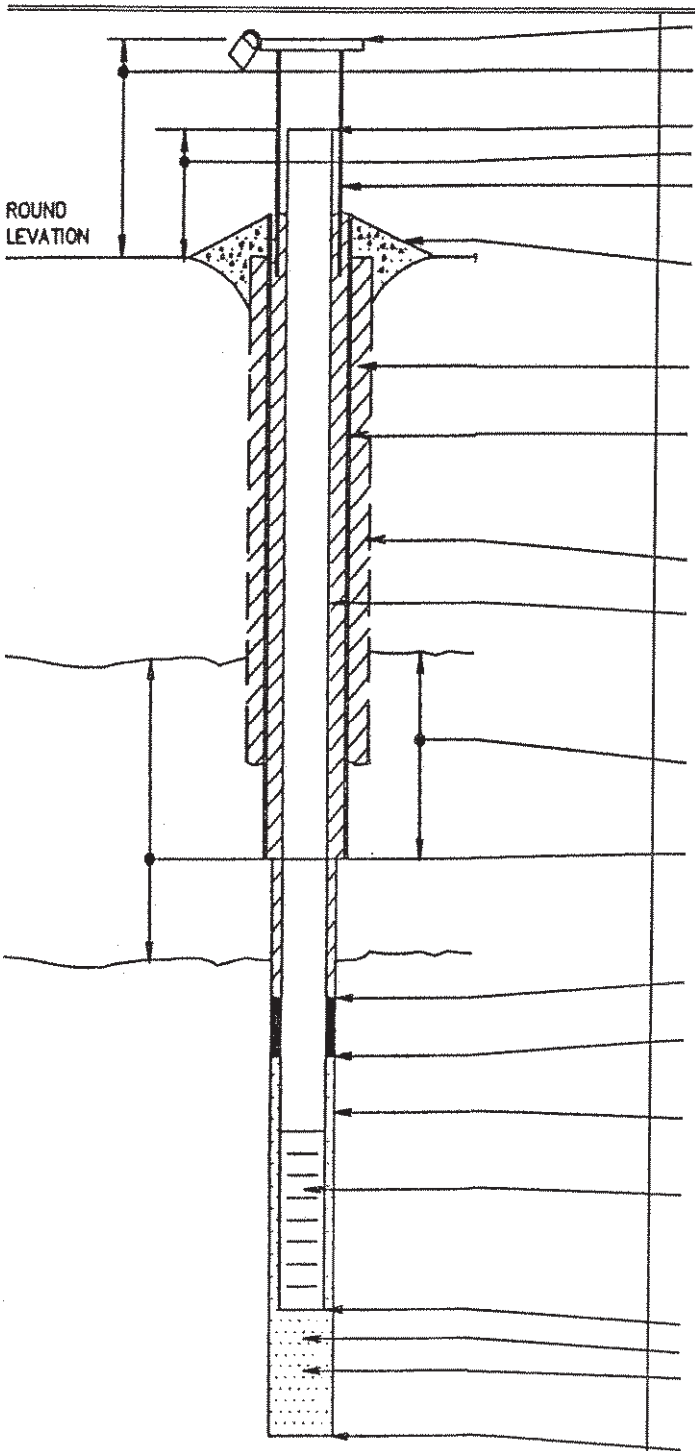
Figure 4

DOUBLE CASED
MONITORING WELL
CONSTRUCTION DIAGRAM

WELL NO. _____

PROJECT _____
PROJECT NO. _____
DATE _____ BORING NO.: _____
ELEVATION _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF CASING: _____
STICK-UP OF CASING ABOVE GROUND SURFACE _____
ELEVATION OF TOP OF RISER PIPE: _____
STICK-UP RISER PIPE: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____
TYPE OF SURFACE SEAL: _____

TYPE OF BACKFILL: _____
I.D. OF UPPER AQUIFER CASING: _____
TYPE OF UPPER AQUIFER CASING: _____

BOREHOLE DIAMETER/DEPTH: _____

I.D.OF RISER: _____
TYPE OF RISER: _____

DEPTH CASING IS SET IN CONFINING LAYER: _____

APPROXIMATE THICKNESS OF CONFINING LAYER: _____

ELEVATION/DEPTH TOP OF SEAL: _____
TYPE OF SEAL: _____
DEPTH TOP OF SAND PACK: _____
TYPE OF SAND PACK: _____
BOREHOLE DIAMETER: _____

TYPE OF SCREEN: _____
SLOT SIZE X LENGTH: _____
I.D. OF SCREEN: _____

ELEVATION/DEPTH BOTTOM OF SCREEN: _____
ELEVATION/DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____
ELEVATION/DEPTH OF HOLE: _____

Figure 5

WELL PURGE DATA SHEET

PROJECT NAME: _____
PROJECT No.: _____
DATE: _____

Well I.D.: _____

Casing Volume
Well Diameter (d) = _____ ft

Well Radius (r_w) = _____ ft

Well Depth (TD) = _____ ft

Static Water Level (WL)= _____ ft

Filter Pack Volume
Borehole Diameter (d_b) = _____ ft

Borehole Radius (r_b) = _____ ft

Depth to Top of Filter Pack (D_f) = _____ ft

P = estimated porosity of filter pack

Height of Water in Well (T):
T = TD (ft) - WL (ft)
T = _____ - _____
T = _____ ft

Height of Water in Filter Pack (T_F)
T_F = TD - WL[1](or TFP[2])
T_F = _____ - _____
T_F = _____ ft

Gallons of Water per Well Volume (Casing):
$V_C = 0.163 \times T(ft) \times r_w(in)^2$
$V_C = 0.163 \times$ ___ x ___ ^{2}
V_C = _____ gallons

Gallons of Water per Filter Pack Volume
$V_F = (0.163 \times r_b^2 - 0.163 \times r_w^2) \times T_F \times P$

$$V_T = V_C + V_F$$

Total Volume Purged: **Design** = _____ **gallons**
Actual = _____ **gallons**

Water Quality:	pH (SU)	Spec. Conduct (umhos/cm)	Temp. (°C)	Eh (mV)	D.O. (ml/L)
Initial					
Volume 1					
Volume 2					
Volume 3					
Volume 4					
Volume 5					

Purge Method: ____ Suction Pump ____ Submersible Pump ____ Bailer ____ Other_____

Notes/Observations: _____

_____

_____

~~FWENC~~ Sampler(s) Present: _____

1. From Top of Inner Casing
2. Top of Filter Pack - used if entire filter pack saturated

Figure 6

SAMPLE LOG SHEET

I. SAMPLE IDENTIFICATION

Project: _____ Project No.:
Client: _____ Project Manager: _____
Sample Name/Number: _____ Date: _____ Time: _____ Hrs
Sampling Location/Depth: _____ Type: _____ Grab _____ Composite
Sample Matrix: _____ Surface Water _____ Groundwater _____ Sediment
_____ Soil _____ Waste
_____ Other (Specify) _____

Sampled By: _____

II. SAMPLE SOURCE

_____ Well _____ Outfall _____ Leachate
_____ Drum _____ Boring _____ River/Stream
_____ Bldg/Structures _____ Tank _____ Impoundment
_____ Test Pit/Trench _____ Other (Specify) _____

Source Description _____

III. FIELD OBSERVATIONS/MEASUREMENTS

Appearance/Color: _____
Volatile Organic Analysis (VOA): _____ HNU _____ OVA _____ Other
VOA Readings: Off Sample _____ Respiratory Zone _____
LEL/O_2/H_2S Readings: LEL _____ O_2 _____ H_2S _____
Radioactivity (mR/hr): _____
pH: _____ Conductivity: _____ Temperature: _____
Salinity: _____ Other: _____
Observations: _____

IV. SAMPLE DISPOSITION

Preservation: _____
Laboratory Name: _____
Laboratory Location: _____ On-Site _____ Off-Site
Forwarded to Laboratory: Date: _____ Time: _____ Hrs
Laboratory Sample No.: _____
Chain of Custody No.: _____ Airbill No.: _____

V. ADDITIONAL REMARKS

ATTACHMENTS

ATTACHMENT A

GROUNDWATER ISSUE – DENSE NONAQUEOUS PHASE LIQUIDS

Environmental Protection Agency | Research and Development | Office of Solid Waste and Emergency Response | EPA/540/4-91-002 March 1991

EPA Ground Water Issue

DENSE NONAQUEOUS PHASE LIQUIDS

Scott G. Huling* and James W. Weaver**

Background

The Regional Superfund Ground Water Forum is a group of EPA professionals representing EPA's Regional Superfund Offices, committed to the identification and the resolution of ground water issues impacting the remediation of Superfund sites. The forum is supported by and advises the Superfund Technical Support Project. Dense nonaqueous phase liquids is an issue identified by the Forum as a concern of Superfund decision-makers. For further information contact Scott G. Huling (FTS:743-2313), Jim Weaver (FTS:743-2420), or Randall R. Ross (FTS: 743-2355).

Introduction

Dense nonaqueous phase liquids (DNAPLs) are present at numerous hazardous waste sites and are suspected to exist at many more. Due to the numerous variables influencing DNAPL transport and fate in the subsurface, and consequently, the remediation complexity, DNAPLs are largely undetected and yet are likely to be a significant limiting factor in site remediation. This issue paper is a literature evaluation focusing on DNAPLs and provides an overview from a conceptual fate and transport point of view, DNAPL phase distribution, monitoring, site characterization, remediation, and modeling.

A nonaqueous phase liquid (NAPL) is a term used to describe the physical and chemical differences between a hydrocarbon liquid and water which result in a physical interface between a mixture of the two liquids. The interface is a physical dividing surface between the bulk phases of the two liquids, but compounds found in the NAPL are not prevented from solubilizing into the ground water. Immiscibility is typically determined based on the visual observation of a physical interface in a water- hydrocarbon mixture. There are numerous methods, however, which are used to quantify the physical and chemical properties of hydrocarbon liquids (31).

Nonaqueous phase liquids have typically been divided into two general categories, dense and light. These terms describe the specific gravity, or the weight of the nonaqueous phase liquid relative to water. Correspondingly, the dense nonaqueous phase liquids have a specific gravity greater than water, and the light nonaqueous phase liquids (LNAPL) have a specific gravity less than water.

Several of the most common compounds associated with DNAPLs found at Superfund sites are included in Table 1. These compounds are a partial list of a larger list identified by a national screening of the most prevalent compounds found at Superfund sites (65). The general chemical categories are halogenated/non-halogenated semi-volatiles and halogenated volatiles. These compounds are typically found in the following wastes and waste-producing processes: solvents, wood preserving wastes (creosote, pentachlorophenol), coal tars, and pesticides. The most frequently cited group of these contaminants to date are the chlorinated solvents.

DNAPL Transport and Fate - Conceptual Approach

Fate and transport of DNAPLs in the subsurface will be presented from a conceptual point of view. Figures have been selected for various spill scenarios which illustrate the general behavior of DNAPL in the subsurface. Following the conceptual approach, detailed information will be presented explaining the specific mechanisms, processes, and variables which influence DNAPL fate and transport. This includes DNAPL characteristics, subsurface media characteristics, and saturation dependent parameters.

Unsaturated Zone

Figure 1 indicates the general scenario of a release of DNAPL into the soil which subsequently migrates vertically under both the forces of gravity and soil capillarity. Soil capillarity is also responsible for the lateral migration of DNAPL. A point is reached at which the DNAPL no longer holds together as a continuous phase, but rather is present as isolated residual globules. The fraction of the hydrocarbon that is retained by capillary forces in the porous media is referred to as residual

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Superfund Technology Support Center for Ground Water

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Technology Innovation Office
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Walter W. Kovalick, Jr., Ph.D.
Director

Table 1. Most prevalent chemical compounds at U.S. Superfund Sites (65) with a specific gravity greater than one.

Compound	Density [1]	Dynamic[2] Viscosity	Kinematic Viscosity[3]	Water[4] Solub.	Henry's Law Constant[5]	Vapor[6] Pressure
Halogenated Semi-volatiles						
1,4-Dichlorobenzene	1.2475	1.2580	1.008	8.0 E+01	1.58 E-03	6 E-01
1,2-Dichlorobenzene	1.3060	1.3020	0.997	1.0 E+02	1.88 E-03	9.6 E-01
Aroclor 1242	1.3850			4.5 E-01	3.4 E-04	4.06 E-04
Aroclor 1260	1.4400			2.7 E-03	3.4 E-04	4.05 E-05
Aroclor 1254	1.5380			1.2 E-02	2.8 E-04	7.71 E-05
Chlordane	1.6	1.1040	0.69	5.6 E-02	2.2 E-04	1 E-05
Dieldrin	1.7500			1.86 E-01	9.7 E-06	1.78 E-07
2,3,4,6-Tetrachlorophenol	1.8390			1.0 E+03		
Pentachlorophenol	1.9780			1.4 E+01	2.8 E-06	1.1 E-04
Halogenated Volatiles						
Chlorobenzene	1.1060	0.7560	0.683	4.9 E+02	3.46 E-03	8.8 E+00
1,2-Dichloropropane	1.1580	0.8400	0.72	2.7 E+03	3.6 E-03	3.95 E+01
1,1-Dichloroethane	1.1750	0.3770	0.321	5.5 E+03	5.45 E-04	1.82 E+02
1,1-Dichloroethylene	1.2140	0.3300	0.27	4.0 E+02	1.49 E-03	5 E+02
1,2-Dichloroethane	1.2530	0.8400	0.67	8.69 E+03	1.1 E-03	6.37 E+01
Trans-1,2-Dichloroethylene	1.2570	0.4040	0.321	6.3 E+03	5.32 E-03	2.65 E+02
Cis-1,2-Dichloroethylene	1.2480	0.4670	0.364	3.5 E+03	7.5 E-03	2 E+02
1,1,1-Trichloroethane	1.3250	0.8580	0.647	9.5 E+02	4.08 E-03	1 E+02
Methylene Chloride	1.3250	0.4300	0.324	1.32 E+04	2.57 E-03	3.5 E+02
1,1,2-Trichloroethane	1.4436	0.1190	0.824	4.5 E+03	1.17 E-03	1.88 E+01
Trichloroethylene	1.4620	0.5700	0.390	1.0 E+03	8.92 E-03	5.87 E+01
Chloroform	1.4850	0.5630	0.379	8.22 E+03	3.75 E-03	1.6 E+02
Carbon Tetrachloride	1.5947	0.9650	0.605	8.0 E+02	2.0 E-02	9.13 E+01
1,1,2,2-Tetrachloroethane	1.6	1.7700	1.10	2.9 E+03	5.0 E-04	4.9 E+00
Tetrachloroethylene	1.6250	0.8900	0.54	1.5 E+02	2.27 E-02	1.4 E+01
Ethylene Dibromide	2.1720	1.6760	0.79	3.4 E+03	3.18 E-04	1.1 E+01
Non-halogenated Semi-volatiles						
2-Methyl Napthalene	1.0058			2.54 E+01	5.06 E-02	6.80 E-02
o-Cresol	1.0273			3.1 E+04	4.7 E-05	2.45 E-01
p-Cresol	1.0347			2.4 E+04	3.5 E-04	1.08 E-01
2,4-Dimethylphenol	1.0360			6.2 E+03	2.5 E-06	9.8 E-02
m-Cresol	1.0380	21.0	20	2.35 E+04	3.8 E-05	1.53 E-01
Phenol	1.0576		3.87	8.4 E+04	7.8 E-07	5.293E-01
Naphthalene	1.1620			3.1 E+01	1.27 E-03	2.336E-01
Benzo(a)Anthracene	1.1740			1.4 E-02	4.5 E-06	1.16 E-09
Flourene	1.2030			1.9 E+00	7.65 E-05	6.67 E-04
Acenaphthene	1.2250			3.88 E+00	1.2 E-03	2.31 E-02
Anthracene	1.2500			7.5 E-02	3.38 E-05	1.08 E-05
Dibenz(a,h)Anthracene	1.2520			2.5 E-03	7.33 E-08	1 E-10
Fluoranthene	1.2520			2.65 E-01	6.5 E-06	E-02 E-06
Pyrene	1.2710			1.48 E-01	1.2 E-05	6.67 E-06
Chrysene	1.2740			6.0 E-03	1.05 E-06	6.3 E-09
2,4-Dinitrophenol	1.6800			6.0 E+03	6.45 E-10	1.49 E-05
Miscellaneous						
Coal Tar	1.028[7]	18.98[7]				
Creosote	1.05	1.08[8]				

[1] g/cc
[2] centipoise (cp), water has a dynamic viscosity of 1 cp at 20°C.
[3] centistokes (cs)
[4] mg/l
[5] atm-m³/mol
[6] mm Hg
[7] 45° F (70)
[8] 15.5°C, varies with creosote mix (62)

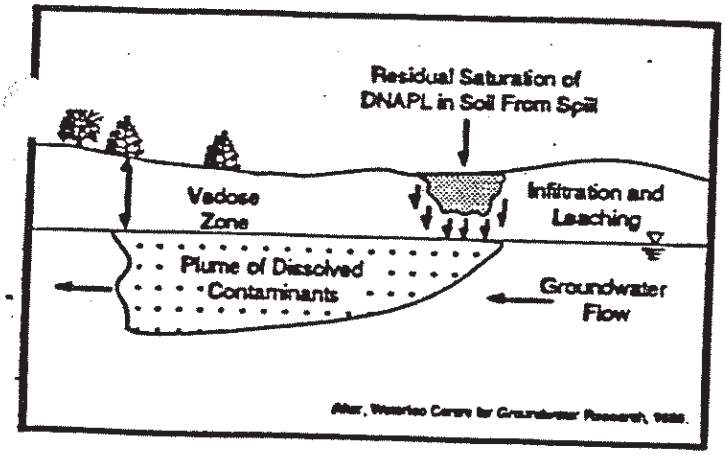


Figure 1. The entire volume of DNAPL is exhausted by residual saturation in the vadose zone prior to DNAPL reaching the water table. Soluble phase compounds may be leached from the DNAPL residual saturation and contaminate the ground water.

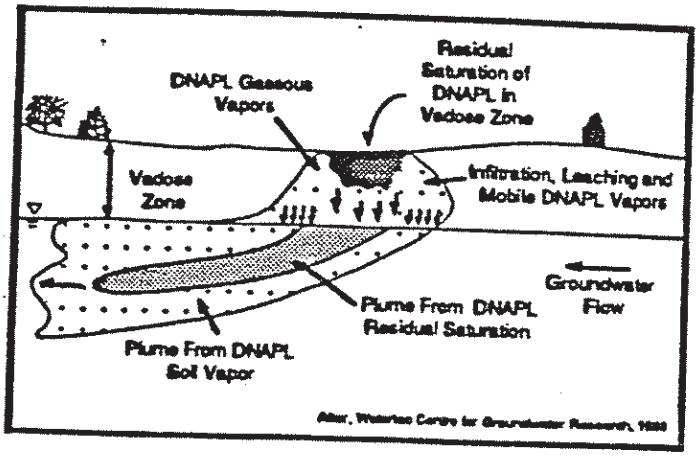


Figure 2. Migration of DNAPL vapors from the spill area and subsequent contamination of the soils and ground water.

saturation. In this spill scenario, the residual saturation in the unsaturated zone exhausted the volume of DNAPL, preventing it from reaching the water table. This figure also shows the subsequent leaching (solubilization) of the DNAPL residual saturation by water percolating through the unsaturated zone (vadose zone). The leachate reaching the saturated zone results in ground-water contamination by the soluble phase components of the hydrocarbon. Additionally, the residual saturation at or near the water table is also subjected to ching from the rise and fall of the water table (seasonal, sea , etc.).

Increasing information is drawing attention to the importance of the possibility that gaseous-phase vapors from NAPL in the unsaturated zone are responsible for contaminating the ground water and soil (18,47). It is reported that the greater "relative vapor density" of gaseous vapors to air will be affected by gravity and will tend to sink. In subsurface systems where lateral spreading is not restricted, spreading of the vapors may occur as indicated in Figure 2. The result is that a greater amount of soils and ground water will be exposed to the DNAPL vapors and may result in further contamination. The extent of contamination will depend largely on the partitioning of the DNAPL vapor phase to the aqueous and solid phases.

DNAPL Phase Distribution - Four Phase System

It is apparent from Figures 1 and 2 that the DNAPL may be present in the subsurface in various physical states or what is referred to as phases. As illustrated in Figure 3, there are four possible phases: gaseous, solid, water, and immiscible hydrocarbon (DNAPL) in the unsaturated zone. Contaminants associated with the release of DNAPL can, therefore, occur in four phases described as follows:

1. Air phase - contaminants may be present as vapors;
2. Solid phase - contaminants may adsorb or partition onto the soil or aquifer material;
3. Water phase - contaminants may dissolve into the water according to their solubility; and
4. Immiscible phase - contaminants may be present as dense nonaqueous phase liquids.

The four phase system is the most complex scenario because there are four phases and the contaminant can partition between any one or all four of these phases, as illustrated in Figure 4. For example, TCE introduced into the subsurface as a DNAPL may partition onto the soil phase, volatilize into the soil gas, and solubilize into the water phase resulting in contamination in all four phases. TCE can also partition between the water and soil, water and air, and between the soil and air. There are six pathways of phase distribution in the unsaturated zone. The distribution of a contaminant between these phases can be represented by empirical relationships referred to as partition coefficients. The partition coefficients, or the distribution of the DNAPL between the four phases, is highly site-specific and highly dependent on the characteristics of both the soil/aquifer matrix and the DNAPL. Therefore, the distribution between phases may change with time and/or location at the same site and during different stages of site remediation.

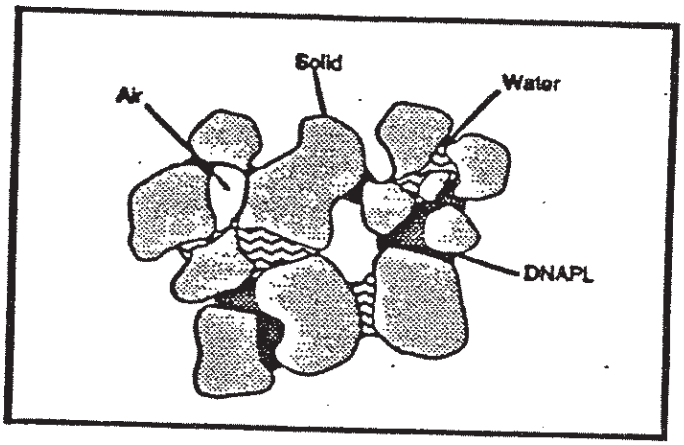


Figure 3. A DNAPL contaminated unsaturated zone has four physical states or phases (air, solid, water, immiscible). The contaminant may be present in any one, or all four phases.

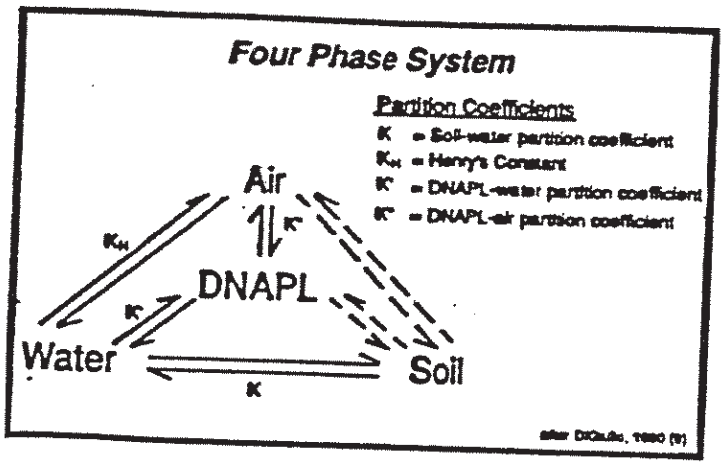


Figure 4. Distribution of DNAPL between the four phases found in the vadose zone.

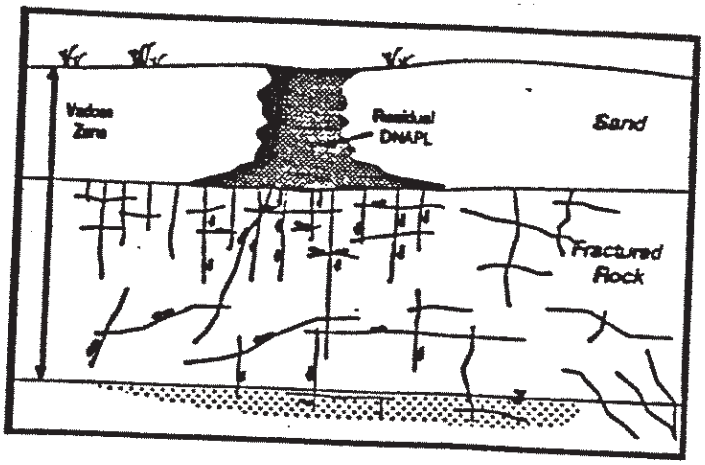


Figure 5. DNAPL spilled into fractured rock systems may follow a complex distribution of the preferential pathways.

The concept of phase distribution is critical in decision-making. Understanding the phase distribution of a DNAPL introduced into the subsurface provides significant insight in determining which tools are viable options with respect to site characterization and remediation.

DNAPL represented by residual saturation in the four phase diagram is largely immobile under the usual subsurface pressure conditions and can migrate further only: 1) in water according to its solubility; or 2) in the gas phase of the unsaturated zone (47). DNAPL components adsorbed onto the soil are also considered immobile. The mobile phases are, therefore, the soluble and volatile components of the DNAPL in the water and air, respectively.

The pore space in the unsaturated zone may be filled with one or all three fluid phases (gaseous, aqueous, immiscible). The presence of DNAPL as a continuous immiscible phase has the potential to be mobile. The mobility of DNAPL in the subsurface must be evaluated on a case by case basis. The maximum number of potentially mobile fluid phases is three. Simultaneous flow of the three phases (air, water, and immiscible) is considerably more complicated than two-phase flow (46). The mobility of three phase flow in a four-phase system is complex, poorly understood, and is beyond the scope of this DNAPL overview. The relative mobility of the two phases, water and DNAPL, in a three-phase system is presented below in the section entitled "Relative Permeability."

Generally, rock aquifers contain a myriad of cracks (fractures) of various lengths, widths, and apertures (32). Fractured rock systems have been described as rock blocks bounded by discrete discontinuities comprised of fractures, joints, and shear zones which may be open, mineral-filled, deformed, or by combination thereof (61). The unsaturated zone overlying these fractured rock systems also contain the myriad of preferential pathways. DNAPL introduced into such formations (Figure 5) follow complex pathways due to the heterogeneous distribution of the cracks, conduits, and fractures', i.e., preferential pathways. Transport of DNAPL may follow non-Darcian flow in the open fractures and/or Darcian flow in the porous media filled fractures. Relatively small volumes of DNAPL may move deep, quickly into the rock because the retention capacity offered by the dead-end fractures and the immobile fragments and globules in the larger fractures is so small (32). Currently, the capability to collect the detailed information for a complete description of a contaminated fractured rock system is regarded as neither technically possible nor economically feasible (61).

Low permeability stratigraphic units such as high clay content formations may also contain a heterogeneous distribution of preferential pathways. As illustrated in Figure 6, DNAPL transport in these preferential pathways is correspondingly complex. Typically, it is assumed that high clay content formations are impervious to DNAPL. However, as DNAPL spreads out on low permeable formations it tends to seek out zones of higher permeability. As a result, preferential pathways allow the DNAPL to migrate further into the low permeable formation, or through it to underlying stratigraphic units. It is apparent from Figures 5 and 6 that the complexity of DNAPL transport may be significant prior to reaching the water table.

Saturated Zone

The second general scenario is one in which the volume of DNAPL is sufficient to overcome the fraction depleted by the residual saturation in the vadose zone, as illustrated in Figure 7. Consequently, the DNAPL reaches the water table and contaminates the ground water directly. The specific gravity of DNAPL is greater than water, therefore, the DNAPL migrates into the saturated zone. In this scenario, DNAPL continues the vertical migration through the saturated zone until the volume is eventually exhausted by the residual saturation process or until it is intercepted by a low permeable formation where it begins to migrate laterally.

DNAPL Phase Distribution - Three Phase System

Due to the lack of the gaseous phase, the saturated zone containing DNAPL is considered a three-phase system consisting of the solid, water, and immiscible hydrocarbon (Figure 8). Contaminant distribution in the three-phase system is less complex than the four-phase system. Again, this is highly dependent on the characteristics of both the aquifer

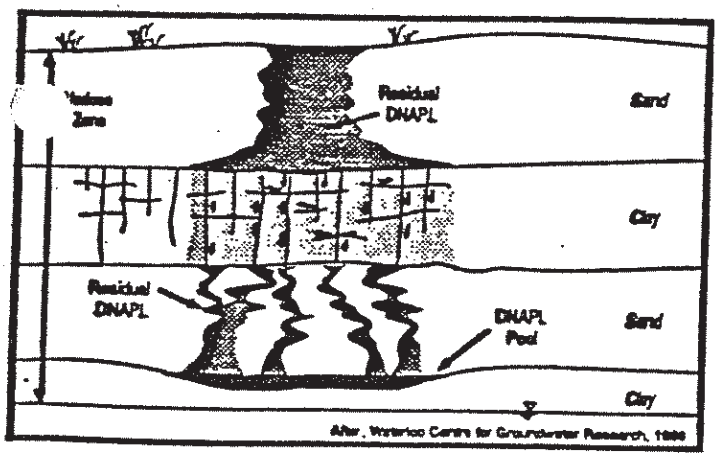


Figure 6. DNAPL spilled into a low permeable formation may follow a complex distribution of preferential pathways. The volume of DNAPL is exhausted in the vadose zone prior to reaching the water table.

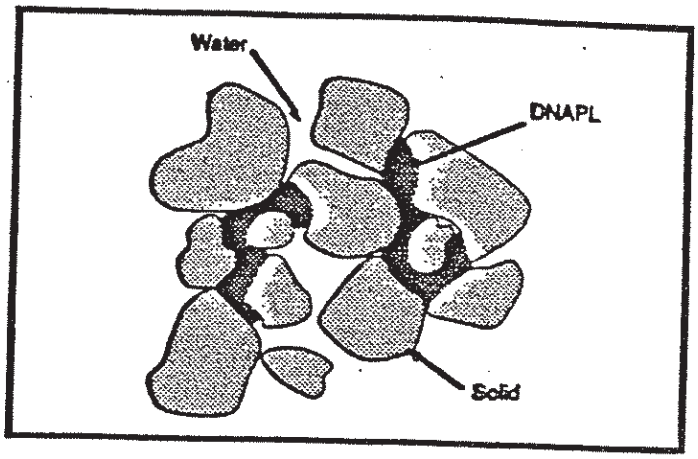


Figure 8. A DNAPL contaminated saturated zone has three phases (solid, water, immiscible). The contaminant may be present in any one, or all three phases.

matrix and the DNAPL. Figure 9 indicates the three phases and the transfer of the mass of contaminant between the phases. In this scenario, there are only three pathways of phase distribution in the saturated zone.

Note that when the DNAPL is represented by residual saturation in the three-phase system, the mobile phase of the contaminant is the water soluble components of the DNAPL and the immobile phases are the residual saturation and the adsorbed components of the DNAPL associated with the [illegible]r material. The main mobilization mechanism of the [illegible]ual saturation is removal of soluble phase components into the ground water. When the DNAPL is present as a continuous immiscible phase, it too is considered one of the mobile phases of the contaminant. While the continuous phase DNAPL has the potential to be mobile, immobile continuous phase DNAPL may also exist in the subsurface. Although the saturated zone is considered a three-phase system, gaseous vapors from DNAPL in the unsaturated zone does have the potential to affect ground-water quality, as was indicated earlier in Figure 2.

Assuming the residual saturation in the saturated zone does not deplete the entire volume of the DNAPL, the DNAPL will continue migrating vertically until it encounters a zone or stratigraphic unit of lower permeability. Upon reaching the zone of lower permeability, the DNAPL will begin to migrate laterally. The hydraulic conductivity in the vertical direction is typically less than in the horizontal direction. It is not uncommon to find vertical conductivity that is one-fifth or one-tenth the horizontal value (4). It is expected that DNAPL spilled into the subsurface will have a significant potential to migrate laterally. If the lower permeable boundary is "bowl shaped", the DNAPL will pond as a reservoir (refer to Figure 10). As illustrated in Figure 11, it is not uncommon to observe a perched DNAPL reservoir where a discontinuous impermeable layer; i.e., silt or clay lens, intercepts the vertical migration of DNAPL. When a sufficient volume of DNAPL has been released and multiple discontinuous impermeable layers exist, the DNAPL may be present in several perched reservoirs as well as a deep

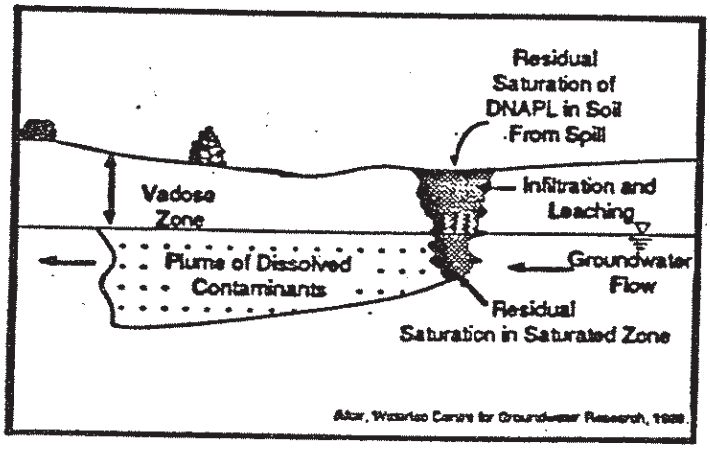


Figure 7. The volume of DNAPL is sufficient to overcome the residual saturation in the vadose zone and consequently penetrates the water table.

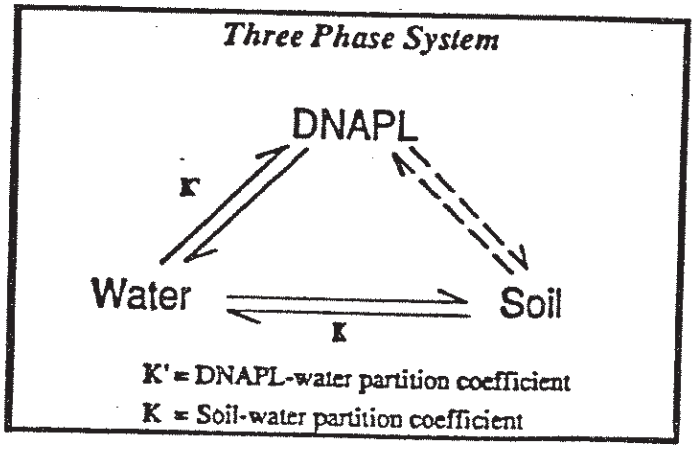


Figure 9. Distribution of DNAPL between the three phases found in the saturated zone.

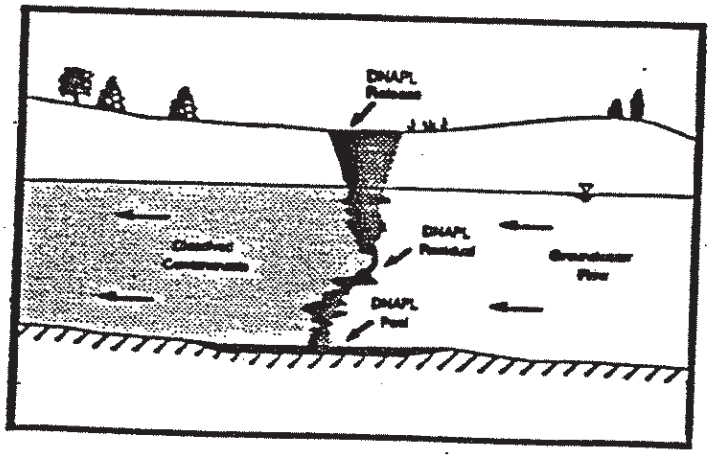


Figure 10. Migration of DNAPL through the vadose zone to an impermeable boundary.

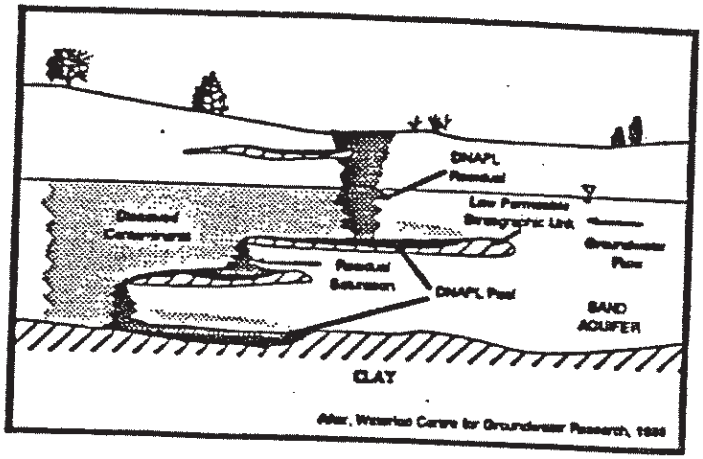
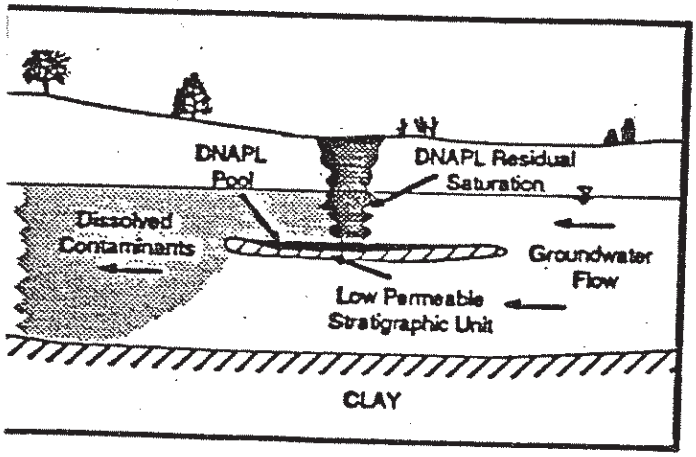


Figure 12. Perched and deep DNAPL reservoirs.

reservoir (refer to Figure 12). Lateral migration continues until either the residual saturation depletes the DNAPL or an impermeable depression immobilizes the DNAPL in a reservoir type scenario. Soluble-phase components of the DNAPL will partition into the ground water from both the residual saturation or DNAPL pools. The migration of DNAPL vertically through the aquifer results in the release of soluble-phase components of the DNAPL across the entire thickness of the aquifer. Note, that ground water becomes contaminated as it flows through, and around, the DNAPL contaminated zone.

As indicated earlier, DNAPL will migrate laterally upon reaching a stratigraphic unit of lower permeability. Transport of DNAPL will therefore be largely dependent on the gradient of the stratigraphy. Occasionally, the directional gradient of an impermeable stratigraphic unit may be different than the direction of ground-water flow as illustrated in Figure 13a. This may result in the migration of the continuous phase DNAPL in a direction different from the ground-water flow. Nonhorizontal stratigraphic units with varying hydraulic conductivity may also convey DNAPL in a different direction than ground-water flow, and at different rates (refer to Figure 13b). Determination of the direction of impermeable stratigraphic units will therefore provide useful information concerning the direction of DNAPL transport.



igure 11. Perched DNAPL reservoir.

Similar to the unsaturated zone, the saturated zone also contains a complex distribution of preferential pathways from cracks, fractures, joints, etc. DNAPL introduced into such formations correspondingly follow the complex network of pathways through an otherwise relatively impermeable rock material. Other pathways which may behave as vertical conduits for DNAPL include root holes, stratigraphic windows, disposal wells, unsealed geotechnical boreholes, improperly sealed hydrogeological investigation sampling holes and monitoring wells, and old uncased/unsealed water supply wells (72). Transport of the DNAPL may migrate very rapidly in these open conduits or follow Darcian flow in the surrounding porous media or porous media filled fractures. A relatively small volume of DNAPL can move deep into a fractured system due to the low retentive capacity of the fractured system. Consequently, fractured clay or rock stratigraphic units, which are often considered lower DNAPL boundary conditions, may have preferential pathways leading to lower formations, as depicted in Figure 14. Careful inspection of soil cores at one Superfund site indicated that DNAPL flow mainly occurred through preferential pathways and was not uniformly distributed throughout the soil mass (8). Due to the complex

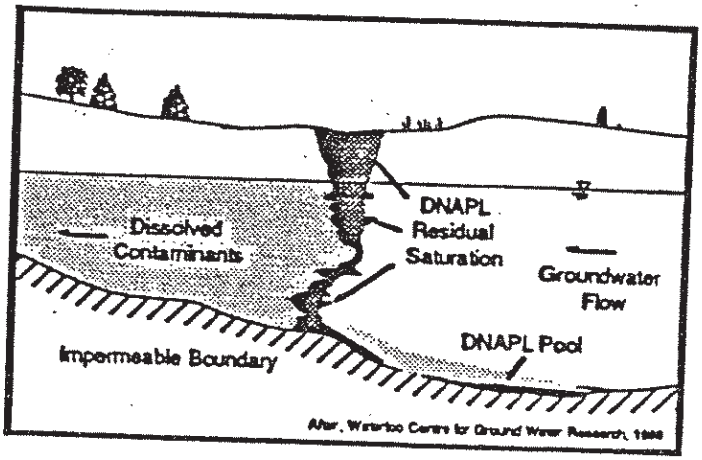


Figure 13a. Stratigraphic gradient different from ground water gradient results in a different direction of flow of the ground water and continuous phase DNAPL.

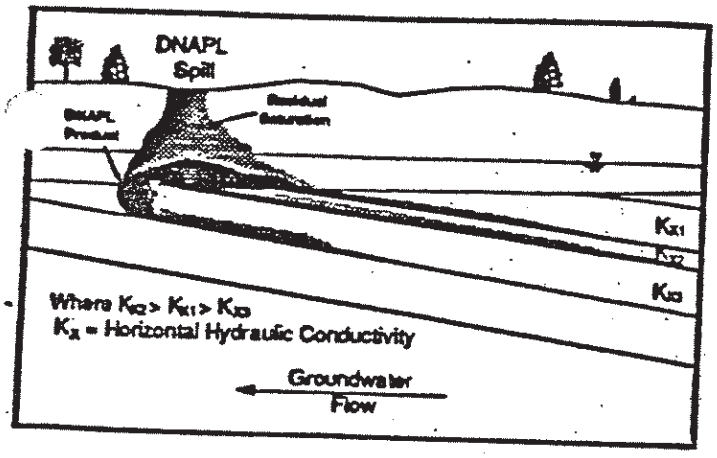


Figure 13b. Non-horizontal stratigraphic units with variable hydraulic conductivity may convey DNAPL in a different direction than the ground water flow direction.

distribution of preferential pathways, characterization of the volume distribution of the DNAPL is difficult.

Important DNAPL Transport and Fate Parameters

There are several characteristics associated with both the subsurface media and the DNAPL which largely determine the fate and transport of the DNAPL. A brief discussion of these ameters is included to help identify the specific details of PL transport mechanisms. Several of the distinctive DNAPL phenomena observed on the field-scale relates back to phenomena at the pore-scale. Therefore, it is important to understand the principles from the pore-scale level to develop an understanding of field-scale observations, which is the scale at which much of the Superfund work occurs in. A more complete and comprehensive review of these parameters is available (2,36,71).

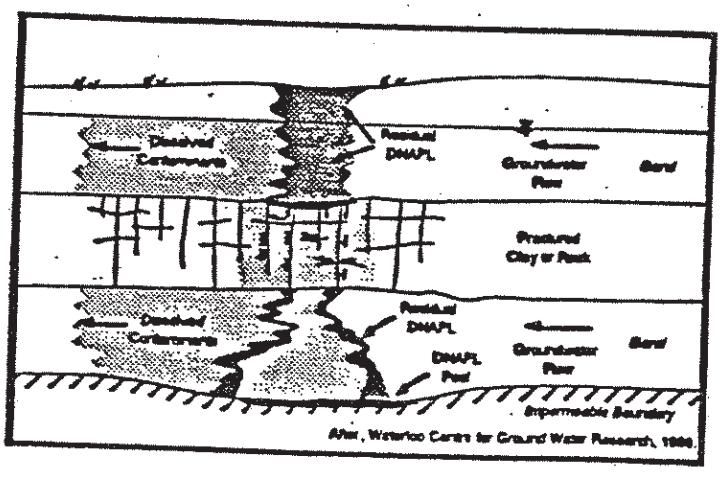


Figure 14. DNAPL transport in fracture and porous media stratigraphic units.

DNAPL Characteristics

Density

Fluid density is defined as the mass of fluid per unit volume, i.e. g/cm³. Density of an immiscible hydrocarbon fluid is the parameter which delineates LNAPL's from DNAPL's. The property varies not only with molecular weight but also molecular interaction and structure. In general, the density varies with temperature and pressure (2). Equivalent methods of expressing density are specific weight and specific gravity. The specific weight is defined as the weight of fluid per unit volume, i.e. lb/ft³. The specific gravity (S.G.) or the relative density of a fluid is defined as the ratio of the weight of a given volume of substance at a specified temperature to the weight of the same volume of water at a given temperature (31). The S.G. is a relative indicator which ultimately determines whether the fluid will float (S.G.< 1.0) on, or penetrate into (S.G.>1.0) the water table. Table 1 contains a list of compounds with a density greater than one that are considered DNAPL's. Note, however, that while the specific gravity of pentachlorophenol and the non-halogenated semi-volatiles is greater than 1.00, these compounds are a solid at room temperature and would not be expected to be found as an immiscible phase liquid at wood preserving sites but are commonly found as contaminants. Pentachlorophenol is commonly used as a wood preservant and is typically dissolved (4-7%) in No. 2 or 3 fuel oil.

Viscosity

The viscosity of a fluid is a measure of its resistance to flow. Molecular cohesion is the main cause of viscosity. As the temperature increases in a liquid, the cohesive forces decrease and the absolute viscosity decreases. The lower the viscosity, the more readily a fluid will penetrate a porous media. The hydraulic conductivity of porous media is function of both the density and viscosity of the fluid as indicated in equation [1]. It is apparent from this equation that fluids with either a viscosity less than water or fluids with a density greater than water have the potential to be more mobile in the subsurface, than water.

$$K = \frac{k \rho g}{\mu} \quad \text{where,} \quad \begin{array}{ll} K = & \text{hydraulic conductivity} \\ k = & \text{intrinsic permeability} \\ \rho = & \text{fluid mass density} \\ g = & \text{gravity} \\ \mu = & \text{dynamic (absolute) viscosity} \end{array} \qquad [1]$$

Results from laboratory experiments indicated that several chlorinated hydrocarbons which have low viscosity (methylene chloride, perchloroethylene, 1,1,1-TCA, TCE) will infiltrate into soil notably faster than will water (47). The relative value of NAPL viscosity and density, to water, indicates how fast it will flow in porous media (100% saturated) with respect to water. For example, several low viscosity chlorinated hydrocarbons (TCE, tetrachloroethylene, 1,1,1-TCA, Methylene Chloride, Chloroform, Carbon Tetrachloride, refer to Table 1) will flow 1.5-3.0 times as fast as water and higher viscosity compounds including light heating oil, diesel fuel, jet fuel, and crude oil (i.e. LNAPL's) will flow 2-10 times slower than water (45). Both coal tar and creosote typically have a specific gravity greater than one and a viscosity greater than water. It is interesting to note

that the viscosity of NAPL may change with time (36). As fresh crude oils lose the lighter volatile components from evaporation, the oils become more viscous as the heavier components compose a larger fraction of the oily mixture resulting in an increase in viscosity.

Solubility

When an organic chemical is in physical contact with water, the organic chemical will partition into the aqueous phase. The equilibrium concentration of the organic chemical in the aqueous phase is referred to as its solubility. Table 1 presents the solubility of several of the most commonly found DNAPL's at EPA Superfund Sites. The solubility of organic compounds varies considerably from the infinitely miscible compounds, including alcohols (ethanol, methanol) to extremely low solubility compounds such as polynuclear aromatic compounds.

Numerous variables influence the solubility of organic compounds. The pH may effect the solubility of some organic compounds. Organic acids may be expected to increase in solubility with increasing pH, while organic bases may act in the opposite way (31). For example, pentachlorophenol is an acid which is ionized at higher pH's. In the ionized form, pentachlorophenol would be more soluble in water (59). Solubility in water is a function of the temperature, but the strength and direction of this function varies. The presence of dissolved salts or minerals in water leads to moderate decreases in solubility (31). In a mixed solvent system, consisting of water and one or more water-miscible compounds, as the fraction of the cosolvent in the mixture increases, the solubility of the organic chemical increases exponentially (12). In general, the greater the molecular weight and structural complexity of the organic compound, the lower he solubility.

)rganic compounds are only rarely found in ground water at oncentrations approaching their solubility limits, even when rganic liquid phases are known or suspected to be present. he observed concentrations are usually more than a factor of 0 lower than the solubility presumably due to diffusional nitations of dissolution and the dilution of the dissolved rganic contaminants by dispersion (74). This has also been ttributed to: reduced solubility due to the presence of other oluble compounds, the heterogeneous distribution of DNAPL the subsurface, and dilution from monitoring wells with long take lengths (10). Detection of DNAPL components in the bsurface below the solubility should clearly not be terpreted as a negative indicator for the presence of DNAPL.

a DNAPL spill scenario where the DNAPL or its vapors are contact with the ground water, the concentration of the luble phase components may range from non-detectable up the solubility of the compound. The rate of dissolution has en expressed as a function of the properties of the DNAPL mponents (solubility), ground water flow conditions, ncentration differential between the actual and solubility, and e contact area between the DNAPL and the ground water 0). The contact area is expected to be heterogeneous and ficult to quantify. Additionally, as the time of contact reases between the DNAPL and the water, the ncentration in the aqueous phase increases.

Vapor Pressure

The vapor pressure is that characteristic of the organic chemical which determines how readily vapors volatilize or evaporate from the pure phase liquid. Specifically, the partial pressure exerted at the surface by these free molecules is known as the vapor pressure (30). Molecular activity in a liquid tends to free some surface molecules and this tendency towards vaporization is mainly dependent on temperature. The vapor pressure of DNAPL's can actually be greater than the vapor pressure of volatile organic compounds. For example, at 20 C, the ratio of the vapor pressures of TCE and benzene is 1.4 (1).

Volatility

The volatility of a compound is a measure of the transfer of the compound from the aqueous phase to the gaseous phase. The transfer process from the water to the atmosphere is dependent on the chemical and physical properties of the compound, the presence of other compounds, and the physical properties (velocity, turbulence, depth) of the water body and atmosphere above it. The factors that control volatilization are the solubility, molecular weight, vapor pressure, and the nature of the air-water interface through which it must pass (31). The Henry's constant is a valuable parameter which can be used to help evaluate the propensity of an organic compound to volatilize from the water. The Henry's law constant is defined as the vapor pressure divided by the aqueous solubility. Therefore, the greater the Henry's law constant, the greater the tendency to volatilize from the aqueous phase, refer to Table 1.

Interfacial Tension

The unique behavior of DNAPLs in porous media is largely attributed to the interfacial tension which exists between DNAPL and water, and between DNAPL and air. These interfacial tensions, result in distinct interfaces between these fluids at the pore-scale. When two immiscible liquids are in contact, there is an interfacial energy which exists between the fluids resulting in a physical interface. The interfacial energy arises from the difference between the inward attraction of the molecules in the interior of each phase and those at the surface of contact (2). The greater the interfacial tension between two immiscible liquids; the less likely emulsions will form; emulsions will be more stable if formed, and the better the phase separation after mixing. The magnitude of the interfacial tension is less than the larger of the surface tension values for the pure liquids, because the mutual attraction of unlike molecules at the interface reduces the large imbalance of forces (31). Interfacial tension decreases with increasing temperature, and may be affected by pH, surfactants, and gases in solution (36). When this force is encountered between a liquid and a gaseous phase, the same force is called the surface tension (66).

The displacement of water by DNAPL and the displacement of DNAPL by water in porous media often involves a phenomena referred to as immiscible fingering. The lower the interfacial tension between immiscible fluids, the greater the instability of the water:DNAPL interface and thus the greater the immiscible fingering (27). The distribution of the fingering effects in porous media has been reported to be a function of the density, viscosity, surface tension (27) and the displacement velocity

(13) of the fluids involved as well as the porous media heterogeneity (28).

Wettability

Wettability refers to the relative affinity of the soil for the various fluids - water, air, and the organic phase. On a solid surface, exposed to two different fluids, it can be inferred from the contact angle (66), also referred to as the wetting angle, refer to Figure 15. In general, if the wetting angle is less than 90 degrees, the fluid is said to be the wetting fluid. In this scenario, water will preferentially occupy the smaller pores and will be found on solid surfaces (14). When the wetting angle is near 90 degrees, neither fluid is preferentially attracted to the solid surfaces. If the wetting angle is greater than 90 degrees, the DNAPL is said to be the wetting fluid. The wetting angle is an indicator used to determine whether the porous material will be preferentially wetted by either the hydrocarbon or the aqueous phase (71). Wettability, therefore, describes the preferential spreading of one fluid over solid surfaces in a two-fluid system. The wetting angle, which is a measure of wettability, is a solid-liquid interaction and can actually be defined in terms of interfacial tensions (71). Several methods have been developed to measure the wetting angle (36,71). In most natural systems, water is the wetting fluid, and the immiscible fluid is the non-wetting fluid. Coal tar may be the exception (i.e. contact angle greater than 90 degrees); which is mainly attributed to the presence of surfactants (70). The wetting fluid will tend to coat the surface of grains and occupy smaller spaces (i.e. pore throats) in porous media, the non-wetting fluid will tend to be restricted to the largest openings (47).

The wetting angle depends on the character of the solid face on which the test is conducted. The test is conducted flat plates composed of minerals which are believed representative of the media, or on glass. Contact angle measurements for crude oil indicates that the wetting angles vary widely depending on the mineral surface (53). Soil and aquifer material are not composed of homogeneous mineral composition nor flat surfaces. The measured wetting angle can only be viewed as a qualitative indicator of wetting behavior.

The reader is recommended to refer to reference No. 82 for review of the basic principles and for various techniques to measure the following DNAPL parameters: density, viscosity, interfacial tension, solubility, vapor pressure, and volatility.

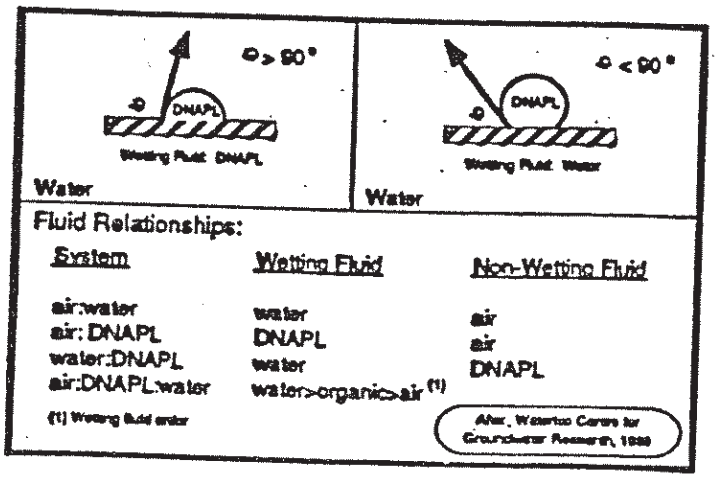


Figure 15. Wetting angle and typical wetting fluid relationships.

Subsurface Media Characteristics

Capillary Force/Pressure

Capillary pressure is important in DNAPL transport because it largely determines the magnitude of the residual saturation that is left behind after a spill incident. The greater the capillary pressure, the greater the potential for residual saturation. In general, the capillary force increases in the following order; sand, silt, clay. Correspondingly, the residual saturation increases in the same order. Capillary pressure is a measure of the tendency of a porous medium to suck in the wetting fluid phase or to repel the nonwetting phase (2). Capillary forces are closely related to the wettability of the porous media. The preferential attraction of the wetting fluid to the solid surfaces cause that fluid to be drawn into the porous media. Capillary forces are due to both adhesion forces (the attractive force of liquid for the solids on the walls of the channels through which it moves) and cohesion forces (the attraction forces between the molecules of the liquid) (32). The capillary pressure depends on the geometry of the void space, the nature of solids and liquids, the degree of saturation (2) and in general, increases with a decrease the wetting angle and in pore size, and with the increase in the interfacial tension (71). All pores have some value of capillary pressure. Before a non-wetting fluid can enter porous media, the capillary pressure of the largest pores (smallest capillary pressure) must be exceeded. This minimum capillary pressure is called the entry pressure.

In the unsaturated zone, pore space may be occupied by water, air (vapors), or immiscible hydrocarbon. In this scenario, capillary pressure retains the water (wetting phase) mainly in the smaller pores where the capillary pressure is greatest. This restricts the migration of the DNAPL (non-wetting phase) through the larger pores unoccupied by water. Typically, DNAPL does not displace the pore water from the smaller pores. It is interesting to note that the migration of DNAPL through fine material (high capillary pressure) will be impeded upon reaching coarser material (low capillary pressure).

The capillary fringe will obstruct the entry of the DNAPL into the saturated zone. When a sufficient volume of DNAPL has been released and the "DNAPL pressure head" exceeds the water capillary pressure at the capillary fringe (entry pressure), the DNAPL will penetrate the water table. This is why DNAPL is sometimes observed to temporarily flatten out on top of the water table. Similarly, laboratory experiments have been conducted in which DNAPL (tetrachloroethylene) infiltrating through porous media was found to flow laterally and cascade off lenses too fine to penetrate (28), (refer to Figure 11). This was attributed to the inability of the DNAPL to overcome the high capillary pressure associated with the lenses. Logically, when "DNAPL pressure head" exceeds the capillary pressure, the DNAPL will penetrate into the smaller pores. These laboratory experiments are important because they illustrate that small differences in the capillary characteristics of porous media can induce significant lateral flow of non-wetting fluids.

A comprehensive investigation of capillary trapping and multiphase flow of organic liquids in unconsolidated porous media revealed many intricacies of this process in the vadose

and saturated zone (66). An important note is that while capillary pressure is rarely measured at hazardous waste sites, the soil texture (sand, silt, clay) is usually recorded during drilling operations and soil surveys. This information, along with soil core analyses will help to delineate the stratigraphy and the volume distribution of NAPL.

Pore Size Distribution/Initial Moisture Content

In natural porous media, the geometry of the pore space is extremely irregular and complex (2). The heterogeneity of the subsurface environment i.e. the variability of the pore size distribution, directly affects the distribution of the capillary pressures along the interfaces between the aqueous and immiscible phases (50). In saturated column experiments, it was observed that NAPL preferentially traveled through strings of macropores, almost completely by-passing the water filled micropores (66). In the same study, a heterogeneous distribution of coarse and fine porous material was simulated. Most of the incoming organic liquid preferentially traveled through the coarse lens material.

In short term column drainage experiments, results indicated that the particle grain size is of primary importance in controlling the residual saturation of a gasoline hydrocarbon (19). Fine and coarse sands (dry) were found to have 55% and 14% residual saturation, respectively. The finer the sand, the greater the residual saturation. During these experiments, the residual saturation was reduced 20-30% in a medium sand and 50% in a fine sand when the sands were initially wet. Soil pore water held tightly by capillary forces in the small pores will limit the NAPL to the larger pores, and thus, result in lower residual saturation. In a similar laboratory (unsaturated) column study, the smaller the grain size used in the experiment, the greater the residual saturation of the NAPL (74). The residual saturation in the saturated column experiments was found to be greater than the unsaturated columns and was independent of the particle size distribution.

These observations follow traditional capillary force theory. Residual saturation resulting from a DNAPL spill in the unsaturated zone is highly dependent on the antecedent moisture content in the porous media. When the moisture content is low, the strong capillary forces in the smaller pores will tenaciously draw in and hold the DNAPL. When the moisture content is high, the capillary forces in the smaller pores will retain the soil pore water, and DNAPL residual saturation will mainly occur in the larger pores. Therefore, greater residual saturation can be expected in dryer soils. Correspondingly, NAPL will migrate further in a wetter soil, and displacement of NAPL from small pores is expected to be more difficult than from large pores.

Stratigraphic Gradient

A DNAPL migrating vertically will likely encounter a zone or stratigraphic unit of lower vertical permeability. A reduction in the vertical permeability of the porous media will induce lateral flow of the DNAPL. The gradient of the lower permeable stratigraphic unit will largely determine the direction in which the DNAPL will flow. This is applicable to both the saturated and unsaturated zones. As depicted in Figures 13a and 13b, the lateral direction of DNAPL flow may be in a different direction than ground-water flow.

Ground Water Flow Velocity

The ground water flow velocity is a dynamic stress parameter which tends to mobilize the hydrocarbon (39). As the ground water velocity increases, the dynamic pressure and viscous forces increase. Mobilization of DNAPL occurs when the viscous forces of the ground water acting on the DNAPL exceeds the porous media capillary forces retaining the DNAPL.

Saturation Dependent Functions

Residual Saturation

Residual saturation is defined as the volume of hydrocarbon trapped in the pores relative to the total volume of pores (38) and therefore is measured as such (74). Residual saturation has also been described as the saturation at which NAPL becomes discontinuous and is immobilized by capillary forces (36). The values of residual saturation vary from as low as 0.75 - 1.25% for light oil in highly permeable media to as much as 20% for heavy oil (50). Residual saturation values have also been reported to range from 10% to 50% of the total pore space (39,74). Other researchers reported that residual saturation values appear to be relatively insensitive to fluid properties and very sensitive to soil properties (and heterogeneities) (66). Laboratory studies conducted to predict the residual saturation in soils with similar texture and grain size distribution yielded significantly different values. It was concluded that minor amounts of clay or silt in a soil may play a significant role in the observed values.

In the unsaturated zone during low moisture conditions, the DNAPL residual saturation will wet the grains in a pendular state (a ring of liquid wrapped around the contact point of a pair of adjacent grains). During high moisture conditions, the wetting fluid, which is typically water, will preferentially occupy the pendular area of adjacent grains and the hydrocarbon will occupy other available pore space, possibly as isolated droplets. In the saturated zone, the DNAPL residual saturation will be present as isolated drops in the open pores (47). Furthermore, results of laboratory experimentation indicated that residual saturation increased with decreasing hydraulic conductivity in both the saturated and unsaturated zones and that the residual saturation is greatest in the saturated zone. Laboratory experiments indicated that vadose zone residual saturation was roughly one third of the residual saturation in the saturated zone (66). The increase in residual saturation in the saturated zone is due to the following: [1] the fluid density ratio (DNAPL:air versus DNAPL:water above and below the water table, respectively) favors greater drainage in the vadose zone; [2] as the non-wetting fluid in most saturated media, NAPL is trapped in the larger pores; and, [3] as the wetting fluid in the vadose zone, NAPL tends to spread into adjacent pores and leave a lower residual content behind, a process that is inhibited in the saturated zone (36). Thus, the capacity for retention of DNAPLs in the unsaturated zone is less than the saturated zone.

Relative Permeability

Relative permeability is defined as the ratio of the permeability of a fluid at a given saturation to its permeability at 100% saturation. Thus it can have a value between 0 and 1 (71).

Figure 16 illustrates a relative permeability graph for a two fluid phase system showing the relationship between the observed permeability of each fluid for various saturations to that of the observed permeability if the sample were 100% saturated with that fluid (73). The three regions of this graph are explained as follows (71): Region I has a high saturation of DNAPL and is considered a continuous phase while the water is a discontinuous phase, therefore, water permeability is low. Assuming the DNAPL is the non-wetting fluid, water would fill the smaller capillaries and flow through small irregular pores. In Region II, both water and DNAPL are continuous phases although not necessarily in the same pores. Both water and

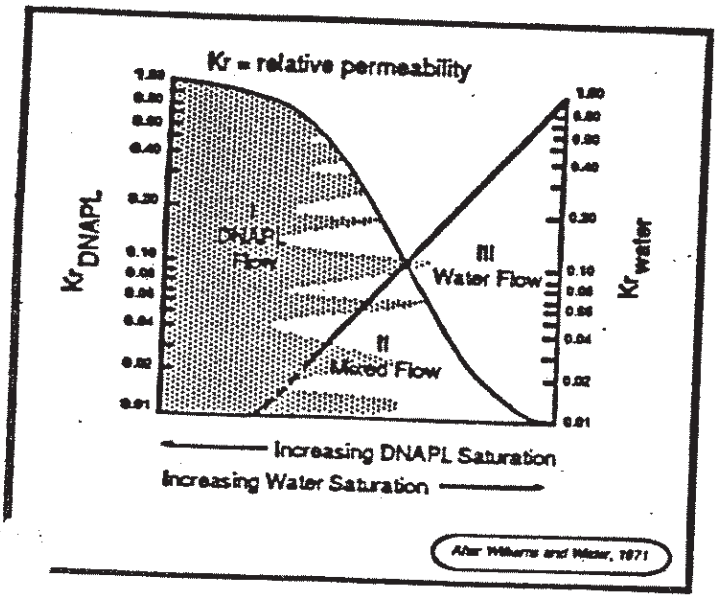


Figure 16. Relative permeability graph.

NAPL flow simultaneously. However, as saturation of either phase increases, the relative permeability of the other phase correspondingly decreases. Region III exhibits a high saturation of water while the DNAPL phase is mainly discontinuous. Water flow dominates this region and there is little or no flow of DNAPL.

Both fluids flow through only a part of the pore space and thus only a part of the cross section under consideration is available for flow of each fluid. Therefore, the discharge of each fluid must be lower corresponding to its proportion of the cross sectional area (46).

Figure 17 is another relative permeability graph which demonstrates several points. Small increases in DNAPL saturation results in a significant reduction in the relative permeability of water. However, a small increase in water saturation does not result in a significant reduction in DNAPL relative permeability. This figure identifies two points, SO1 and SO2, where the saturation of the DNAPL and the water are greater than 0 before there is a relative permeability for this fluid. The two fluids hinder the movement of the other to different degrees and both must reach a minimum saturation before they achieve any mobility at all (47). These minimum saturations, for the water and DNAPL, are identified as immobile and residual saturation, respectively.

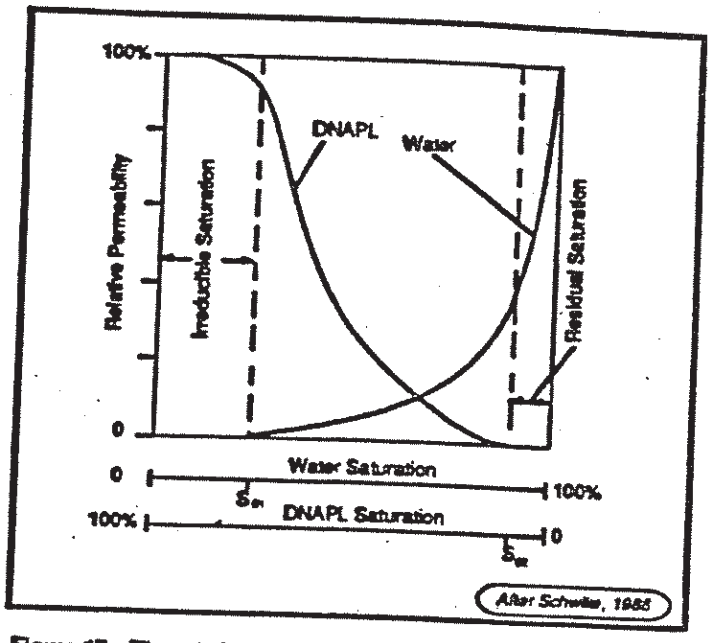


Figure 17. The relative permeability curves for water and a DNAPL in a porous medium as a function of the pore space saturation.

Site Characterization for DNAPL

Characterization of the subsurface environment at hazardous waste sites containing DNAPL is complex and will likely be expensive. Specific details associated with the volume and timing of the DNAPL release are usually poor or are not available and subsurface heterogeneity is responsible for the complicated and unpredictable migration pathway of subsurface DNAPL transport. As discussed previously, slight changes in vertical permeability may induce a significant horizontal component to DNAPL migration.

Site characterization typically involves a significant investment in ground-water analyses. Although analysis of ground water provides useful information on the distribution of the soluble components of the DNAPL, the presence of other phases of the DNAPL may go unrecognized. The investigation must, therefore, be more detailed to obtain information concerning the phase distribution of the DNAPL at a site. Site characterization may require analyses on all four phases (aqueous, gaseous, solid, immiscible) to yield the appropriate information (refer to Table 2). In brief, data collected on the various phases must be compiled, evaluated and used to help identify: where the contaminant is presently located; where it has been; what phases it occurs in; and what direction the mobile phases may be going. A comprehensive review of site characterization for subsurface investigations is available (68). Development of monitoring and remediation strategies can be focused more effectively and efficiently after a clear definition of the phase distribution has been completed.

Ground Water

Ground water analyses for organic compounds, in conjunction with ground water flow direction data, has repeatedly been used to: delineate the extent of ground water contamination from DNAPL; determine the direction of plume migration; and

Table 2 - Phase Distribution of DNAPL in the Subsurface

MATRIX	PHASE
1. ground water	aqueous - soluble components of DNAPL
2. soil/aquifer material	solid - adsorbed components of DNAPL on solid phase material
3. DNAPL	immiscible - continuous phase (mobile), residual saturation (immobile)
4. soil gas	gaseous - volatile components

to identify probable DNAPL source area(s). While this approach has been used successfully to characterize the distribution of contaminants in the subsurface, there are limitations. For example, since DNAPL and ground water may flow in different directions, as indicated in Figures 13a and 13b, ground water analyses may not necessarily identify the direction of DNAPL migration.

Ground water analyses may be useful to identify probable DNAPL source areas, but, estimating the volume of DNAPL in the subsurface is limited using this approach. Soluble phase components of DNAPL are rarely found in excess of 10% of the solubility even when organic liquids are known or suspected to be present. The concentration of soluble DNAPL components in the ground water is not only a function the amount of DNAPL present, but also the chemical and physical characteristics of the DNAPL, the contact area and time between the ground water and DNAPL, and numerous transport and fate parameters (retardation, biodegradation, dispersion, etc.). One technique has been developed using chemical ratios in the ground water as a means of source identification and contaminant fate prediction (18).

Soil/Aquifer Material

Exploratory Borings

Physical and chemical analyses of soil and aquifer material (drill cuttings, cores) from exploratory borings will provide useful information in the delineation of the horizontal and vertical mass distribution of DNAPL. While simple visual examination for physical presence or absence of contamination might seem like a worthwhile technique, it can be deceiving and does nothing to sort out the various liquid phases and their relationship to each other (71). A quantitative approach is necessary to determine DNAPL distribution.

Drill cuttings or core material brought to the surface from exploratory borings can be screened initially to help delineate the depth at which volatile components from the various phases of the hydrocarbon exists. The organic vapor analyzer and the HNU are small portable instruments that can detect certain volatile compounds in the air. These methods are used to initially screen subsurface materials for volatile components of DNAPL. Identification of individual compounds and their concentrations may be confirmed by other, more precise, analyses.

Analysis of the soil or aquifer material by more accurate means, such as gas chromatography or high pressure liquid chromatography, will take longer but will provide more specific information on a larger group of organic compounds, i.e., volatile/non-volatile, and on specific compounds. This information is necessary to help fix the horizontal and vertical mass distribution of the contaminant and to help delineate the phase distribution. These analyses do not distinguish between soluble, sorbed or free-phase hydrocarbon, however; a low relative concentration indicates that the contaminant may mainly be present in the gaseous or aqueous phases; and a high relative concentration indicates the presence of sorbed contaminant or free phase liquid either as continuous-phase or residual saturation. A more rigorous set of analyses is required to distinguish between the various phases.

Additional tests to identify the presence of NAPL in soil or aquifer core sample are currently undeveloped and research in this area is warranted. Squeezing and immiscible displacement techniques have been used to obtain the pore water from cores (40). Other methods of phase separation involving vacuum or centrifugation may also be developed for this use. A paint filter test was proposed in one Superfund DNAPL field investigation where aquifer cores were placed in a filter/funnel apparatus, water was added, and the filtrate was examined for separate phases. These core analysis techniques have potential to provide valuable field data to characterize NAPL distribution.

Cone Penetrometer

The cone penetrometer (ASTM D3441-86)(69) has been used for some time to supply data on the engineering properties of soils. Recently, the application of this technology has made the leap to the hazardous waste arena. The resistance of the formation is measured by the cone penetrometer as it is driven vertically into the subsurface. The resistance is interpreted as a measure of pore pressure, and thus provides information on the relative stratigraphic nature of the subsurface. Petroleum and chlorinated hydrocarbon plumes can be detected most effectively when the cone penetrometer is used in conjunction with in-situ sensing technologies (48). Features of the cone penetrometer include: a continuous reading of the stratigraphy/permeability; in-situ measurement; immediate results are available; time requirements are minimal; vertical accuracy of stratigraphic composition is high; ground-water samples can be collected in-situ; and the cost is relatively low.

Data from the cone penetrometer can be used to delineate probable pathways of DNAPL transport. This is accomplished by identifying permeability profiles in the subsurface. A zone of low permeability underlying a more permeable stratigraphic unit will likely impede vertical transport of the DNAPL. Where such a scenario is found, a collection of DNAPL is probable and further steps can be implemented to more accurately and economically investigate and confirm such an occurrence. This general approach has successfully been implemented at one Superfund site (8).

DNAPL

Well Level Measurements

In an effort to delineate the horizontal and vertical extent of the DNAPL at a spill site, it is important to determine the elevation

of DNAPL in the subsurface. Monitoring DNAPL elevation over time will indicate the mobility of the DNAPL. There are several methods that can be used to determine the presence of DNAPL in a monitoring well. One method relies on the difference in electrical conductivity between the DNAPL and water. A conductivity or resistivity sensor is lowered into the well and a profile is measured. The interface of the DNAPL is accurately determined when the difference in conductivity is detected between the two fluids. This instrument may also be used to delineate LNAPL, also. A transparent, bottom-loading bailer can also be used to measure the thickness (and to sample) of DNAPL in a well (36). The transparent bailer is raised to the surface and the thickness of the DNAPL is made by visual measurement.

Several laboratory and field studies have been performed which investigate the anomaly between the actual and measured LNAPL levels in ground-water wells (15,16,24,25). The anomaly between actual and measured NAPL thickness in the subsurface is also applicable to DNAPL, but for different reasons. The location of the screening interval is the key to understanding both scenarios. First, if the well screen interval is situated entirely in the DNAPL layer, and the hydrostatic head (water) in the well is reduced by pumping or bailing, then to maintain hydrostatic equilibrium, the DNAPL will rise in the well (36,44,71) (refer to Figure 18). Secondly, if the well screen extends into the barrier layer, the DNAPL measured thickness will exceed that in the formation by the length of the well below the barrier surface (36) (refer to Figure 19). Both of these scenarios will result in a greater DNAPL thickness in the well and thus a false indication (overestimate) of the actual DNAPL thickness will result. One of the main purposes of the monitoring well in a DNAPL investigation is to provide information on the thickness of the DNAPL in the aquifer. Therefore, construction of the well screen should intercept the ground water:DNAPL interface and the lower end of the screen should be placed as close as possible to the impermeable stratigraphic unit.

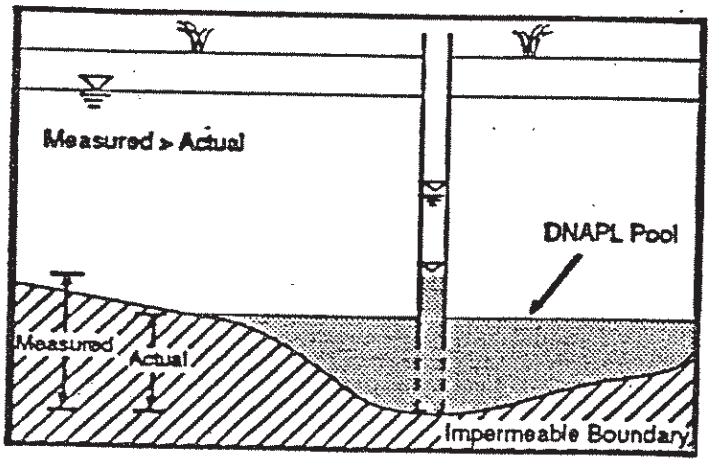


Figure 18. A well screened only in the DNAPL in conjunction with lower hydrostatic head (i.e. water) in the well may result in an overestimation of DNAPL thickness.

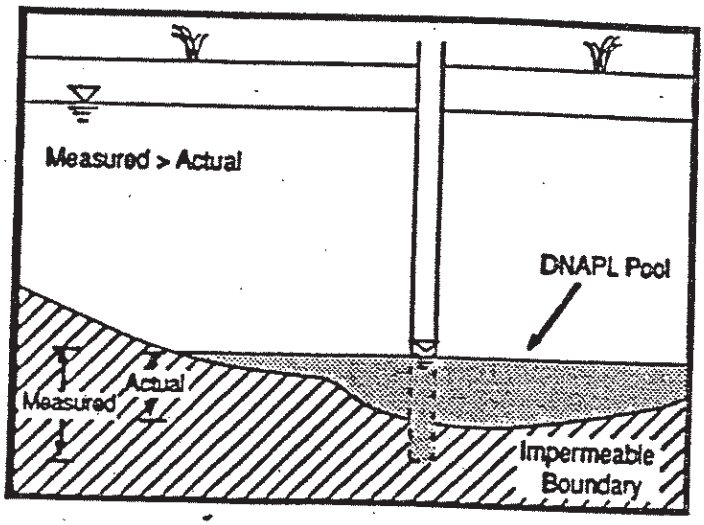


Figure 19. A well screened into an impermeable boundary may result in an over-estimation of the DNAPL thickness.

DNAPL Sampling

Sampling of DNAPL from a well is necessary to perform chemical and physical analyses on the sample. Two of the most common methods used to retrieve a DNAPL sample from a monitoring well are the peristaltic pump and the bailer. A peristaltic pump can be used to collect a sample if the DNAPL is not beyond the effective reach of the pump, which is typically less than 25 feet. The best method to sample DNAPL is to use a double check valve bailer. The key to sample collection is controlled, slow lowering (and raising) of the bailer to the bottom of the well (57). The dense phase should be collected prior to purging activities.

Soil-Gas Surveys

A soil-gas survey refers to the analysis of the soil air phase as a means to delineate underground contamination from volatile organic chemicals and several techniques have been developed (34,52). This investigative tool is mainly used as a preliminary screening procedure to delineate the areal extent of volatile organic compounds in the soil and ground water. This method is quick, less expensive than drilling wells and can provide greater plume resolution (33).

Data from a soil-gas survey is a valuable aid in the development of a more detailed subsurface investigation where ground water monitoring wells and exploratory borings are strategically located for further site characterization. There are limitations to soil-gas surveys (26,52) and data interpretation must be performed carefully (35,49). Soil-gas investigations have mainly been conducted to identify the location of the organic contaminants in ground water. At the time of this publication, the scientific literature did not contain information specifically applicable to the delineation of DNAPL from soil-gas survey data. However, it is surmisable that soil-gas surveys can be used to help delineate DNAPL residual saturation in the unsaturated zone or the location of perched DNAPL reservoirs.

Miscellaneous

The vertical migration of DNAPL in the saturated zone will eventually be challenged by a low permeability stratigraphic unit. According to the principles of capillary pressure, the lower permeability unit will exhibit a greater capillary pressure. Displacement of water by DNAPL requires that the hydrostatic force from the mounding DNAPL exceed the capillary force of the low permeability unit. The Hobson formula is used to compute the critical height calculation to overcome the capillary pressure under different pore size conditions (70).

In an effort to minimize further DNAPL contamination as a result of drilling investigations, precautionary steps should be taken. Penetration of DNAPL reservoirs in the subsurface during drilling activities offers a conduit for the DNAPL to migrate vertically into previously uncontaminated areas. It is very easy to unknowingly drill through a DNAPL pool and the bed it sits on, causing the pool to drain down the hole into a deeper part of the aquifer or into a different aquifer (32). Special attention to grouting and sealing details during and after drilling operations will help prevent cross-contamination.

Precautionary efforts should also be considered when a DNAPL reservoir is encountered during drilling operations. The recommended approach is to cease drilling operations and install a well screen over the DNAPL zone and cease further drilling activities in the well. If it is necessary to drill deeper, construction of an adjacent well is recommended. Alternatively, if it is not necessary to screen off that interval, it is recommended to carefully seal off the DNAPL zone prior to drilling deeper.

Well construction material compatibility with DNAPL should be investigated to minimize downhole material failure. A construction material compatibility review and possible testing will prevent the costly failure of well construction material. The manufacturers of well construction material are likely to have the most extensive compatibility data and information available.

Remediation

Remediation of DNAPL mainly involves physical removal by either pumping or trench-drainline systems. Removal of DNAPL early in the remediation process will eliminate the main source of contaminants. This step will substantially improve the overall recovery efficiency of the various DNAPL phases including the long term pump and treat remediation efforts for soluble components. Remediation technologies such as vacuum extraction, biodegradation, ground water pumping, and soil flushing is mainly directed at the immobile DNAPL and the various phases in which its components occur. Physical barriers can be used in an effort to minimize further migration of the DNAPL.

Clean-up of DNAPL can involve sizable expenditures: they are difficult to extract and the technology for their removal is just evolving (43). Historically, field recovery efforts usually proceed with a poor understanding of the volume distribution of the DNAPL. This reflects the difficulties involved in adequate site characterization, poor documentation of the release, and the complexity associated with the DNAPL transport in the subsurface.

Pumping Systems

Pumping represents an important measure to stop the mobile DNAPL from migrating as a separate phase by creating a hydraulic containment and by removal of DNAPL (44). Very simply, DNAPL recovery is highly dependent on whether the DNAPL can be located in the subsurface. The best recovery scenario is one in which the DNAPL is continuous and has collected as a reservoir in a shallow, subsurface impermeable depression. Once the DNAPL has been located and recovery wells are properly installed, pumping of pure phase DNAPL is a possible option but depends largely on site specific conditions which include, but are not limited to: DNAPL thickness, viscosity, and permeability.

Many DNAPL reservoirs in the subsurface are of limited volume and areal extent. Therefore, it can be expected that both the level of DNAPL (saturated thickness) in the well will decline from the prepumping position and the percentage of DNAPL in the DNAPL:water mixture will decrease rather rapidly. Correspondingly, DNAPL recovery efficiency decreases. Field results indicate that recovery wells screened only in the DNAPL layer will maintain maximum DNAPL:water ratios (102). Well diameter was not found to influence long term DNAPL recovery; however, large diameter wells allow high volume pumping for short durations; and small diameter wells result in lower DNAPL:water mixtures and greater drawdown.

An enhanced DNAPL recovery scheme may be used to improve recovery efficiency. An additional well is constructed with a screen interval in the ground water zone located vertically upward from the DNAPL screen intake. Ground water is withdrawn from the upper screen which results in an upwelling of the DNAPL (70), refer to Figure 20. The upwelling of the DNAPL, coal tar in this case, improved the rate (twofold) at which the coal tar was recovered resulting in a more efficient operation. The ground water withdrawal rate must be carefully determined; too much will cause the coal tar from rising excessively and being either mixed (emulsions) with or suppressed by the higher water velocity above; too low will not

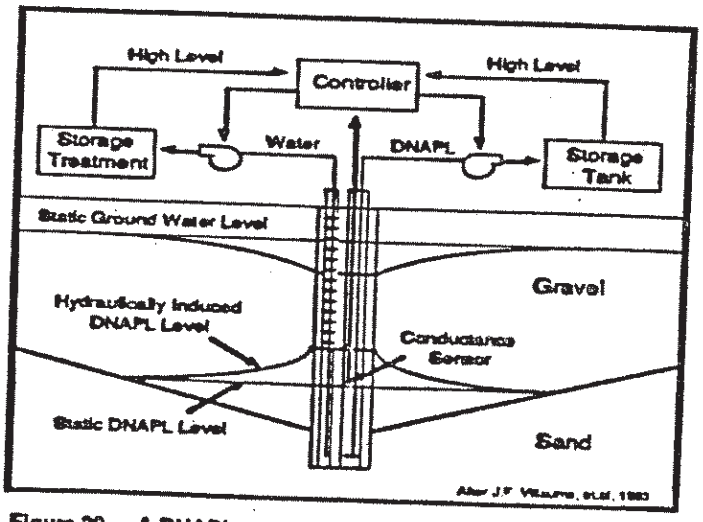


Figure 20. A DNAPL recovery system where deliberate upwelling of the static coal-tar surface is used to increase the flow of product into the recovery wells.

caused upwelling. An estimate of this upwelling can be calculated using the simplified Ghyben-Herzberg Principle for ideal conditions (4). Laboratory studies indicated that ...ethyl phthalate (1.19 g/cc) recovery rate was doubled or tripled over the conventional, non-upconing, recovery scheme (75). A similar application of this technique was used to increase the level of DNAPL (solvents) in a sandstone bedrock formation (11). Other enhanced DNAPL recovery techniques were implemented utilizing both water flooding and wellbore vacuum. Essentially, this minimized drawdown, allowing a maximum pumping rate of the DNAPL:water mixture. Both techniques offered significant advantages in terms of the rate and potential degree of DNAPL removal (8).

The highly corrosive nature of some DNAPL's may increase maintenance problems associated with the recovery system. A design consideration during any DNAPL recovery program should include a material compatibility review to minimize downhole failures. This is applicable to the well construction material and the various appurtenances of the recovery system. Manufacturers of the construction material would most likely have the best compatibility information available.

While most researchers agree that the residual saturation of immiscible hydrocarbon droplets in porous media are immobile, researchers have investigated the mobility of residual saturation in porous media for enhanced oil recovery and for NAPL remediation at spill sites. Specifically, this includes a complex interplay between four forces (viscous, gravity, capillary, buoyancy). These forces are dependent on both the chemical and physical characteristics of the DNAPL and porous media. The mobilization of residual saturation ...ly hinges on either increasing the ground water velocity ...n increases the viscous forces between the residual saturation and the ground water, or decreasing the interfacial tension between the residual saturation and the ground water which decreases the capillary forces.

The capillary number is an empirical relationship which measures the ratio between the controlling dynamic stresses (absolute viscosity and ground water velocity) and static stresses (interfacial tension) of the residual saturation (39). The former are the viscous stresses and the dynamic pressure in the water which tend to move the oil. The latter are the capillary stresses in the curved water/oil interfaces which tend to hold the oil in place. As the capillary number is increased, the mobility of the residual saturation increases. In a laboratory column study, the capillary number had to be increased two orders of magnitude from when motion was initiated to complete displacement of the hydrocarbon in a sandstone core (74). In a glass bead packed column, only one order of magnitude increase was required. However, a higher capillary number was required to initiate mobility. The difference in mobility between the two columns was attributed to the pore geometry, i.e. size, shape.

There are limitations to residual saturation mobilization. The ground water gradient (dh/dl) necessary to obtain the critical capillary number to initiate blob mobilization would be 0.24. To obtain complete NAPL removal would require a gradient of 18 (3). Ground water gradients of this magnitude are unrealistic. Another estimate of the gradient necessary to mobilize carbon tr... chloride in a fine gravel and medium sand was 0.09 and 9... respectively (74). The former gradient is steep but not u...asonable and the latter gradient is very steep and impractical to achieve in the field. The same researchers concluded from more recent, comprehensive studies, that the earlier predictions were optimistic, and that the gradient necessary to mobilize residual organic liquid is clearly impractical (66). Another limitation is that along with residual saturation mobilization, the NAPL blobs disperse into smaller blobs and that the blob distribution was dependent on the resulting capillary number (6). Recovery of the NAPL residual saturation by pumping ground water may be more feasible where the porous media is coarse and capillary forces are low, i.e. coarse sands and gravel. However, even in this scenario, it is expected that the radius of residual saturation mobilization would be narrow.

It is held in petroleum engineering theory that the only practical means of raising the capillary number dramatically is by lowering the interfacial tension (39) and that this can be achieved by using surfactants (66). Surfactants reduce the interfacial tension between two liquids, and therefore, are injected into the subsurface for enhanced recovery of immiscible hydrocarbons. In laboratory experiments, surfactant flushing solutions produced dramatic gains in flushing even after substantial water flushing had taken place (54). Unfortunately, surfactants can be quite expensive and cost prohibitive in NAPL recovery operations. Surfactants are usually polymeric in nature and a surfactant residue may be left behind in the porous media which may not be environmentally acceptable. Additionally, surfactants may be alkaline and thus effect the pH of the subsurface environment. It has been suggested that such a surfactant may inhibit bacterial metabolism and thus preclude subsequent use of biological technologies at the site. Significant research in this area is currently underway which may uncover information improving the economics and feasibility of this promising technology.

In summary, practical considerations and recommendations in mobilization and recovery of residual saturation include the following: more effective in very coarse porous media i.e. coarse sands and gravel; installation of recovery wells at the source to minimize flow path distance; large volume of water to treat/dispose at the surface; compounds with high interfacial tension or viscosity will be difficult to mobilize; implementation of linear one-dimensional sweeps through the zones of residual saturation (74) and surfactants will optimize recovery.

Pumping the soluble components (aqueous phase) of DNAPL from the immiscible (continuous and residual saturation), solid (sorbed), and gaseous phases has been perhaps one of the most effective means to date to both recover DNAPL from the subsurface and to prevent plume migration. Recovery of soluble components quite often has been the only remediation means available. This is attributed to the inability to locate recoverable DNAPL pools and due to low DNAPL yielding formations. The basic principles and theory of pump and treat technology and the successes and failures have been summarized in other publications (64,67) and is beyond the scope of this publication.

Pumping solubilized DNAPL components from fractured rock aquifers historically has been plagued with a poor recovery efficiency. Although the rock matrix has a relatively small intergranular porosity, it is commonly large enough to allow dissolved contaminants from the fractures to enter the matrix by diffusion and be stored there by adsorption (32). The

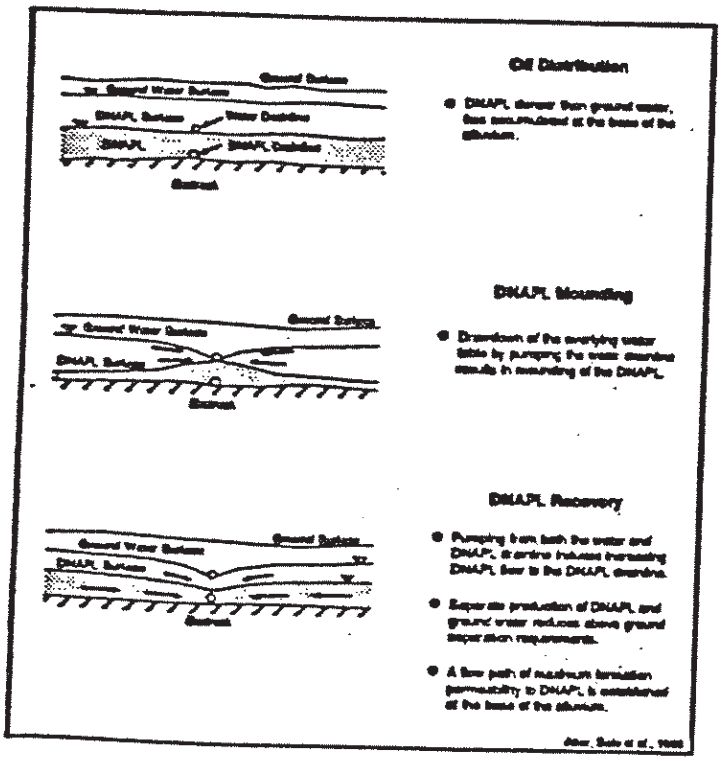


Figure 21. Trench recovery system of DNAPL utilizing the dual drainline concept.

release of these components is expected to be a slow diffusion dominated process. This is because little or no water flushes through dead-end fracture segments or through the porous, impervious rock matrix. Therefore, clean-up potential is estimated to be less than that expected for sand and gravel aquifers.

Trench Systems

Trench systems have also been used successfully to recover DNAPL and are used when the reservoir is located near the ground surface. Trench systems are also effective when the DNAPL is of limited thickness. Recovery lines are placed horizontally on top of the impermeable stratigraphic unit. DNAPL flows into the collection trenches and seep into the recovery lines. The lines usually drain to a collection sump where the DNAPL is pumped to the surface. Similar to the pumping system, an enhanced DNAPL recovery scheme may be implemented using drain lines to improve recovery efficiency. This "dual drain line system" (41) utilizes a drain line located in the ground water vertically upward from the DNAPL line. Ground water is withdrawn from the upper screen which results in an upwelling of the DNAPL which is collected in the lower line, refer to Figure 21. This increases the hydrostatic head of the DNAPL. Excessive pumping of either single or dual drain line systems may result in the ground water "pinching off" the flow of DNAPL to the drain line. An advantage of the dual drain system is that the oil:water separation requirements at the surface are reduced.

Vacuum Extraction

Soil vacuum extraction (SVE) is a remediation technology which involves applying a vacuum to unsaturated subsurface strata to induce air flow. Figure 22 illustrates that the volatile contaminants present in the contaminated strata will evaporate and the vapors are recovered at the surface and treated. Common methods of treatment include granular activated carbon, catalytic oxidation, and direct combustion. SVE can effectively remove DNAPL present as residual saturation. In general, vacuum extraction is expected to be more applicable for the chlorinated solvents (PCE, TCE, DCE) than the polycyclic aromatic compounds (wood preserving wastes, coal tars, etc.). This technology is most effective to remove DNAPL residual saturation and soluble components in the unsaturated zone. When DNAPL is present in perched pools (Figure 12) it is more effective to remove DNAPL in the unsaturated zone prior to the implementation of SVE. The same strategy is applicable in the saturated zone where DNAPL removal by SVE is attempted concomitantly with lowering the water table. Upon lowering the water table, SVE can be used to remove the remnant volatile wastes not previously recovered. Often, the precise location of the DNAPL is unknown; therefore, SVE can be used to remediate the general areas where the presence of DNAPL is suspected. Removal of DNAPL by SVE is not expected to be as rapid as direct removal of the pure phase compound. One advantage of SVE however, is that he precise location of the DNAPL need not be known.

Important parameters influencing the efficacy of SVE concern both the DNAPL and porous media. Porous media specific parameters include: soil permeability, porosity, organic carbon, moisture, structure, and particle size distribution. DNAPL specific parameters include: vapor pressure, Henry's constant, solubility, adsorption equilibrium, density, and viscosity (20). These parameters and their relationships must be evaluated on a site specific basis when considering the feasibility of vacuum extraction and a practical approach to the design, construction, and operation of venting systems (22). Additionally, soil gas surveys which delineate vapor concentration as a function of depth is critical in locating the contaminant source and designing an SVE system.

Historically, SVE has been used to remove volatile compounds from the soil. Recently it has been observed that SVE enhances the biodegradation of volatile and semivolatile organic compounds in the subsurface. While SVE removes volatile components from the subsurface, it also aids in supplying oxygen to biological degradation processes in the unsaturated zone. Prior to soil venting, it was believed that biodegradation in the unsaturated zone was limited due to inadequate concentrations of oxygen (17). In a field study where soil venting was used to recover jet fuel, it was observed that approximately 15% of the contaminant removal was from the result of microbial degradation. Enhanced aerobic biodegradation during SVE increases the cost effectiveness of the technology due to the reduction in the required above ground treatment.

Vacuum extraction is one form of pump and treat except that the fluid is a gas mixture and that it occurs in the unsaturated zone. Therefore, many of the same limitations to pump and treat are also applicable to vacuum extraction. While the application of vacuum extraction is conceptually simple, its success depends on understanding complex subsurface

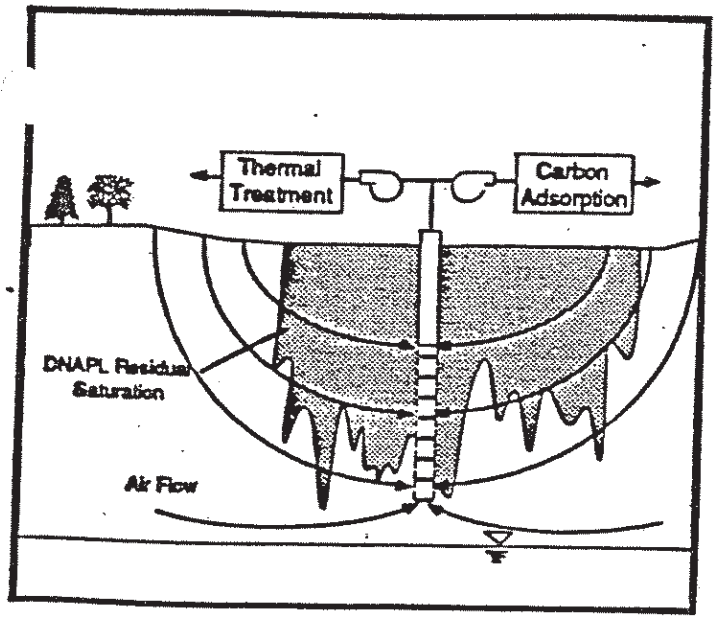


Figure 22. Vacuum extraction of DNAPL volatile components in the unsaturated zone. As shown here, vapors are treated by thermal combustion or carbon adsorption and the air is discharged to the atmosphere.

chemical, physical, and biological processes which provide insight into factors limiting its performance (9).

degradation

The potential for biodegradation of immiscible hydrocarbon is highly limited for several reasons. First, pure phase hydrocarbon liquid is a highly hostile environment to the survival of most microorganisms. Secondly, the basic requirements for microbiological proliferation (nutrients, electron acceptor, pH, moisture, osmotic potential, etc.) is difficult if not impossible to deliver or maintain in the DNAPL. A major limitation to aerobic bioremediation of high concentrations of hydrocarbon is the inability to deliver sufficient oxygen. A feasible remediation approach at sites where immiscible hydrocarbon is present is a phased technology approach. Initial efforts should focus on pure phase hydrocarbon recovery to minimize further migration and to decrease the volume of NAPL requiring remediation. Following NAPL recovery, other technologies could be phased into the remediation effort. Bioremediation may be one such technology that could be utilized to further reduce the mass of contaminants at the site. NAPL recovery preceding bioremediation will improve bioremediation feasibility by reducing the toxicity, time, resources, and labor.

Similar to other remediation technologies, a comprehensive feasibility study evaluating the potential effectiveness of bioremediation is critical and must be evaluated on a site specific basis. A comprehensive review of biodegradation of surface soils, ground water, and subsoils of wood preserving wastes, i.e. PAH's (29,37,51,62,63) are available. A c rehensive review of microbial decomposition of c nated aromatic compounds is also available (58).

Soil Flushing

Soil flushing utilizing surfactants is a technology that was developed years ago as a method to enhance oil recovery in the petroleum industry. This technology is new to the hazardous waste arena and available information has mainly been generated from laboratory studies. Surfactant soil flushing can proceed on two distinctly different mechanistic levels: enhanced dissolution of adsorbed and dissolved phase contaminants, and displacement of free-phase nonaqueous contaminants. These two mechanisms may occur simultaneously during soil flushing (42).

Surfactants, alkalis, and polymers are chemicals used to modify the pore-level physical forces responsible for immobilizing DNAPL. In brief, surfactants and alkalis reduce the surface tension between the DNAPL and water which increases the mobility. Polymers are added to increase the viscosity of the flushing fluid to minimize the fingering effects and to maintain hydraulic control and improve flushing efficiency. Based on successful laboratory optimization studies where an alkali-polymer-surfactant mixture was used, field studies were conducted on DNAPL (creosote) which resulted in recovery of 94% of the original DNAPL (42). Laboratory research has also been conducted which indicated that aqueous surfactants resulted in orders of magnitude greater removal efficiency of adsorbed and dissolved phase contaminants than water flushing (55).

Depth to contamination, DNAPL distribution, permeability, heterogeneities, soil/water incompatibility, permeability reduction, and chemical retention are important factors when considering soil flushing (42). Prior to this technology being cost effective in the field, surfactant recycling will be necessary to optimize surfactant use (55). Soil flushing is complex from a physical and chemical point of view; is relatively untested in the field; and will likely be challenged regulatorily. Considerable research currently being conducted in this area may result in the increased use of this technology to improve DNAPL recovery in the future.

Thermal methods of soil flushing involve injecting hot water or steam in an effort to mobilize the NAPL. The elevated temperature increases volatilization and solubilization and decreases viscosity and density. A cold-water cap is used to prevent volatilization. The mobile phases of the DNAPL are then recovered using a secondary approach, i.e. pumping, vacuum extraction etc. This approach (Contained Recovery of Oily Wastes) to enhance recovery of DNAPL is currently under EPA's Superfund Innovative Technology Evaluation Program and a pilot-scale demonstration is forthcoming (21). A limitation in the use of thermal methods is that the DNAPL may be converted to LNAPL due to density changes (36). The adverse effects from this are that the DNAPL, existing as a thin layer, becomes buoyant and mobilizes vertically resulting in a wider dispersal of the contaminant. Other limitations involve the high energy costs associated with the elevated water temperature and the heat loss in the formation (36).

Physical Barriers

Physical barriers may be used to prevent the migration of DNAPL's in the subsurface and are typically used in conjunction with other recovery means. One feature of physical

barriers is the hydraulic control it offers providing the opportunity to focus remediation strategies in treatment cells. Unfortunately, physical barriers, while satisfactory in terms of ground water control and containment of dissolved-phase plumes, may contain small gaps or discontinuities which could permit escape of DNAPL (7). Chemical compatibility between physical barriers and construction material must agree to insure the physical integrity of the barrier. The history of the performance of these containment technologies is poorly documented and is mainly offered here for completeness of review. A more complete review of these physical barriers is available (5,56).

Sheet piling involves driving lengths of steel that connect together into the ground that form an impermeable barrier to lateral migration of DNAPL. Ideally, the bottom of the sheet pile should be partially driven into an impermeable layer to complete the seal. Slurry walls involve construction of a trench which is backfilled with an impermeable slurry (bentonite) mixture. Grouting is a process where an impermeable mixture is either injected into the ground or is pumped into a series of interconnected boreholes which together form an impermeable boundary. Again, the main feature of these techniques is to physically isolate the DNAPL.

In summary, site characterization and remediation options for sites containing DNAPL are limited. Field results from site characterization and remediation efforts are also limited. This is largely due to the complexity of DNAPL transport and fate in the subsurface; poorly developed techniques currently available to observe and predict DNAPL in the subsurface, and due to the fact that this issue has not been widely recognized, until recently. Clearly, there is a growing realization within the scientific and regulatory community that DNAPL is a significant factor in limiting site remediation. Correspondingly, current research efforts within the private industrial, and public sectors are focusing on both the fundamentals and applications aspects of DNAPL behavior in subsurface systems. Additionally, the number of field investigations reflecting an increased awareness of DNAPLs, is growing.

NAPL Modeling

A modeling overview report identified nineteen (numeric and analytic) multiphase flow models which are currently available (9). Most of these models were developed for salt water intrusion, LNAPL transport, and heat flow. Four models are qualitatively described as immiscible flow models but do not specifically indicate DNAPL. A more recent model has been developed which simulates density driven, three phase flow, and it is capable of modeling DNAPL transport (23). Presently, very little information is available on DNAPL modeling in the scientific literature.

Multiphase flow modeling involves modeling systems where more than one continuous fluid phase (NAPL, water, gaseous) is present. Modeling any subsurface system requires a conceptual understanding of the chemical, physical, and biological processes occurring at the site. Modeling of simultaneous flow of more than one fluid phase requires a conceptual understanding of the fluids and the relationship between the fluid phases. The significance of multiphase flow over single phase flow is the increased complexity of fluid flow and the additional data requirements necessary for modeling.

As presented earlier, numerous variables strongly influence DNAPL transport and fate, and consequently, the mathematical relationship of these variables is complex. Therefore, it follows that DNAPL modeling presents paramount technical challenges.

Presently, it is exceedingly difficult to obtain accurate field data which quantitatively describes DNAPL transport and fate variables within reasonable economic constraints. DNAPL transport is highly sensitive to subsurface heterogeneities (8,27,28) which compounds the complexity of modeling. Heterogeneities are, by nature, difficult to identify and quantify and models are not well equipped to accommodate the influence of heterogeneities. Additionally, relative permeability and capillary pressure functions must be quantified to identify the relationship between fluids and between the fluids and the porous media. Unfortunately, these parameters are very difficult to measure, particularly in three phase systems. Prior to an investment of time and money to model a given site, a careful evaluation of the specific objectives and the confidence of the input and anticipated output data should be performed. This will help illuminate the costs, benefits, and therefore, the relative value of modeling in the Superfund decision making process.

In summary, DNAPL modeling at Superfund sites is presently of limited use. This is mainly due to: the fact that very little information is available in the scientific literature to evaluate previous work; accurate and quantitative input data is expected to be costly; the sensitivity of DNAPL transport to subsurface heterogeneities; and, the difficulty in defining the heterogeneities in the field and reflecting those in a model. However, multiphase flow models are valuable as learning tools.

References

1. Baehr, A.L., Selective Transport of Hydrocarbons in the Unsaturated Zone Due to Aqueous and Vapor Phase Partitioning, Water Resources Research, Vol. 23, No. 10, pp. 1926-1938, 1987.

2. Bear, J., 1972, Dynamics of Fluids in Porous Media, American Elsevier Publishing Co., New York, 763 p.

3. Bouchard, D., Contaminant Transport in the Subsurface: Sorption Equilibrium and the Role of Nonaqueous Phase Liquids, in, Intermedia Pollutant Transport: and Field Measurement, (David T. Allen, Yoram Cohen and Isaac R. Kaplan, Eds.), New York, Plenum Pub. Corp., pp. 189-211.

4. Bower, H., Groundwater Hydrology, McGraw-Hill Book Co., 1978, 480 pp.

5. Canter, L. W. and R. C. Knox, Ground Water Pollution Control, Lewis Publishers Inc., Chelsea, Mich., 1986, 526 pp.

6. Chatzis, I., M.S. Kuntamukkula, and N.R. Morrow, Blob-size Distribution as a Function of Capillary Number in Sandstones, Paper 13213, Presented at SPE Annual Tech. Conference and Exhibition, Houston, TX, 1984.

7. Cherry, J.A., S. Feenstra, B.H. Kueper and D.W. McWhorter, "Status of In Situ Technologies for Cleanup of Aquifers Contaminated by DNAPL's Below the Water Table," in, International Specialty Conference on How Clean is Clean? Cleanup Criteria for Contaminated Soil and Groundwater, Air and Waste Management Association, pp. 1-18, November 6-9, 1990.

8. Connor, J.A., C.J. Newell, D.K. Wilson, Assessment, Field Testing, Conceptual Design for Managing Dense Nonaqueous Phase Liquids (DNAPL) at a Superfund Site, in, Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, A Conference and Exposition, The Westin Galleria, Houston, TX, Vol. 1, pp. 519-533, 1989.

9. DiGiulio, D.C. and J.S. Cho, Conducting Field Tests for Evaluation of Soil Vacuum Extraction Application, in, Proceedings of the Fourth National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring, and Geophysical Methods, Las Vegas, NV, May 14-17, 1990, pp. 587-601.

10. Feenstra, S., Evaluation of Multi-Component DNAPL Sources by Monitoring of Dissolved-Phase Concentrations, in, Proceedings of the Conference On Subsurface Contamination by Immiscible Fluids, International Association of Hydrogeologists, Calgary, Alberta, April 18-20, 1990.

11. Ferry, J.P. and P.J. Dougherty, Occurrence and Recovery of a DNAPL in a Low-Yielding Bedrock Aquifer, in, Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration, Nov. 12-14, Houston, TX., 1986, pp. 722-733.

12. Fu, J.K. and R.G. Luthy, Effect of Organic Solvent on Sorption of Aromatic Solutes onto Soils, Journal of Environmental Engineering, Vol. 112, No. 2, pp. 346-366, 1986.

13. Glass, R.J., T.S. Steenhuis, and J.Y. Parlange, Mechanism for Finger Persistence in Homogeneous Unsaturated Porous Media: Theory and Verification, Soil Science, 148(1), pp. 60-70, 1989.

14. Hall, A.C., S.H. Collins, and J.C. Melrose, Stability of Aqueous Wetting Films, Society of Petroleum Engineering Journal, 23(2), pp. 249-258, 1983.

15. Hall, R.A., S.B. Blake, and S.C. Champlin, Jr., Determination of Hydrocarbon Thickness in Sediments Using Borehole Data, in, Proceedings of the 4th National Symposium and Exposition on Aquifer Restoration and Ground Water Monitoring, Columbus, OH, pp. 300-304, May 23-25, 1984.

16. Hampton, D.R., and P.D.G. Miller, Laboratory Investigation of the Relationship Between Actual and Apparent Product Thickness in Sands, in, Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, A Conference and Exposition, The Westin Galleria, Houston, Texas, Vol. 1, pp. 157-181, November 9-11, 1988.

17. Hinchee, R.E., D.C. Downey, R.R. Dupont, P. Aggarwal, and R.N. Miller, Enhancing Biodegradation of Petroleum Hydrocarbon Through Soil Venting, Journal of Hazardous Materials, (accepted) 1990.

18. Hinchee, R.E. and H.J. Reisinger, A Practical Application of Multiphase Transport Theory to Ground Water Contamination Problems, Ground Water Monitoring Review, pp. 84-92, Winter, 1987.

19. Hoag, G.E. and M.C. Marley, Gasoline Residual Saturation in Unsaturated Uniform Aquifer Materials, Journal of Environmental Engineering, Vol. 112, No. 3, pp. 586-604, 1989.

20. Hutzler, N.J., B.E. Murphy, and J.S. Gierke, Review of Soil Vapor Extraction System Technology, Presented at Soil Vapor Extraction Technology Workshop, June 28-29, 1989, Edison, New Jersey.

21. Johnson, L.A. and F.D. Guffey, "Contained Recovery of Oily Wastes, Annual Progress Report." Western Research Institute, Laramie, Wyoming, June, 1989.

22. Johnson, P.C., C.C. Stanley, M.W. Kemblowski, D.L. Byers, and J.D. Colthart, A Practical Approach to the Design, Operation, and Monitoring of In Situ Soil-Venting Systems, Ground Water Monitoring Review, pp. 159-178, Spring 1990.

23. Katyal, A.K., J.J. Kaluarachchi, and J.C. Parker, MOFAT: A Two-Dimensional Finite Element Program for Multiphase Flow and Multicomponent Transport, Program Documentation, Version 2.0, Virginia PolyTechnic Institute and State University, 58 pp., August, 1990.

24. Kemblowski, M.W. and C.Y. Chiang, Analysis of the Measured Free Product Thickness in Dynamic Aquifers, in, Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, A Conference and Exposition, The Westin Galleria, Houston, Texas, Vol. 1, pp. 183-205, November 9-11, 1988.

25. Kemblowski, M.W. and C.Y. Chiang, Hydrocarbon Thickness Fluctuations in Monitoring Wells, Ground Water, Vol. 28, No. 2, pp. 244-252, 1990.

26. Kerfoot, H.B., Is Soil-Gas Analysis an Effective Means of Tracking Contaminant Plumes in Ground Water? What are the Limitations of the Technology Currently Employed? Ground Water Monitoring Review, pp. 54-57, Spring 1988.

27. Kueper, B.H. and E.O. Frind, An Overview of Immiscible Fingering in Porous Media, Journal of Contaminant Hydrology, Vol. 2, pp. 95-110, 1988.

28. Kueper, B.H., W. Abbott, and G. Farquhar, Experimental Observations of Multiphase Flow in Heterogeneous Porous Media, Journal of Contaminant Hydrology, Vol. 5, pp. 83-95, 1989.

29. Lee, M.D., J.M. Thomas, R.C. Borden, P.B. Bedient, J.T. Wilson, and C.H. Ward, Biorestoration of Aquifers Contaminated with Organic Compounds, National Center for Ground Water Research, CRC Critical Reviews in Environmental Control, Vol. 18, Issue 1, pp. 29-89, 1988.

30. Lindeburg, M.R., 1986, Civil Engineering Reference Manual, 4th edition, Professional Publications Inc. Belmont, CA.

31. Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt, Handbook of Chemical Property Estimation Methods, McGraw-Hill Book Company, 1982.

32. Mackay, D.M. and J.A. Cherry, Ground-Water Contamination: Pump and Treat Remediation, Environmental Science & Technology, Vol. 23, No. 6, pp. 630-636, 1989.

33. Marrin, D.L. and G.M. Thompson, Gaseous Behavior of TCE Overlying a Contaminated Aquifer, Ground Water, Vol. 25, No. 1, pp. 21-27, 1987.

34. Marrin, D., Kerfoot, H, Soil-gas surveying techniques Environmental Science & Technology, Vol. 22, No. 7, pp. 740-745, 1988.

35. Marrin, D.L., Soil-Gas Sampling and Misinterpretation, Ground Water Monitoring Review, pp. 51-54, Spring 1988.

36. Mercer, J.W. and R.M. Cohen, A Review of Immiscible Fluids in the Subsurface: Properties, Models, Characterization and Remediation, Journal of Contaminant Hydrology, Vol. 6, pp. 107-163, 1990.

37. Mississippi Forest Products Laboratory, Proceedings of the Bioremediation of Wood Treating Waste Forum, Mississippi State University, March 14-15, 1989.

38. Morrow, N.R., Interplay of Capillary, Viscous and Bouyancy Forces in the Mobilization of Residual Oil, The Journal of Canadian Petroleum, Vol. 18, No. 3, pp. 35-46, 1979.

39. Ng, K.M., H.T. Davis, and L.E. Scriven, Visualization of Blob Mechanics in Flow Through Porous Media, Chemical Engineering Science, Vol. 33, pp. 1009-1017, 1978.

40. Patterson, R.J., S.K. Frape, L.S. Dykes, and R.A. McLeod, A Coring and Squeezing Technique for the Detailed Study of Subsurface Water Chemistry, Canadian Journal Earth Science, Vol. 15, pp. 162-169, 1978.

41. Sale, T., CH2M Hill, and Kuhn, B., Recovery of Wood-Treating Oil from an Alluvial Aquifer Using Dual Drainlines, in, Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, A Conference and Exposition, The Westin Galleria, Houston, Texas, Vol. 1, pp. 419-442, November 9- 11, 1988.

42. Sale, T., K. Piontek, and M. Pitts, Chemically Enhanced In-Situ Soil Washing, in Proceedings of the Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, Houston, TX, November 15-17, 1989.

43. Schmidtke, K., E. McBean, and F. Rovers, Drawdown Impacts in Dense Non-Aqueous Phase Liquids, in NWWA Ground Water Monitoring Symposium, Las Vegas, Nevada, pp. 39-51, May, 1987.

44. Schmidtke, K., E. McBean, and F. Rovers, Evaluation of Collection Well Parameters for DNAPL, Journal of Environmental Engineering, accepted, August, 1990.

45. Schwille, F., Groundwater Pollution in Porous Media by Fluids Immiscible With Water, The Science of the Total Environment, Vol. 21, pp. 173-185, 1981.

46. Schwille, F., Migration of Organic Fluids Immiscible with Water in the Unsaturated Zone, in, Pollutants in Porous Media: The Unsaturated Zone Between Soil Surface and Groundwater, (B. Yaron, G. Dagan, J. Goldshmid, Eds.) Springer-Verlag, New York, pp. 27-48, 1984.

47. Schwille, F., Dense Chlorinated Solvents in Porous and Fractured Media: Model Experiments (English Translation), Lewis Publishers, Ann Arbor, MI 1988.

48. Seitz, W.R., In-Situ Detection of Contaminant Plumes in Ground Water, Special Report 90-27, U.S. Army Corps of Engineers, Cold Regions Research & Engineering Laboratory, August 1990, 12 pp.

49. Silka, L., Simulation of Vapor Transport Through the Unsaturated Zone - Interpretation of Soil-Gas Surveys, Ground Water Monitoring Review, pp. 115-123, Spring 1988.

50. Sitar, N., J.R. Hunt, and K.S. Udell, Movement of Nonaqueous Liquids in Groundwater, in, Proceedings of a Speciality Conference, Geotechnical Practice for Waste Disposal '87, University of Michigan, Ann Arbor, MI, pp. 205-223, June 15-17, 1987.

51. Sims, R., Soil Remediation Techniques at Uncontrolled Hazardous Waste Sites, Air & Waste Management Association, Vol. 40, No. 5, pp. 704-732, May 1990.

52. Thompson, G., and Marrin, D., Soil Gas Contaminant Investigations: A Dynamic Approach, Ground Water Monitoring Review, pp. 88-93, Summer, 1987.

53. Treiber, L.E., D.L. Archer, and W.W. Owens, A Laboratory Evaluation of Wettability of Fifty Oil-Producing Reservoirs, Society of Petroleum Engineering Journal, 12(6), 531-540.

54. Tuck, D.M., P.R. Jaffe, and D.A. Crerar, Enhancing Recovery of Immobile Residual Non-Wetting Hydrocarbons from the Unsaturated Zone Using Surfactant Solutions, in, Proceedings of Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection, and Restoration, A Conference

and Exposition, The Westin Galleria, Houston, Texas, Vol. 1, pp. 457-478, November 9-11, 1988.

55. U.S. EPA,, Treatment of Contaminated Soils with Aqueous Surfactants, EPA/600/2-85/129, NTIS PB86-122561, 84 pp., 1985.

56. U.S. EPA, Handbook Remedial Action at Waste Disposal Sites, EPA/625/6-85/006, October, 1985.

57. U.S. EPA, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD), OSWER Directive 9950.1, 1986c.

58. U.S. EPA, Microbial Decomposition of Chlorinated Aromatic Compounds, EPA/600/2-86/090, September 1986.

59. U.S. EPA, Characterization and Laboratory Soil Treatability Studies for Creosote and Pentachlorophenol Sludges and Contaminated Soil, EPA/600/2-88/055 or NTIS Publication #PB89-109920, 138 p., 1988.

60. U.S. EPA, Ground Water Modeling: An Overview and Status Report, EPA/600/2-89/028, December, 1988.

61. U.S. EPA, Contaminant Transport in Fractured Media: Models for Decision Makers, EPA/600/SF-88/002, October, 1988.

62. U.S. EPA, Characterization and Laboratory Soil Treatability Studies for Creosote and Pentachlorophenol Sludges and Contaminated Soil, EPA/600/2-88/055, September 1988.

U.S. EPA, Bioremediation of Contaminated Surface Soils, EPA-600/9-89/073, 23 pp., August 1989.

64. U.S. EPA, Performance Evaluations Of Pump And Treat Remediations, Superfund Ground Water Issue, EPA/540/4-89/005, 19 pp.,1989.

65. U.S. EPA, Subsurface Contamination Reference Guide, EPA/540/2- 90/011, October, 1990.

66. U.S. EPA, Laboratory Investigation of Residual Liquid Organics from Spills, Leaks, and Disposal of Hazardous Wastes in Groundwater, EPA/600/6-90/004, April, 1990.

67. U.S. EPA, Basics of Pump and Treat Ground Water Remediation Technology, EPA-600/8-90/003, 31 pp., March 1990.

68. U.S. EPA, Site Characterizations for Subsurface Remediations, EPA/625/ - /(in press) 1990.

69. U.S. Federal Highway Administration, Guidelines for Cone Penetration Test: Performance and Design, FHWA-TS-78-209 (TS 78 No. 209) February, 1977.

70. Villaume, J.F., P.C. Lowe, and D.F. Unites, Recovery of Coal Gasification Wastes: An Innovative Approach, in, Proceedings Third National Symposium on Aquifer Restoration and Ground Water Monitoring, National Water Well Association, Worthington, OH, pp. 434-445, 1983.

71. Villaume, J.F., Investigations at Sites Contaminated with Dense, Non-Aqueous Phase Liquids (NAPLs), Ground Water Monitoring Review, Vol. 5, No. 2, pp. 60-74, 1985.

72. Waterloo Centre for Ground Water Research, University of Waterloo Short Course, "Dense Immiscible Phase Liquid Contaminants in Porous and Fractured Media," Kitchener, Ontario, Canada, Nov. 6-9, 1989.

73. Williams, D.E. and D.G. Wilder, Gasoline Pollution of a Ground- Water Reservoir - A Case History, Ground Water, Vol. 9, No. 6, pp. 50- 54, 1971.

74. Wilson, J.L. and S.H. Conrad, Is Physical Displacement of Residual Hydrocarbons a Realistic Possibility in Aquifer Restoration?, in, Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Ground Water—Prevention, Detection, and Restoration, The Intercontinental Hotel, Houston, Texas, pp. 274-298, November 5-7, 1984.

75. Wisniewski, G.M., G.P. Lennon, J.F. Villaume, and C.L. Young, Response of a Dense Fluid Under Pumping Stress, in, Proceedings of the 17th Mid-Atlantic Industrial Waste Conference, Lehigh, University, pp. 226-237, 1985.

ATTACHMENT B

PACKER TEST PROCEDURE

PACKER TEST PROCEDURES

I. Introduction

Packer testing is a method used to estimate the hydraulic conductivity of discrete bedrock zones within an open-bedrock corehole or open-bedrock well/piezometer. A packer test involves tightly sealing off a selected interval in the bedrock hole, pumping clean water into the test interval under a specified head for a specified duration, and recording the volume of water pumped into the formation during the test duration. To allow interpretation of the flow characteristics (e.g., laminar or turbulent), the rock fracture response (e.g., dilation, washout, or void filling) and the representative conductivity value for the tested bedrock interval, five test increments are performed at three different head conditions. The hydraulic conductivity is calculated based on the observed test pumping rates, the total applied head values, the geometry of the tested interval, and the pattern of pumping rates achieved during each of the five test increments.

The following presents methods for both single and double packer testing.

II. Materials

The equipment used for packer testing consists of two assemblies:

(1) A packer apparatus consisting of inflatable rubber packer(s) and a length of perforated pipe; and

(2) A water system, including a water meter, pressure gauge and valves to adjust and maintain the water pressure and flow.

The following list of equipment to be used for packer testing is meant to serve only as a guide because actual site and borehole conditions may require modifications. The driller may provide much of the equipment. Typical equipment and materials used to perform packer testing include:

- Drill rig to install and remove the packer and water pipe;
- Packer (pneumatic or hydraulically actuated);
- Water pipe, ranging from 1 to 2 inches in diameter, depending on the permeability and surface area of the test section;
- Flow meter of the same diameter as the water pipe above;
- Pump, capacity to approximately 50 gpm;
- Storage tanks of appropriate volume for holding clean water for injection into test interval;
- Two pressure transducers, sized in accordance with the depth of the test interval and the excess injection pressure to be applied during the test;
- Compressed gas cylinders, regulators, and tubing for inflating pneumatic packers or alternative pressure source if hydraulically-actuated packers are used;
- Water swivel or elbow;
- Hose or piping of the same diameter as the water pipe;
- Electronic data logger for recording transducer output;

- Water level indicator or equivalent oil/water interface meter with 0.01 foot increments;
- Stopwatch;
- Constant-head injection data sheets (an example is provided in Figure 1);
- Personal Protective Equipment (PPE) as required by the Site-specific EHS Plan;
- Decontamination supplies (as needed); and
- Field logbook.

III. Packer Apparatus Configurations

Either single-packer or double-packer configurations may be used to perform the packer test. The single-packer test typically is performed after each core run during the drilling of corehole. The packer is seated at the top of the interval of rock core just removed, and the newly exposed section of bedrock is tested. To remove sediment from the corehole wall, the corehole may be bailed, surged or swabbed prior to packer testing. The test should not be initiated, however, until the water level in the drill casing returns to the static level.

Single-packer tests may provide more reliable results than double-packer tests because if water leaks past a single, upper packer, the leak may be discerned by the recognition of a rising water level in the corehole or drill casing above the packer or by the appearance of water in the casing at the ground surface. In contract, if a double-packer configuration is used, leakage past the lower packer may enter a permeable corehole section below the lower packer without being recognized as leakage.

The double-packer configuration is used if discrete rock intervals are to be tested in a previously-drilled long open corehole. Two packers are placed in the corehole and inflated with the perforated portion of the pipe between the packers. The spacing between the packers, corresponding to the test interval length, typically is 5 to 0 feet. Specified bedrock intervals are tested starting from the bottom of the hole and working upwards at intervals selected by the supervising geologist/engineer.

IV. Water System

The water system typically is assembled with a bypass valve and line connected to the main water line before the water meter valve. The purposes of the bypass valve are (1) to dampen the surge of water produced by the action of the pump, thus providing a relatively constant flow rate and water pressure; and (2) to allow a pressure bypass so that relatively low pressures may be applied to the tested rock interval, if appropriate. A surge suppression tank may also be plumbed into the water system before the bypass line to help dampen pump surge affects.

A water meter valve and the water meter follow the bypass valve and line. Flow to the tested rock interval passes through the water meter valve and is recorded by the water meter. The bypass and water meter valves are used simultaneously to maintain the water in the line at the desired pressure. The maximum water pressure for a particular pumping rate is achieved with the meter valve fully opened and the bypass valve fully closed. The bypass valve should be used as much as possible, however, to utilize its surge damping effect.

The remainder of the water system apparatus consists of a check valve, a relief valve and line, a water pressure gauge, and finally a length of riser pipe connecting the perforated pipe and packer assembly to the water supply apparatus. The pressure gauge indicates the water pressure in the apparatus at that location, rather than the pressure applied to the tested rock interval. The total head applied during a test consists of the gauge pressure plus the elevation head (the vertical distance between the pressure gauge and the static water level in the corehole), minus the frictional head loss between the pressure gauge and the perforated pipe where the water exits the apparatus and enters the tested rock interval. The magnitude of frictional head loss depends on the length of riser pipe used and the pumping rate, and is best determined empirically by calibrating the test assembly in the field. Alternately, frictional losses may be estimated based on hydraulics equation such as the Hazen-Williams equation (Meritt, 1983), which relates head loss to pipe geometry and flow rate.

V. Packer Test Apparatus Calibration

The frictional head loss in the riser pipe assembly should be determined in the field by a calibration process to obtain a reliable estimate of the total head applied to the test interval. The calibration is performed by pumping water through the apparatus at a constant pressure and flow rate for a specified duration, typically a few minutes. The gauge pressure, total flow volume, pumping duration, and riser pipe length are recorded, and the procedure is repeated at a different flow rate. The process is repeated at several flow rates that span the representative range of flow rates achievable by the pump.

The calibration is performed with the water system and packer apparatus laid out horizontally along the ground surface. The packer(s) remain deflated during the calibration procedure to avoid rupturing. The perforated section of pipe is supported slightly above the ground surface so that water may drain freely during pumping through the test assembly. The perforated pipe section and the pressure gauge are situated at approximately equal elevation during the calibration to eliminate the elevation head between the pressure gauge and the perforated pipe section. Because the elevation head is zero, the pressure gauge measurements obtained during calibration indicate only the frictional head loss in the pipe assembly.

The calibration process should be repeated and a separate set of gauge pressure versus pumping rate data generated for each total length of riser pipe used during actual packer testing. The calibration procedure may be performed after the appropriate riser-pipe lengths are identified by the performance of packer tests. The data of gauge pressure versus pumping rate are later plotted on a X-Y axis. A best-fit power-law regression curve is calculated for each data set to determine the mathematical relationship between pumping rate and frictional loss. During hydraulic conductivity calculation, frictional head loss for each observed flow rate is estimated from the plot of calibration data corresponding to the length of riser pipe used during the test.

VI. Test Gauge Pressure Calculation

Appropriate test pressures to be used during each of the five test increments are calculated as follows:

(1) Calculate the maximum gauge pressure, to be used during test increment #3 as:

$$P_3 \text{ (psi)} = 0.75 \times \text{Depth of Test Section Midpoint (feet)}$$

(2) Calculate the gauge pressures to be used during the other test increments as:

$P_1 = P_5 = 0.4 \times P_3$ and

$P_2 = P_4 = 0.7 \times P_3$.

VII. Packer Test Procedures

Prior to testing a given bedrock interval, the corehole identification number, the depth of the test interval, the static depth to water in the corehole, the gauge height above ground surface, and the length of riser pipe used in the apparatus are recorded on a packer test data log. After the packer(s) have been seated at the desired interval, the remainder of the test is performed as follows:

1. Open the bypass valve completely with the water meter valve closed.

2. Start the pump or open other water supply.

3. Open the meter valve slowly to allow water to flow and pressure to build. If this valve is completely opened and additional pressure is still needed, it may be obtained by slowly closing off the bypass valve, thus forcing more water through the water meter valve.

4. After the desired pressure for a desired given test increment has been achieved, record the time and volume form the totalizing water meter.

5. To perform a test increment, record the water meter reading at one minute intervals for 5 to 10 minutes of continuous pumping. Check the gauge to ensure the pressure remains constant throughout the test increment, and adjust the flow valves as needed to maintain constant pressure.

6. Adjust the valves in the water system to achieve the calculated appropriate pressure for the next test increment, and repeat steps #4 and #5 above.

7. If the appropriate test interval gauge pressure cannot be achieved due to a highly-permeable tested bedrock interval, the maximum achieved gauge pressure and the pumping rate data for the five minute test increment should be recorded.

8. The packer test for a given bedrock interval is complete after all five test increments have been performed.

9. Record the test data on the packer test data log.

VIII. Packer Test Data Reduction

Packer test data are reduced to develop estimates of hydraulic conductivity for each tested interval based on standard data reduction procedures (United States Bureau of Reclamation, 1974; Houlsby, 1976). Data are entered into an automatic packer-test data reduction spreadsheet program. The spreadsheet calculates the hydraulic conductivity from each of the five test increments for each tested bedrock interval as:

$$K = Cp\ Q/H$$

where:

K = hydraulic conductivity (feet per year);
Q = flow rate (gallons per minute);
H = total head applied during test (feet); and
Cp = packer coefficient.

Based on equations published in the Earth Manual (United States Bureau of Reclamation 1974), the packer coefficient can be calculated from:

$$Cp = [70267 \ln (L/r)] / 2\pi L$$

where:

L = length of the tested bedrock interval (feet); and
r = radius of tested bedrock corehole (feet).

In addition to the hydraulic conductivity value, the packer test reduction spreadsheet calculates a Ludgeon value (Houlsby, 1976) for each of the five test increments. The five Ludgeon values are evaluated to interpret the type of flow and bedrock formation response and most representative calculated hydraulic conductivity value for the tested bedrock interval from the following list:

(1) Laminar Flow
- Indication: Ludgeon values are approximately equal.
- Conductivity: Average of values from five test increments.

(2) Turbulent Flow
- Indication: Ludgeon value from increment #3 is less than those from the lower pressure increments, which are approximately equal in value.
- Conductivity: Value from increment #3.

(3) Dilation of Bedrock Fractures
- Indication: Ludgeon value from increment #3 is greater than those from the lower pressure increments which are approximately equal in value.
- Conductivity: Average value from increments #1 and #5.

(4) Wash-out of Fracture Filling Materials
- Indication: Progressive increase in five Ludgeon values without any return to lower values during increments #4 and #5.

Conductivity: Value from increment #1.

(5) Void Filling

Indication: Progressive decrease in five Ludgeon values without any return to values during increments #4 and #5.

Conductivity: Value from increment #5.

REFERENCES

Houlsby, A.C., 1976, Routine Interpretation of the Ludgeon Water-Test, Q. Jl. Engng. Geol. Vol. 9, pp. 303-313.

Meritt, F.S., 1983, Standard Handbook for Civil Engineers, McGraw-Hill, New York.

United States Bureau of Reclamation, 1974, Earth Manual, 2nd Edition, Department of the Interior, Denver, Colorado, pp. 573-578.

FIGURE 1
TYPICAL CONSTANT-HEAD INJECTION TEST
DATA SHEET

SITE:		ENV. CONSULTING FIRM:	
BOREHOLE NO.:		FIELD PERSONNEL:	
LOCATION:		DATE:	
		TEST NO:	
Pilot hole diameter:		Pretest water level:	
Top of test section:		Product layer thickness:	
Bottom of test section:		Reference point:	
ID of water pipe:		Elevation of reference point:	
Packer type:		Transducer type:	
Length of packer:		Transducer calibration:	
Depth to packer bottom:		Flowmeter:	
Pretest water pressure (Po):		Start reading:	
Packer inflation pressure:		End reading:	

S#	Pt	t	Q	delta Q
Step No.	Test Section Pressure (psi)	Time from Start of Test (min)	Flow Rate (gpm)	Change in Flow Rate between Readings (gpm)

GENERIC
SITE CHARACTERIZATION/IRM WORK PLAN

FOR

SITE INVESTIGATIONS

AT NON-OWNED FORMER MGP SITES

Prepared for:

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LIST OF ABBREVIATIONS AND ACRONYMS

ASP	Analytical Service Protocol
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	Benzene, toluene, ethylbenzene and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DOT	Department of Transportation
DQOs	Data Quality Objectives
DUSR	Data Usability Summary Report
EHS	Environmental Health and Safety
FOL	Field Operations Leader
FSP	Field Sampling Plan
FWIA	Fish and Wildlife Impact Analysis
IDW	Investigation Derived Waste
IRM	Interim Remedial Measure
LNAPL	Light Non-Aqueous Phase Liquid
MGP	Manufactured Gas Plant
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSDS	Material Safety Data Sheets
NAPL	Non-aqueous phase liquid
NCP	National Contingency Plan
NM	Niagara Mohawk
NMFS	National Marine Fisheries Service
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSECL	New York State Environmental Conservation Law
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SHPO	State Historic Preservation Office
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TOC	Total Organic Carbon
UFPO	Underground Facilities Protective Organization
USCS	United Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VCO	Voluntary Consent Order
VOC	Volatile Organic Compound

1.0 INTRODUCTION

This document, herein referred to as the Work Plan ("the Generic SC/IRM Work Plan") for the Niagara Mohawk, a National Grid Company, (NM) Non-owned Former Manufactured Gas Plant (MGP) Sites, was prepared by Foster Wheeler Environmental Corporation on behalf of NM. Preparation of this Generic SC/IRM Work Plan has been conducted in response to and in accordance with the requirements of the Voluntary Consent Order (VCO) between the New York State Department of Environmental Conservation (NYSDEC) and NM (Index D0-0001-0011) dated July 3, 2001. Implementation of the Generic Work Plan will meet the spirit and intent of the New York State Environmental Conservation Law (NYSECL), the VCO, NYSDEC requirements, protocols and guidance, as well as applicable Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), National Contingency Plan (NCP) and United States Environmental Protection Agency (USEPA) guidelines, as appropriate.

The Site Characterizations conducted at each Non-owned Former MGP Site will consist of an initial Site Characterization (SC) and, if required, a Remedial Investigation (RI). If MGP-impacted media is encountered during the SC and it is determined that further investigation and/or remediation is needed to allow a particular site to be used for the contemplated use, a RI work plan will be prepared and submitted. The SC may consist of a soil and groundwater investigation; test pit excavations and a baseline ground survey. The Fish and Wildlife Resource Impact Analysis (FWRIA), and a Phase 1A Cultural Resource Survey will be completed during the RI. The detailed scope of work for the Site Characterization at each Site is presented in the respective Site-Specific SC/IRM Work Plan. In developing the Site-Specific Work Plan, NM's Engineering Consultant will review the specific and unique Site conditions and evaluate the specific objectives of the Site Characterization. Modifications to this Generic Plan as determined appropriate and necessary by the Engineering Consultant, are to be included in the Site-Specific Work Plan. To the extent discrepancies exist between this Generic SC/IRM Work Plan and the Site-Specific SC/IRM Work Plan, the Site-Specific SC/IRM Work Plan shall control. Following implementation of Site Characterization field activities, an evaluation regarding the necessity for implementation of an Interim Remedial Measure (IRM) to address MGP impacts, if any, will be performed at each Site.

1.1 Non-owned Former MGP Site Locations

This Generic SC/IRM Work Plan covers the implementation of standard tasks to be conducted at each of the Non-owned Former MGP Sites. Site-Specific information, including a Site description and history for each of the Non-owned Former MGP Sites is presented in the respective Site-Specific SC/IRM Work Plans.

1.2 Objective of the Site Characterization

The following are the specific objectives for each Site Characterization/IRM:

- Evaluate whether MGP-impacted soil or groundwater are present at the Site;
- Determine the potential presence of MGP-related non-aqueous phase liquid (NAPL) in on-site soil and groundwater;
- Evaluate, to the extent practicable, whether groundwater flow may be a pathway for off-site migration of MGP consituents (if present);
- Provide sufficient data to evaluate necessary interim remedial measures.

1.3 Work Plan Organization

Section 1 of this Generic Work Plan is the Introduction, providing information on the scope of work, and objectives of the Site Characterization/IRM. Section 2 is the Work Plan Rationale, which includes the specific data requirements in order to meet project objectives. This section also discusses the Data Quality Objectives for the project. Section 3 is the scope of work for the Site Characterization/IRM and the Site Characterization/IRM Report to be prepared upon completion of the field activities. Section 4 is the schedule of the Site Characterization/IRM for each of the sites. Section 5.0 lists the references used in preparation of the report.

This Generic Work SC/IRM Plan is presented as Appendix A (Volume II) to the Site-Specific Work Plan for each Site subject to the VCO. Appendix B is the Generic Field Sampling Plan (Generic FSP) that describes the field procedures to be employed during the project. Appendix C is the Environmental Health and Safety (EHS) Plan for the Sites. (Site-specific information such as an emergency contact list, route to the hospital, etc. for each Site is contained in the respective Site-Specific SC/IRM Work Plan.) Appendix D is the Generic Quality Assurance Project Plan (Generic QAPP), which provides information on the quality assurance/quality control (QA/QC) measures to be followed during all Site Characterization efforts. Site-Specific QA/QC measures (e.g. number of QC samples to be collected) are presented in the Site-Specific SC/IRM Work Plan for each Site.

2.0 WORK PLAN RATIONALE

2.1 Approach/Basis for Data Collection

This section of the Generic Work Plan provides the basis for the field activities.

- **Evaluate whether potential sources of MGP-Impacted soil or groundwater are present at the Site;**

During preparation of the Generic Work Plan, the Engineering Consultant should review historical information (i.e. Sanborn Fire Insurance maps, abstracts-of-title, and deed etc.) as well as perform a complete records search including: MacRae's Industrial Directory, Site Plans and as-built (if any), and Department Geographic Information Systems. Additionally, the Engineering Consultant should visit the Federal, State and local government offices to evaluate adjacent property information, evaluate the possible presence of storage tanks and locate any aerial photographic surveys. The completion of the historical review will result in the identification of structures associated with the former MGP operations. A component of Site Characterization field activities will be the excavation of test pits through the subgrade former holder walls or in the vicinity of former purifier(s), or both. The test pits, if proposed in the site-specific SC/IRM work plan, will be visually examined to aid with the evaluation of the location, dimensions, and construction of the former structures and whether impacts to surrounding media are evident.

- **Determine the potential presence of MGP-related non-aqueous phase liquid (NAPL) in on-site soil and groundwater;**

Soil borings will be located on-site in a modified grid pattern to identify locations representing potential sources of MGP-impacted groundwater, if any. The grid will be modified; however, so that soil in the vicinity of former MGP structures is characterized. Monitoring wells will be installed in some of the boring locations for the collection of groundwater samples for testing and for the collection of water level measurements to ascertain groundwater flow direction. A component of field activities will include the collection of groundwater samples for chemical analysis. The data generated will be the basis for evaluating whether former structures at the Site (e.g. gas holders, purifiers) contain residuals that are impacting local groundwater. Laboratory analyses were selected based on suspected chemical constituents.

The Engineering Consultant will also collect surface soil samples at Sites that are not currently (or formerly) covered with asphalt, from a depth interval of 0 to 2 inches below ground surface (bgs). The surface soil samples will determine if constituents (PAHs) that may have been associated with former Site operations are present in on-site surface soils. Samples will also be collected at off-site locations so that background conditions may be established. These background locations must be representative of the present/former use conditions at the site. The Engineering Consultant, in consultation with NM, NYSDEC and NYSDOH, will select locations for background samples.

- **Evaluate, to the extent practicable, whether groundwater flow may be a pathway for off-site migration of MGP constituents (if present);**

Based on the location of former MGP structures as identified above, locations of groundwater wells were placed in the most logical locations utilizing information collected prior to the start of field work, to provide upgradient and downgradient data, using an assumed direction of groundwater flow. Monitoring wells will be installed, gauged, and sampled in order to verify the direc-

tion of groundwater flow and to characterize constituents in groundwater. These data will be used to assess whether groundwater flow may be a pathway for the off-site migration of chemical constituents.

- **Provide sufficient data to evaluate necessary interim or long-term remedial measures.**

The Engineering Consultant will evaluate, based on data and visual observations at each Site, whether IRMs are necessary. At the discretion of NM, and in consultation with the NYSDEC and New York State Department of Health (NYSDOH), an IRM may be initiated while Site Characterization field activities are on going.

2.2 Data Quality Objectives

The Generic FSP (Appendix B) outlines the procedures to be implemented for collection of the data. The Generic QAPP (Appendix D) specifies the appropriate analytical methodologies to be utilized for the testing of the various media and the data quality necessary to meet the objectives of the Site Characterization.

3.0 SITE CHARACTERIZATION FIELD ACTIVITIES

This section provides an overview of the field activities to be performed as part of the Site Characterization at each of the Non-owned Former MGP Sites. Further details associated with the field activities are provided in the Generic FSP (see Appendix B), the Generic HSP (see Appendix C), and the Generic QAPP (see Appendix D).

3.1 Site Reconnaissance

The purpose of the Site reconnaissance task is to verify and mark proposed sampling locations, waste storage locations, and the location for placement of the temporary decontamination pad. In addition, the Site owner or company representative will be asked to identify the location of known subsurface utilities and/or structures on the Site. Site reconnaissance activities will be attended by the NM Project Manager, Engineering Consultant's Project Manager or Field Operations Leader (FOL), and a representative from the NYSDEC and/or NYSDOH. The Site meeting will be scheduled within (10) ten days of NM establishing an access agreement with the owner or tenant of the Site, as appropriate (assuming prior approval of the Site-Specific Work Plan by NYSDEC).

3.2 Site Characterization Field Sampling Activities

Following the Site reconnaissance task, the Engineering Consultant will mobilize the necessary equipment, manpower, and materials to the Site. Notification of NYSDEC and NYSDOH will be provided (10) ten days prior to mobilization to the Site. The drilling subcontractor will set-up a temporary decontamination pad and decontaminate all subsurface sampling and downhole equipment in accordance with the Generic FSP (see Appendix B).

3.2.1 Mobilization/Utility Markout

The Engineering Consultant will coordinate with the Underground Facilities Protective Organization (UFPO), and the property owner or company representative of the Site to schedule the meeting. The Engineering Consultant, through UFPO, will contact local utility companies (i.e., telephone, gas, electric, cable, water, sewer, etc.) at least 72 hours prior to mobilization. NM will request that the property owner/company representative locate all other known on-site utilities/subsurface structures prior to mobilization. (See Appendix B, Generic FSP for details).

Following completion of these activities, the Engineering Consultant will mobilize to the Site to review the utility markouts, in relation to the approved Site-Specific Work Plan sampling locations and initiate field activities.

Proposed soil boring, monitoring well, and test pit excavation locations will be evaluated with respect to nearby (i.e. within 20 ft) overhead obstructions. The locations will also be evaluated with respect to on-site and off-site utility markouts and available engineering drawings of the Site. After proposed sampling locations have been modified, if necessary, the sampling locations will be finalized by the placement of markings on the ground surface with paint or painted stakes.

A decontamination pad will be constructed in an area approved by NM and the property owner. An area will also be established for the storage of drummed cuttings and fluids generated during the Site Characterization and for equipment and materials.

3.2.2 Surface Soil Sampling

Surface soil samples will be collected on-site to assess the near surface conditions and to determine if shallow soils have been impacted by the chemical constituents. The sample locations have been selected based on a modified grid pattern. The sampling locations will be finalized during the Site reconnaissance task. Visual evidence of near surface MGP related impacts and/or stressed vegetation, related to former MGP structures, will assist in final determination of the sample location orientation. The surface soil sampling locations are presented in the appropriate Site-Specific Work Plan (Volume I).

Surface soil samples will be collected with a stainless steel spoon from the interval 0 to 2 inches below the surface ground cover (e.g. gravel), if present. Surface soils will be screened with a PID and through visual and olfactory observation prior to collection. If surface soil samples do not contain observable impacts then the VOC analysis will not be performed, if observable impacts are identified then the soil sample will be analyzed for volatile organic compounds (VOCs) on the Target Compound List (TCL). All Samples, at a minimum, will be analyzed for semi-volatile organic compounds (SVOCs), Target Analyte List (TAL) metals, and total organic carbon (TOC). Additional details on the sampling procedure are provided in the Generic FSP (see Appendix B) and the Generic QAPP (see Appendix D).

3.2.3 Soil Boring Installation

Soil borings will be drilled for the purpose of obtaining subsurface soil samples for analytical testing, geological characterization, and for the installation of monitoring wells. Boring locations were established according to a modified grid, biased toward areas where former MGP structures were located. Soil boring locations at each Site are presented in the respective Site-Specific Work Plan. The top 5 feet at each soil boring location will be hand-dug if subsurface live utilities are suspected to be present. If subsurface live utilities are found near a boring location then the location will be reoriented and the live subsurface utility will be properly protected.

Soil borings will be advanced through the unconsolidated deposits to the top of the bedrock surface, to the first confining layer, or to a pre-determined depth (either 20 or 30 feet, as specified in the Site-Specific Work Plan) whichever is encountered first. If at this depth MGP impacts are encountered, the soil borings will be advanced deeper until there is reasonable assurance we are beyond the impact zone. Drilling methods are presented in the Generic FSP (see Appendix B).

Following the completion of the soil borings and sampling, the boreholes will be abandoned with a cement-bentonite grout or utilized for the installation monitoring wells. All soil cuttings generated during the drilling process will be stored in Department of Transportation (DOT) approved 55-gallon steel drums or roll-offs and moved to an on-site location approved by NM and the property owner. Disposal of these soils will be in accordance with applicable regulations and NYSDEC guidance.

3.2.4 Subsurface Soil Sampling

Split-spoon samples will be collected continuously from each soil boring. Split-spoon samples will be screened with field instruments and using odor and visual characteristics for residues or staining. The results will be noted in the field logbook. In addition, soil samples will be logged in accordance with ASTM D2487 (engineering purposes)/D2488 (desorption) or the Burmeister method and classified with respect to the United Soil Classification System (USCS). All soil classification data, instrument readings, and other observations will be documented in the field log-

book. Details are provided in the Generic FSP (see Appendix B) and the Generic QAPP (see Appendix D).

Soil samples will be collected at predetermined depth intervals (see Site-Specific Work Plan) from each boring and sent to the laboratory for chemical testing. Soil samples will be analyzed for benzene, toluene, ethylbenzene and xylene (BTEX); polycyclic aromatic hydrocarbons (PAHs); and total cyanide. In addition, one sample will be collected from each boring and submitted for TOC analysis and (10%) ten percent of all subsurface soils will be analyzed for TCL/TAL parameters. Certain soil samples will also be analyzed for polychlorinated biphenyls (PCBs) where historical electrical equipment was suspected to have been located. Additional details are provided in the Generic FSP (see Appendix B), and the Generic QAPP (see Appendix D).

3.2.5 Test Pit Excavations

Test pits will be excavated in former MGP structures or across subgrade holder walls with a backhoe or mini-excavator. Surface cover (e.g. gravel) will be stockpiled on plastic for use following completion of the excavation. Excavated soil will be placed on plastic on the ground surface. Test pits will be advanced to a maximum depth of 12-ft bgs, to the top of the bedrock surface, or to the water table, whichever is encountered first. Each location will be logged and the information recorded in the field logbook.

If prescribed in the Site-Specific Work Plan, soil samples may be collected from an impacted interval. The sampling interval will be selected based on field screening techniques. The soil samples will be analyzed for BTEX, PAHs, and Total Cyanide. Additional details regarding test pit excavation are presented in the Generic FSP (see Appendix B).

3.2.6 Monitoring Well Installation

Monitoring wells will be installed at each Site. Groundwater data collected from the wells will be evaluated with respect to up- and downgradient water quality at the Site, groundwater flow direction, and impact to groundwater, if any. Monitoring well locations at each Site are presented in the respective Site-Specific Work Plan.

The procedures for drilling and sampling at each monitoring well location are described in Sections 3.2.3 and 3.2.4. Details of these procedures are provided in the Generic FSP (see Appendix B). Following the advancement of the borehole to a target depth of 30-ft. bgs, a monitoring well will be installed straddling the water table. If the top of the bedrock surface is encountered prior to encountering the water table, a monitoring well will not be installed. The well construction will consist of 2-inch diameter Schedule 40, slot screen surrounded by an appropriate size sand pack with a bentonite pellet layer on top. The PVC riser will consist of flush joint connections surrounded by a cement-bentonite grout. The screen length and slot size will be selected in the field based on aquifer thickness and geology. The well will be completed with a flushmount roadbox or stickup protective pipe surrounded by a concrete collar at the surface. The well will also have a locking well cap. Monitoring wells will be developed no sooner than 24 hours after installation is complete. The wells will be developed by the surge and evacuate method in accordance with New York State TAGM-HWR-88-4008 (NYSDEC, 1988). Further details on well construction, installation and development are provided in the Generic FSP (see Appendix B) and the Generic QAPP (see Appendix D).

3.2.7 Groundwater Sampling

Two rounds of groundwater samples will be collected from monitoring wells installed during Site Investigation. Methodologies for monitoring well development and groundwater sampling are described in the Generic FSP (see Appendix B).

3.2.8 Groundwater Level Measurements

As a component of groundwater sampling, water level measurements will be collected from each well with an oil/water interface probe. The presence of light non-aqueous phase liquid (LNAPL) and/or a dense non-aqueous phase liquid (DNAPL), if any, will be noted in the field logbook along with a water level measurement. If LNAPL or DNAPL is encountered, a sample may be collected for analysis. Methodology for groundwater level monitoring is presented in the Generic FSP (see Appendix B).

3.2.9 Analytical Program

Laboratory analyses will be conducted in accordance with NYSDEC Analytical Service Protocol (ASP) protocols. Modification and/or use of other testing protocols will be considered, if ASP protocols are not available/applicable. Laboratory analyses will be performed by a NYSDOH approved laboratory.

The individual analyses for each medium to be sampled are discussed above and in the Generic FSP (see Appendix B). Details of the analytical program, including methodologies, containers, and holding times are discussed in the Generic QAPP (see Appendix D).

Data Quality Objectives

The results of the Site Characterization will undergo a detailed review by NYSDEC as well as NM. To support this review, laboratory analyses will be conducted in accordance with NYSDEC ASP protocols and Category B deliverables in accordance with the Data Quality Objectives (DQOs) outlined in the Generic QAPP (see Appendix D). As part of the ASP analyses, the laboratory will generate analytical packages for the Engineering Consultant.

Quality Assurance/Quality Control (QA/QC)

Quality assurance measures for maintaining the quality of laboratory samples collected during field sampling are described in the Generic FSP (Appendix B) and the Generic QAPP (Appendix D).

The analytical data generated from the field activities will be validated in accordance with NYSDEC and USEPA guidance. Data Usability Summary Report (DUSR) will be prepared following completion of the data validation task. Details regarding the data validation are provided in the Generic QAPP (Appendix D).

3.2.10 Waste Management

Investigation derived wastes (IDW) will be generated during implementation of the Site Characterization investigation. These will include soil cuttings, purge water, decontamination fluids, plastic, asphalt/concrete, and personal protective equipment (PPE). These wastes will be containerized and properly labeled in DOT approved 55-gallon steel drums, roll-off containers and/or polypropylene agricultural tanks. The drums will be properly stored at a designated on-site area identified by NM and the property owner. NM will properly dispose of these IDW. Further details are provided in the Generic FSP (Appendix B).

3.3 Baseline Ground Survey

Following the completion of the field activities, the Engineering Consultant will coordinate surveying activities with a surveying subcontractor. All Sampling locations will be surveyed and placed on a Site base map prepared by the surveying subcontractor. Survey data will be provided to the Engineering Consultant within three weeks of the completion of the Site Characterization field activities. Additional discussion of the survey is provided in the Generic FSP (see Appendix B).

3.4 IRM Evaluation

The Engineering Consultant will evaluate whether, based on the current conditions at the Site, an IRM is necessary. An evaluation of IRM alternatives will be performed if an imminent threat to human health and/or to the environment exists based on the data generated in the Site Characterization. An IRM may also be performed at the desecration of Niagara Mohawk if localized MGP-related LNAPL or DNAPL is encountered during field activities and if it appears that removal of such material may facilitate natural attenuation of residual soil and groundwater, reduce the overall project schedule, or reduce the extent of field activities ultimately necessary at the Site.

3.5 Draft Site Characterization/IRM Report

The results of the SC/IRM report will first be submitted to the NYSDEC in a data report format. If it is determined that no MGP-impacted media is present and further investigation and/or remediation is not, a draft Site Characterization/IRM Report (Report) will be prepared and submitted to the NYSDEC. If additional investigation is required, a RI work plan will be submitted to NYSDEC. As the onsite effort for the SC investigation is substantial, the primary focus of any additional investigation would be offsite. The RI work plan will consist of a scope of work and will incorporate the generic QAPP, FSP and EHS Plans.

If a SC/IRM report will be submitted, it will contain the following:

- Site Conditions;
- Site History;
- A detailed and comprehensive description of all tasks completed;
- Results of the Site Characterizationfield activities, analytical testing program and IRM evaluation;
- Conclusions;
- Recommendations for No Further Action at the Site, additional investigation (if necessary) or any recommneded Interim Remedial Measure IRM efforts; and
- Certification that the Site Characterization was performed in accordance with this NYSDEC-approved Site-Specific Work Plan.

Figure 3-1 presents a preliminary table of contents for the draft Report.

Figure 3-1

Draft Site Characterization/IRM Report
Example Table Of Contents

1.0 EXECUTIVE SUMMARY
- 1.1 Site Background
- 1.2 Site Assessment
  - 1.2.1 Project Objectives
  - 1.2.2 Soil Investigation Results
  - 1.2.3 Groundwater Investigation Results
  - 1.2.4 Sediment/Surface Water Investigation Results
- 1.3 Interim Remedial Measure Evaluation
- 1.4 Recommendations

2.0 INTRODUCTION
- 2.1 Purpose and Project Objectives of Site Investigation
- 2.2 Site Location and Description
- 2.3 Site History
  - 2.3.1 Records Identified and Located
- 2.4 Background
- 2.5 Regional Setting
  - 2.5.1 Regional Geology
  - 2.5.2 Regional Hydrogeology
  - 2.5.3 Groundwater Usage In Site Vicinity
  - 2.5.4 Soils
- 2.6 Site Characterization/IRM Report Organization

3.0 SCOPE OF WORK
- 3.1 Introduction
- 3.2 Field Investigation
  - 3.2.1 Field Mobilization
  - 3.2.2 Surface Soil Sampling/Analysis
  - 3.2.3 Soil Boring Drilling and Sampling/Analysis
  - 3.2.4 Monitoring Well Installation and Development
  - 3.2.5 Test Pit Excavations and Sampling/Analysis
  - 3.2.6 Surface Water/Sediment Sampling/Analysis
  - 3.2.7 Groundwater Sampling/Analysis
  - 3.2.8 Groundwater Level Measurements
  - 3.2.9 Visual Inspection of Structures
  - 3.2.10 Surveying
  - 3.2.11 Waste Management

Figure 3-1 (Cont'd)

Draft Site Investigation/IRM Report
Example Table Of Contents

4.0 SITE CHARACTERIZATIONRESULTS
- 4.1 Site Topography
- 4.2 Site Investigation
  - 4.2.1 Surface Water
  - 4.2.2 Geology
  - 4.2.3 Groundwater Hydrogeology
- 4.3 Site Conceptual Model

6.0 CONCLUSIONS AND RECOMMENDATIONS
- 6.1 Conclusions
- 6.2 Recommendations

APPENDICES
- A Soil Boring Logs
- B Monitoring Well Construction Details
- C Test Pit Excavation Logs
- D Surveying Data
- E Analytical Data

4.0 SCHEDULE

The schedule for implementation of each of the Site Characterization at the Non-owned Former MGP Sites is presented in the Site-Specific Work Plans. The field activities will commence following execution of any required property access agreements and procurement of an environmental/engineering consultant to implement the Site-Specific Work Plan.

5.0 REFERENCES

NYSDEC, 1988. Technical and Administrative Guidance Memorandum #4008 – Phase II Investigation Oversight Guidance New York State Department of Environmental Conservation, May 9, 1988.

APPENDIX K

RESPONSIBILITIES OF OWNER AND REMEDIAL PARTY

APPENDIX K

RESPONSIBILITIES OF SITE OWNER, REMEDIAL PARTY AND OFF-SITE-OWNER

Responsibilities

The responsibilities for implementing the Interim Site Management Plan ("ISMP") for the Patchogue Former MGP Site (the "Site"), Site #1-52-182, and the 234 West Main Street Property (the "Off-Site Property) are divided between the Site owner(s) and a Remedial Party (also known as the Respondent), as defined below. The owner(s) is/are currently listed as: (the "owner").

Site: KeySpan Gas East Corporation d/b/a National Grid (a predecessor company of National Grid), 175 East Old Country Road, Hicksville, New York 11801

Off-Site Property: 210 West Main Realty Corp., 50 Gilpin Avenue, Hauppauge, New York 11788

Solely for the purposes of this document and based upon the facts related to a particular site and the remedial program being carried out**,** the term Remedial Party ("RP"), also referenced herein as the Respondent, currently refers to National Grid. The RP (Respondent) is:

National Grid Contact:

Sarah Aldridge
175 East Old Country Road
Hicksville, New York 11801
(516) 545-2568

Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the Site.

Site Owner's Responsibilities:

The Site owner is currently National Grid who is also the RP/Respondent. National Grid maintains the following responsibilities. In a future scenario in which National Grid sells the property and is no longer the Site owner, the future Site owner will be responsible for the following:

1) The owner shall follow the provisions of the ISMP as they relate to future construction and excavation at the Site.

2) In accordance with a periodic time frame determined by the NYSDEC, the owner shall periodically certify, in writing, that Institutional Controls set forth in an Environmental Easement remain in place and continue to be complied with. The owner shall provide a written certification to the RP, upon the RP's request, in order to allow the RP to include the certification in the Site's PRR certification to the NYSDEC.

3) In the event the Site is delisted, the owner remains bound by the Environmental Easement and shall submit, upon request by the NYSDEC, a written certification that the Environmental Easement is still in place and has been complied with.

4) The owner shall grant access to the Site to the RP and the NYSDEC and its agents for the purposes of performing activities required under the ISMP and assuring compliance with the ISMP.

5) The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. In the event that damage to the remedial components or vandalism is evident, the owner shall notify the Site's RP and the NYSDEC in accordance with the timeframes indicated in Section 1.3 - Notifications.

6) In the event some action or inaction by the owner adversely impacts the Site, the owner must notify the Site's RP and the NYSDEC in accordance with the time frame indicated in 1.3 - Notifications and (ii) coordinate the performance of necessary corrective actions with the RP.

7) The owner must notify the RP and the NYSDEC of any change in ownership of the Site property (identifying the tax map numbers in any correspondence) and provide contact information for the new owner of the Site property. 6 NYCRR Part contains notification requirements applicable to any construction or activity changes and changes in ownership. Among the notification requirements is the following: Sixty days prior written notification must be made to the NYSDEC. Notification is to be submitted to the NYSDEC Division of Environmental Remediation's Site Control Section. Notification requirements for a change in use are detailed in Section 1.3 of the ISMP. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html.

Off-Site Property Owner's Responsibilities:

1) The owner of the Off-Site Property will responsible to notify the RP/Respondent (National Grid) within the established time frames documented in this ISMP of plans for the performance of invasive activities in areas of the Off-Site Property that may encounter known or potential contaminated soils and/or groundwater.

2) The owner of the Off-Site Property shall grant access to the Off-Site Property to the RP/Respondent (National Grid) and its agents for the purposes of performing activities required under the ISMP, including groundwater monitoring activities, and assuring compliance with the ISMP.

2) The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. In the event that damage to the remedial components or vandalism is evident, the owner shall notify National Grid in accordance with the timeframes indicated in Section 1.3.1 - Notifications.

3) In the event some action or inaction by the owner adversely impacts the Off-Site Property, the owner must notify the RP/Respondent (National Grid) in accordance with the time frames indicated in Section 1.3.1 - Notifications and (ii) coordinate the performance of necessary corrective actions with National Grid.

4) The owner must notify National Grid of any change in ownership of the Off-Site Property (identifying the tax map numbers in any correspondence) and provide contact information for the new owner of the Off-Site Property.

Remedial Party Responsibilities

1) The RP must follow the ISMP provisions regarding any construction and/or excavation it undertakes at the Site.

2) The RP shall report to the NYSDEC activities required for remediation, operation, maintenance, monitoring, and reporting. Such reporting includes, but is not limited to, periodic review reports and certifications, electronic data deliverables, corrective action work plans and reports, and updated ISMPs.

3) Before accessing the Site property to undertake a specific activity, the RP shall provide the owner advance notification that shall include an explanation of the work expected to be completed. The RP shall provide to (i) the owner, upon the owner's request, (ii) the NYSDEC, and (iii) other entities, if required by the ISMP, a copy of any data generated during the Site visit and/or any final report produced.

4) If the NYSDEC determines that an update of the ISMP is necessary, the RP shall update the ISMP and obtain final approval from the NYSDEC. Within 5 business days after NYSDEC approval, the RP shall submit a copy of the approved ISMP to the owner(s).

5) The RP shall notify the NYSDEC and the owner of any changes in RP ownership and/or control and of any changes in the party/entity responsible for the operation, maintenance, and monitoring of and reporting with respect to any remedial system (Engineering Controls). The RP shall provide contact information for the new party/entity. Such activity constitutes a Change of Use pursuant to 375-1.11(d) and requires 60-days prior notice to the NYSDEC. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html .

6) The RP shall notify the NYSDEC of any damage to or modification of the systems as required under Section 1.3- Notifications of the ISMP.

7) Prior to a change in use that impacts the remedial system or requirements and/or responsibilities for implementing the ISMP, the RP shall submit to the NYSDEC for approval an amended ISMP.

8) Any change in use, change in ownership, change in Site classification (*e.g.*, delisting), reduction or expansion of remediation, and other significant changes related to the Site may result in a change in responsibilities and, therefore, necessitate an update to the ISMP and/or updated legal documents. The RP shall contact the NYSDEC to discuss the need to update such documents.

Change in RP ownership and/or control and/or Site ownership does not affect the RP's obligations with respect to the Site unless a legally binding document executed by the NYSDEC releases the RP of its obligations.

Future Site owners and RPs and their successors and assigns are required to carry out the activities set forth above.

APPENDIX L

PERMITS AND/OR PERMIT EQUIVALENT

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PERMITS AND/OR PERMIT EQUIVALENT

All permits required for the implementation of the remedy, post-remedial monitoring as well as compliance with this ISMP will be obtained by National Grid. The following summarizes the Federal, State and Local permits that relate to the implementation of the remedy at the Site/Off-Site Property .

Federal Permits

According to Part II, Chapter 210 (Flood Damage Prevention), Article V, section 210-14 C(2), on streams with a regulatory floodway, as shown on the Flood Boundary and Floodway Map or the Flood Insurance Rate Map adopted in § 210-6, no new construction, substantial improvements or other development in the floodway (including fill) shall be permitted unless a technical evaluation by a licensed professional engineer shows that such an encroachment shall not result in any increase in flood levels during occurrence of the base flood. The remedial activities will be designed such that no additional fill will be added to the Site and the excavation areas will be returned to pre-remedial grades thus there is no loss of flood plain area and an increase in flood levels during occurrence of the base flood would not be anticipated.

Other federal permits are not anticipated to be required for the pre-remedial design or remedy implementation. Should other permits be required, they will be obtained by National Grid, as necessary.

State Permits

Since the remedial activities at the Site and the Off-Site Property are being performed under Order on Consent D1-001-99-05 signed by KeySpan (d.b.a., National Grid) and the NYSDEC September 30, 1999, state permits will generally not be required unless dewatering activities are deemed necessary to complete the remedial activities. If

dewatering activities are required, then a State Pollutant Discharge Elimination System (SPDES) permit will be necessary for discharge of the water to the Patchogue River.

In accordance with 6 NYCRR 375-1, NYSDEC-issued permits are not required for any other activities associated with pre-remedial design or remedy implementation. Rather, the remedial measures are evaluated and implemented based on the substantive elements of the applicable and relevant and appropriate state environmental laws and regulations.

Local Permits

As per 6 NYCRR 375-1.7c, no permits, consents, approvals or other authorizations are required under any local zoning, land use or other regulatory program to implement the remedy. However, consultation with local officials and other stakeholders will occur prior to completion of the final design.

Although permits may not be required to be obtained, the project will be discussed with the local regulators to ensure a seamless implementation. The Remedial Contractor will be responsible to conduct all remedial activities in accordance with the substantive requirements of the local regulations. Construction activities will have to be performed with applicable Patchogue codes and regulations including the development of trucking routes, consistency with noise ordinances and observation of potential road or street closures that may be necessary for work conducted adjacent to West Main Street.