PRELIMINARY SITE ASSESSMENT REPORT

FOR

TWO FORMER MANUFACTURED GAS PLANT SITES, HAVERSTRAW, NEW YORK

Prepared For:

ORANGE and ROCKLAND UTILITIES, INC.
One Blue Hill Plaza
Pearl River, New York 10965

Prepared By:

REMEDIATION TECHNOLOGIES, INC.
1001 West Seneca Street
Ithaca, New York 14850

RETEC Project No. 3-2632-400

August 26, 1997

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Prepared By: James Edwards/gsb

Reviewed By: Bruce Coulombe

August 26, 1997

EXECUTIVE SUMMARY

Remediation Technologies, Inc. (RETEC) conducted a preliminary site assessment (PSA) at two former manufactured gas plant sites in the Village of Haverstraw, Rockland County, New York. Gas production in Haverstraw was initially at the Maple and West site around 1859, and switching to the nearby Clove and Maple site in about 1893. Gas production ended in 1935. Both sites were investigated during the PSA. The objectives of the PSA were to:

- identify the nature and extent of constituents of interest (COI);
- determine if COI identified at the sites constitute a significant threat to human health or the environment; and
- whether interim remedial measures may be appropriate at the sites.

The PSA included soil gas field screening and laboratory analysis, surface soil analysis, Geoprobe borings in historic MGP structures, field and laboratory testing of subsurface soil samples, monitoring well installation, groundwater sampling, hydraulic conductivity testing and a site survey.

RETEC performed a review of the results of the laboratory analyses of soil gas, soil, groundwater and DNAPL samples taken during the PSA. Based on the review, all data generated, and all quality control operations completed by the laboratory during the analyses was found to be acceptable. No data was found to be unusable.

Clove and Maple

This site is located between Clove and Maple Avenues. The site is approximately 1 acre in size and is located in an urban setting zoned for light industrial use. The site is bordered by two residential properties to the north, by an unoccupied manufacturing facility to the south, by Clove Avenue and residential property to the west and by Maple Avenue and an apartment building complex to the east.

The site is currently owned by Orange and Rockland Utilities, Inc. The site currently serves as a regulator station for active natural gas lines. The majority of the site is covered by grass or is wooded. Surface water run-off is controlled by a gully on the northern section of the site and then by a series of catch basins in Maple Ave. The Hudson River is approximately 1000 feet to the southeast.

The depth to water across the site varies from 20 feet below ground surface to 6 feet along the eastern edge of the site. The groundwater flow direction is from west to east with a very slight gradient.

Elevated PAH concentrations (above NYSDEC TAGM Cleanup Objectives) in surface soils were found at nine sample locations, with the greatest concentrations found near a former MGP building currently adjacent to the regulator. Elevated levels (above NYSDEC TAGM background ranges) of arsenic, copper, mercury, nickel, selenium and zinc in surface soil samples were detected at the site. Elevated BTEX and PAH concentrations and stringers of hydrocarbon product were observed in saturated subsurface soils along the eastern section of the site. Concentrations of BTEX and PAH compounds were elevated (above NYSDEC groundwater standards) in samples from wells downgradient of the former gas holder foundation and the former oil tank location.

A two foot thick layer of DNAPL was found in a monitoring well installed downgradient of the former oil tank. A sample of the DNAPL material exceeded the hazardous waste characteristic limits for benzene, arsenic and selenium. The DNAPL has a low viscosity and therefore has the potential to migrate in the environment.

A small area of surface soil was found to be impacted with PAH compounds. This area has been covered with gravel to prevent contact with persons who may visit the site. This work was done in conjunction with an extensive surface soil sampling event to further define the distribution of metals and PAH COI at the site. The results of the detailed surface sampling were used to prepare a quantitative risk assessment. Utility workers, grounds keepers, recreational users, and local residents were identified as potential receptors. Although MGP constituents are present at the site, the frequency and duration of exposure for most potential receptors was found to be low. Potential risk to downgradient receptors of groundwater COI was not found to be significant. No impact to the village water supply is possible due to its upgradient and distant location.

Additional investigative work recommended includes an assessment of groundwater conditions downgradient of the impacted groundwater and DNAPL, additional testing to delineate the extent of the DNAPL found in MW2 and further delineation of impacts found in the former tar well location.

Maple and West

The former West and Maple MGP site is currently owned by Mr. William Confrey. The site is a landlocked property with no street frontage. The site is bounded by two residential properties to the north, by a commercial property (construction business office and storage garage) to the south, by an alley to the east, and by a residential property to the west. The site is currently unoccupied and, until recently, was covered with refuse and debris from a scrap processing business.

Elevated concentrations of seven PAH compounds and six TAL metals were detected in surface soil samples taken for the site. Trace amounts of a visible hydrocarbon product, elevated BTEX and PAH compounds were found in a subsurface soil sample taken in the southeastern area of the site. Groundwater was found to contain benzene and cyanide in concentrations greater than the New York State standards. Trace amounts of PAHs were found in groundwater in concentrations greater than the NYSDEC guidance values.

An evaluation of potential receptors of COI in surface soil at the site include site visitors, local residents, utility workers and future occupants. With the exception of future occupants, risks to potential receptors is low due to incomplete exposure pathways and anticipated short exposure times. Potential risk to downgradient receptors of groundwater COI was not found to be significant. No impact to the village water supply is possible due to its upgradient and distant location.

Additional work recommended for the site includes additional borings and wells to further define the extent of soil and groundwater impacts within, and downgradient of the site. Hydrocarbon characterization analysis of soil samples is recommended to identify the source of hydrocarbons present at the site.

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1.0 INTRODUCTION

1.1 Statement of Purpose

This Preliminary Site Assessment (PSA) Report has been prepared for Orange and Rockland Utilities, Inc. (O&R) by Remediation Technologies, Inc. (RETEC) to document an investigation conducted at two former manufactured gas plant (MGP) sites in Haverstraw, New York. Gas production occurred at two locations in Haverstraw: initially at the Maple and West site and finally at the Clove and Maple site. Each site was investigated during the PSA. The investigation was conducted in accordance with the New York State Department of Environmental Conservation (NYSDEC) Order on Consent #D3-0002-9412 which requires O&R to investigate the sites.

The purpose of the PSA Investigation was to collect sufficient environmental data to facilitate an evaluation of the following:

- the nature and extent of constituents of interest (COI) which may be present at the sites;
- whether constituents identified at the sites constitute a significant threat to human health or the environment; and
- whether interim remedial measures (IRMs) may be appropriate to mitigate an ongoing impact or migration of MGP residuals.

This investigation was carried out in accordance with the most recent and applicable guidelines of the NYSDEC, USEPA as well as the National Contingency Plan (NCP). The detailed scope of work for this PSA investigation is documented in the PSA Work Plan for Suffern, Middletown and Haverstraw, New York Former Manufactured Gas Plant Sites (RETEC, 1997a). Two separate companion documents were developed to support the field effort: a Quality Assurance Project Plan (QAPP) (RETEC, 1997b) which specifies procedures for data collection and quality control in the field and in the laboratory, and a site-specific Health and Safety Plan (HASP) (RETEC, 1997c) which contains the necessary procedures and information which were followed during the PSA to protect the health and safety of the field personnel and the public.

1.2 Scope of Work

The scope of work for this investigation, as defined in the NYSDEC approved work plan, or added to the scope of work in the field, contained the following elements:

- collection of surface soil samples;
- soil gas sampling;
- soil borings and collection of subsurface soil samples;
- installation of shallow (water table) monitoring wells;
- collection of groundwater samples;
- hydraulic conductivity testing; and
- test pit excavation.

1.3 Report Organization

This PSA Report is organized into eight sections and appendices as follows:

- Section 2.0 presents site background information including a site description and site history.
- Section 3.0 describes the field procedures used to collect the environmental data at the Maple and West site.
- Section 4.0 describes the field procedures used to collect the environmental data at the Clove and Maple site.
- Section 5.0 provides a summary of the regional and local geology and field observations made at the sites.
- Section 6.0 presents a summary of analytical results for soil gas, soil and groundwater for the Maple and West site.
- Section 7.0 presents a summary of analytical results for soil gas, soil, groundwater and dense non-aqueous phase liquid (DNAPL) for the Clove and Maple site.
- Section 8.0 discusses the data validation results;

- Section 9.0 presents an evaluation of the risk associated with MGP constituents, pathways, and receptors found at the sites;

- Section 10.0 presents a summary and evaluation of the environmental findings; and

- Section 11.0 provides a list of references cited in this report.

Boring and well completion logs are attached as Appendix A and B. The laboratory data package is gathered under a separate cover as Appendix C.

2.0 HAVERSTRAW GAS PLANT SITES

According to historical records, there are two parcels which were involved in the production of gas in Haverstraw. Both the Haverstraw Gas Plant Site, located between Clove and Maple Avenues (Clove and Maple site), and a predecessor site located between Maple Avenue and West Street (Maple and West site) were investigated during the PSA. No previous investigations have been conducted for these sites. The location of both sites is shown on Figure 2-1.

2.1 Site Description

2.1.1 Clove and Maple Site

The primary site of gas production in Haverstraw was located between Clove and Maple Avenues in the Village of Haverstraw, Rockland County, New York as shown in Figure 2-1. The site is a rectangular shaped parcel comprised of Section 27.62 Block 1 Lot # 9. The site is currently owned by O&R and has active natural gas lines and regulators on the property. The site is currently unoccupied and consists of a mowed grass area and a hedgerow of trees along Maple Avenue. A gully follows the northern boundary of the site which intermittently carries storm water to a storm sewer culvert under Maple Avenue. Figure 2-2 presents the site plan and the layout of the historical MGP structures. The area is zoned as light industrial.

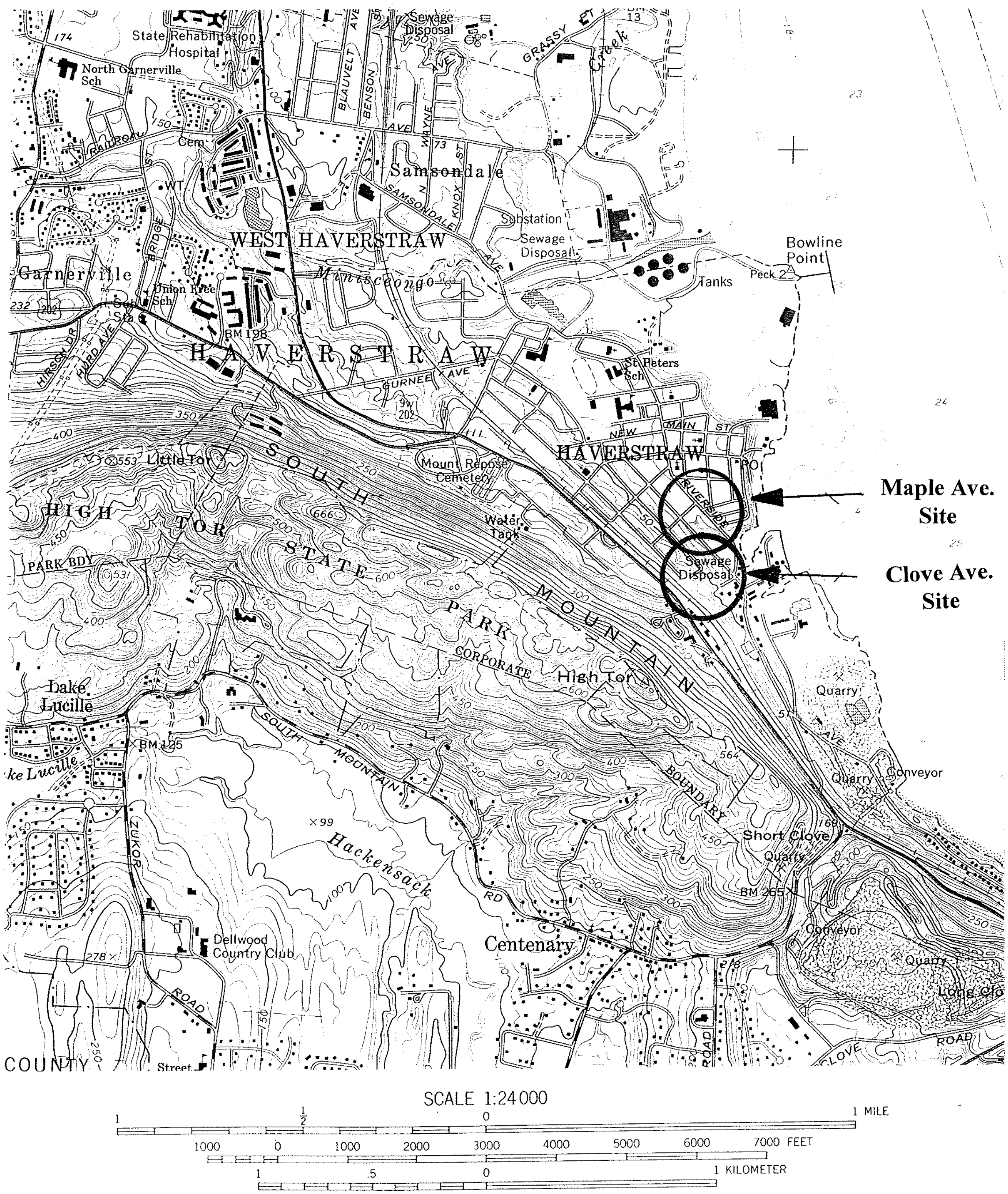
The properties which are adjacent to the site and their respective tax map numbers are:

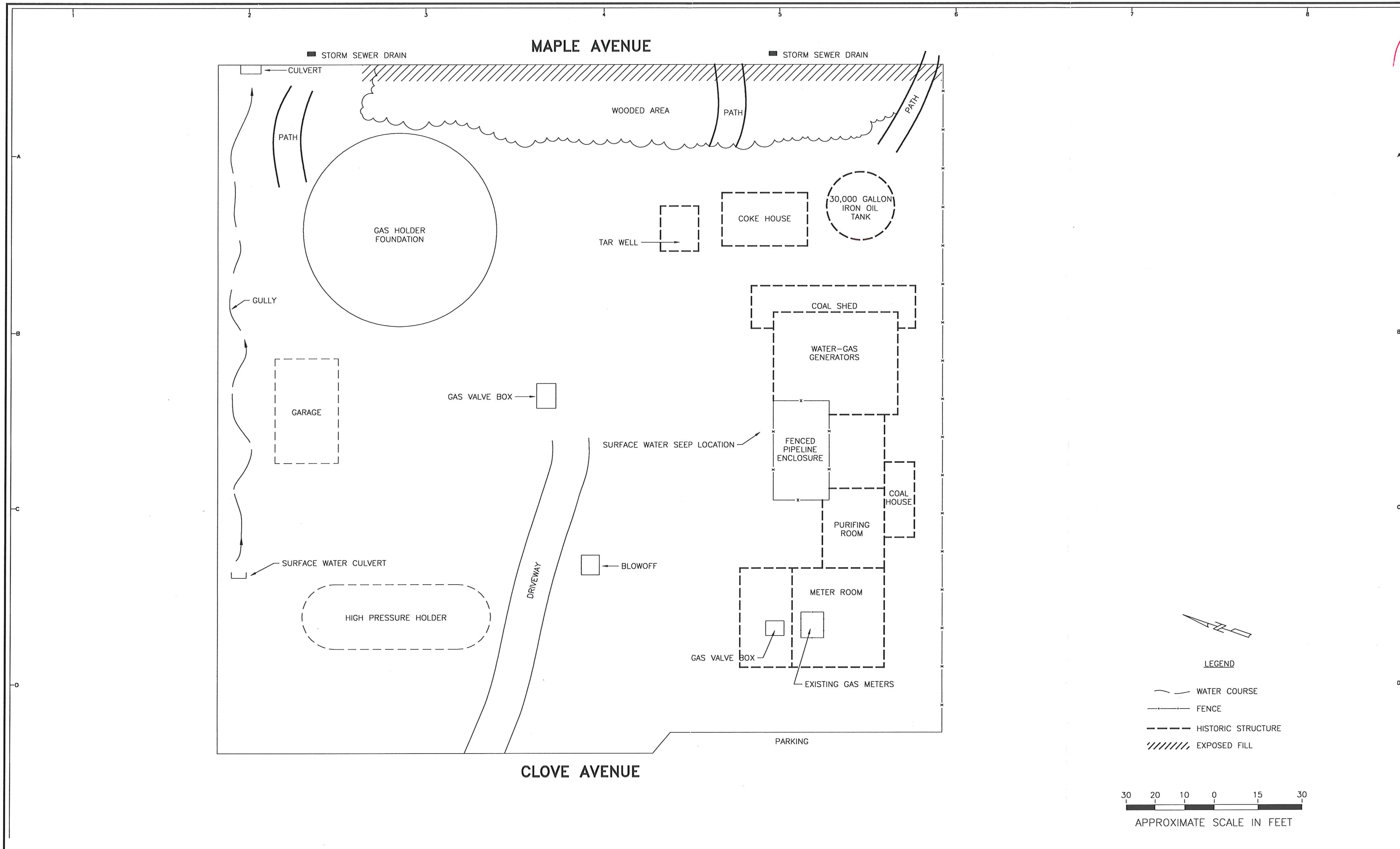
- To the north are two residential properties (Lots 8 and 44).
- To the east is Maple Avenue then a residential apartment complex (Lot 17.4).
- To the west is Clove Avenue then residential property (Lots 27 to 33).
- To the south is property owned by Navin Realty Co. (the site of the former Doig Nail Corporation) and is currently unoccupied (Lot 10).

2.1.2 Maple and West Site

A small parcel which was used for gas production prior to development of the Clove and Maple site is located between Maple Avenue and West Street and is located approximately 150 feet to the north of the Clove and Maple Gas Plant Site as shown on Figure 2-1. The site is a rectangular

Figure 2-1
Haverstraw Site Location Map





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CURRENT DATE: 08/06/97 CAD FILE SITE

SITE PLAN

CLOVE AND MAPLE AVE SITE
HAVERSTRAW, NEW YORK

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 2-2 REV. 0

shaped parcel with dimensions of approximately 60 by 85 feet which is comprised of Section Lot # 78. The site has no street frontage, though it can be accessed by a village-owned alley which connects to Tor Avenue and by a driveway from Maple Avenue. The site is bounded by a driveway and concrete block building on the south, the alley to the northeast, and by residential property to the north and west. A 52 inch storm sewer culvert runs beneath the alley on the east side of the site and carries what was once an open channel stream. This culvert drains to the southeast and is presumed to discharge to the Hudson River. Prior to the start of the PSA, the site was covered with refuse piles, abandoned vehicles and some stored construction materials. These materials have since been removed from the site. Figure 2-3 presents the site plan, the layout of the historical MGP structures, and the tax map numbers of the adjacent properties.

2.2 Site History

2.2.1 Clove and Maple Site

A chronological history of the Haverstraw Gas Plant site is as follows:

- The first listing for the Haverstraw Gas Plant site is in the Brown's Directory for 1893 citing gas production utilizing a carburetted water gas method.
- A 1896 Sanborn map shows a gas plant at the site with a 50,000 cubic foot gas holder, a 30,000 gallon oil tank and a coke shed.
- A 1921 Sanborn map shows that the coke storage shed was removed. A 1921 plant utility drawing shows a tar well located between the holder and the oil tank as shown in Figure 2-2 (Peck, 1921).
- A 1931 Sanborn map shows that a coal shed was added to the east end of the plant building.
- According to the Brown's Directory, natural gas was distributed as of July 1, 1935 in place of manufactured gas.
- According to O&R's records, the gas plant structures were demolished in the 1960s.

Table 2-1 presents a summary of the site ownership records for the Clove and Maple site.

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CURRENT DATE: 08/06/97 CAD FILE FIG3-1

SITE PLAN
MAPLE AND WEST SITE

HAVERSTRAW, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 2-3 REV. 0

Table 2-1
Site Ownership Information
Former Clove and Maple MGP Site, Haverstraw, New York

Property Owner	Years	Comments
Ira M. Hedges and wife	note 1-1894	Deed recorded May 23, 1884
Haverstraw Light and Fuel Gas Company	1894-1905	Deed recorded April 5, 1905, in Liber 219 at page 249
Charles M. Jesup	1905-1906	The West Shore Gas Company filed a Certificate of Incorporation on Dec. 19, 1905
Henry J. White	1906-1906	Deed recorded July 26, 1906
West Shore Gas Company	1906-1935	Deed recorded October 29, 1935
Rockland Gas Company, Incorporated	1935-1953	
Rockland Light and Power Co.	1953-1954	
Orange and Rockland Utilities Inc.	1954-present	

Note (1) - transaction date not available

This site ownership history is based on a combination of sources and is for general information purposes only. It should not be used for legal purposes without further verification.

2.2.2 Maple and West Site

A chronological history of the Maple and West MGP site is as follows:

- The plant was constructed and began initial operation by at least 1859.
- A New Historical Atlas of Rockland County (1876) and a 1884 lithograph show the presence of a gas plant and gas holder. The plant is located on the northeast side of the site along a railroad line, and the holder is located along a stream at the southwest side of the site.
- A reference to a gas plant at the site is included on a 1887 Sanborn map, though the site itself is not mapped.
- The 1887 to 1891 Brown's Directory lists oil gas production for Haverstraw.
- The site was acquired by the Haverstraw Light and Fuel Company in 1894.

- The plant was likely shut down in 1893 or 1894 when the first reference to carburetted water gas production in noted in the Brown's Directory.

Table 2-2 presents a summary of the site ownership records for the Maple and West site.

Table 2-2
Site Ownership Information
Former Maple and West MGP Site, Haverstraw, New York

Property Owner	Years	Comments
Edward Pye	(Note 1)-1859	Deed recorded March 13, 1860.
E.V. Haughwout	1859-1860	Warren Gas Light Company Incorporates on November 9, 1859.
Warren Gas Light Company	1860-1871	Deed recorded April 5, 1860, in Liber 37 at page 267.
Nyack and Warren Gas Light Company	1871-1893	Nyack and Warren Gas Light Company Incorporates on July 4, 1871. Adjacent property of Clarence R. Conger added on June 10, 1886.
Andrew Murray and wife	1893-1895	The Haverstraw Light and Fuel Gas Company filed a Certificate of Incorporation on May 4, 1894.
John H. Seeds	1895-1905	Transaction to satisfy a mortgage held by the National Bank of Haverstraw.
Charles M. Jesup	1905- 1906	West Shore Gas Company filed a Certificate of Incorporation on December 19, 1905.
Henry J. White	1906-1909	Deed recorded Jan. 21, 1909.
Hallmuth Moerchen	1909-note 1	End of gas company ownership of property, various individual owners follow.
Michael Friscoe	1929-1996	Scrap processing business operated on the property.
County of Rockland	1996-1997	Property taken for back taxes.
William Confrey	1997 - present	Property sold at tax sale.

(Note 1) - transaction date not available.

This site ownership history is based on a combination of sources and is for general information purposes only. It should not be used for legal purposes without further verification.

2.3 Environmental Setting

RETEC completed a database search for the area surrounding the Haverstraw Gas Plant sites. The objective of this work was to identify off-site sources of contamination which may impact the site. RETEC contracted Toxic Targeting, of Ithaca, New York, to generate the environmental data for the Haverstraw MGP sites. The results of the search indicate that no obvious adjacent or upgradient source of environmental impacts were found.

3.0 SITE INVESTIGATION - MAPLE AND WEST SITE

The PSA Investigation activities focused on defining the nature and extent of constituents of interest (COI) in soil gas, soil and groundwater, and on developing a more detailed understanding of the geology and hydrogeology of the site. The investigation included: soil gas sampling; soil probing to determine the location of subsurface structures; surface soil sampling; subsurface soil sampling at the monitoring well locations; monitoring well installation; groundwater sampling; test pit excavation and hydraulic conductivity testing. The activities for the Maple and West site are discussed in this section. The activities for the Clove and Maple site are discussed in Section 4.0 of this report.

North Star Drilling of Cortland, New York was contracted to provide drilling services during the soil boring, soil gas and monitoring well installation tasks. A test pit was excavated by Creamer Environmental of Hackensack, New Jersey. Lancaster Laboratories of New Holland, Pennsylvania was contracted to complete the chemical analysis of the samples. Lancaster is certified by the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program and the Analytical Services Protocol (ASP) program. Descriptions of all field activities conducted during the investigation are included in the following sections by environmental media.

3.1 Underground Utility Clearance

Prior to the start the field work, RETEC scheduled a site meeting on May 8, 1997 with the Underground Facilities Protective Organization (UFPO). Utilities responding as a result of the UFPO listing included:

- United Water - marked water lines surrounding the site;
- Continental Cable - was not involved at the site;
- Orange and Rockland Utilities - marked active gas lines surrounding the site;
- NYNEX - was not involved at the site;
- Citizens Telephone - was not involved at the site;
- AT&T - was not involved at the site; and

- Algonquin Gas - was not involved at the site.

RETEC contacted the Village of Haverstraw regarding the location of the 52 inch storm water culvert in the alley east of the site. The exact location of the culvert could not be determined in the field. Representatives of the village recommended that a test pit be excavated to determine if the culvert was within the boundary of the site.

3.2 Surface Soil Sampling

Sample Locations

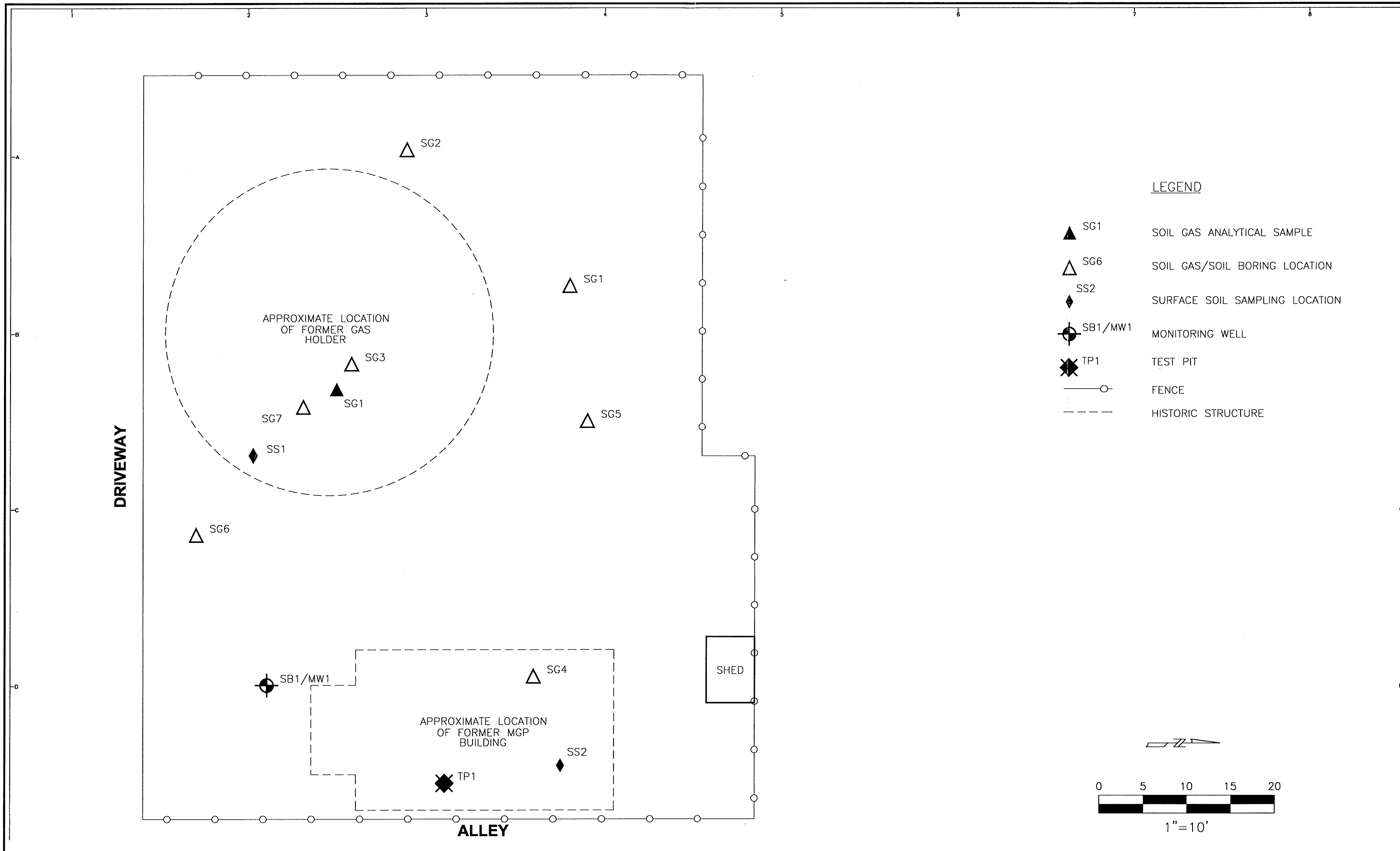
Two surface soil samples were collected during the investigation. Samples SS1 and SS2 were collected from a depth of between 0 to 0.5 feet below ground surface (bgs) from locations shown on Figure 3-1.

Sampling Methodology

Surface soil samples were collected using a stainless steel trowel. The trowel was used to clear brush, rocks, leaves and other debris from the sampling location. A representative portion of soil was then placed directly into a 125 ml clear glass, wide-mouth sample jar and sealed with a Teflon lined plastic cap, and used for BTEX analysis. Additional surface soil was placed into a stainless steel bowl. This composite sample was then placed into a one-liter, wide-mouth clear glass sample jar for analysis of PAHs, TAL metals and cyanide.

3.3 Test Pit Excavation

One test pit was excavated by Creamer Environmental during the PSA investigation. The test pit, not part of the original scope of work for the PSA, was added by RETEC following utility clearance activities conducted at the site. The objective of the test pit excavation was to determine if the 52 inch stormwater culvert was present within the boundary of the site and to provide additional information regarding subsurface conditions in the area of the former MGP building. The location of the test pit (TP1) is shown on Figure 3-1.



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REFERENCE DWG | DESCRIPTION

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CURRENT DATE: 08/06/97 CAD FILE FIG2-2

SAMPLING LOCATIONS

MAPLE AND WEST SITE
HAVERSTRAW, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 3-1 REV. 0

3.4 Geoprobe Soil Borings

A truck-mounted Geoprobe drilling rig was used to obtain a soil gas sample and to complete subsurface soil borings at each of the seven locations shown on Figure 3-1. A soil boring summary is presented in Table 3-1. Sampling methods are discussed in the following sections.

3.4.1 Soil Gas Sampling

Sample Locations

Seven soil gas samples were collected within the boundary of the former Maple and West MGP site (Figure 3-1). The objective of this sampling was to determine if historical MGP subsurface structures were potential source areas of COI. The results of the field screening indicated that the greatest concentrations of soil gas were found in the vicinity of SG7. An additional borehole was advanced in the vicinity of SG7 and an analytical sample (SG1) was collected and sent to the laboratory for the analysis of BTEX compounds. The results of the analysis are discussed in Section 7.3.

Table 3-1
Soil Boring Summary
Maple and West MGP Site

Identification	Total Depth of Boring (Feet)	Depth to Water (Feet)	Soil Gas Analytes	Soil Analytes	Rationale
			Soil Gas/Geoprobe Borings		
SG1	16.0	8.02	PID Screening	Field Characterization	Former Holder Location
SG2	16.0	7.02	PID Screening	Field Characterization	Former Holder Location
SG3	10.0	7.23	PID Screening	Field Characterization	Former Holder Location
SG4	11.2	7.38	PID Screening	Field Characterization	Former MGP Building
SG5	11.0	7.80	PID Screening	Field Characterization	Downgradient of Former Holder Location
SG6	12.0	8.02	PID Screening Drager Tube	Field Characterization	Downgradient of Former Holder Location
SG7	12.0	7.70	PID Screening Drager Tube	Field Characterization	Former Holder Location
SG1	4.0	NT	BTEX	NT	Highest Field Screening Result - Laboratory Sample Collected
			Soil Borings/Monitoring Wells		
SB1(8-10)	14.0	7.40	NT	BTEX, PAH, Cyanide	Downgradient of Former Holder

Note: NT - Not Tested

Soil Gas Sampling Methodology

The samples were collected in borings advanced with a hydraulic Geoprobe drilling rig. Soil gas samples were collected by advancing a direct push probe rod equipped with an expendable drive point head to a depth of approximately 4 feet below the ground surface. The probe was then slightly retracted to open the rod. The rod was then coupled to an adapter to allow soil gas vapors to flow up polyethylene tubing in response to applied vacuum. One volume of the sampling equipment (probe and tube) was purged with a calibrated pump in order to fill the sampling equipment with formation soil gas. A grab sample of soil gas was then screened for the presence of organic vapors by using a photo-ionization detector (PID) equipped with a 10.6 eV bulb, calibrated to 100 ppm isobutylene. At each sample location, if organic vapors were detected by the PID, a grab sample of soil gas was then screened for the presence of benzene using a detector tube (Drager-benzene 0.5/a). The location showing the highest PID field screening results was selected for collection of a laboratory sample. An additional borehole was then advanced in the vicinity of the sample location. An analytical sample was collected in a Tedlar bag and sent to the laboratory for the analysis of BTEX compounds.

3.4.2 Geoprobe Soil Borings

Soil Boring Locations

At each of the seven soil gas sampling locations, a Geoprobe soil boring was completed following the collection of the gas sample. The objectives of the borings were: to verify the location of subsurface structures related to the former MGP; to determine the contents of these structures; and to assess whether MGP site residuals are present in the soil and groundwater. The Geoprobe boring locations are shown in Figure 3-1. Soil samples were collected from each boring for field characterization and screening; however, no analytical samples were collected during the Geoprobe boring program.

The total number and locations of some of the borings at the Maple and West site differ slightly from the locations presented in the PSA Work Plan. The revised locations were selected by Mr. James Edwards (RETEC field geologist), and Mr. Bill Zeppetelli of NYSDEC. Soil boring SG7 was added to further define subsurface conditions encountered at SG3, a location believed to be within the footprint of a subsurface gas holder pit. Borings SG5 and SG6 were added to further define the surface conditions downgradient of the former gas holder.

Soil Boring Methodology

The borings were advanced using a truck-mounted Geoprobe drill rig. A 2-inch outside diameter, 4-foot long Macrocore sampling tube was used to advance each borehole. The tube sampler was equipped with a plastic liner. Each sample tube from the borehole was examined by the RETEC geologist for physical characteristics and visual evidence of MGP impacts to soil. A jar headspace analysis was performed on soil samples with a photo-ionization detector equipped with a 10.6 eV bulb. At the completion of each boring, a depth to water measurement was collected, and if possible, a sample of groundwater was collected with a bailer and screened for the presence of organic vapors with the PID. The results of the classification and field screening are provided on the boring logs in Appendix B.

Following completion of each Geoprobe boring, the borehole was filled to the ground surface according to work plan specifications with a cement/bentonite slurry, tremied to the bottom of the borehole.

3.5 Subsurface Soil Samples and Monitoring Wells

A subsurface soil sample was collected from the boring for the installation of monitoring well MW1. The objective for the soil sampling and well installation was to investigate soil and groundwater quality downgradient of the former gas holder location. The location of well MW1 is shown on Figure 3-1.

3.5.1 Soil Sampling

The PSA work plan specified that the subsurface soil samples from the borings for the monitoring wells be collected with a rotary drilling rig using hollow stem augers and split-spoon samplers. The technique for sampling subsurface soils was modified in the field following approval by NYSDEC. Geoprobe tools (Macrocore samplers) were found to obtain greater sample recoveries and were used for all subsurface soil sampling. Soil samples were described by the geologist in the field using the American Society for Testing and Materials (ASTM) and the Unified Soil Classification System (USCS). The soils were also screened for the presence of organic vapors by placing a sample in a jar, allowing the jar to warm, and using a PID to perform a headspace analysis.

The PSA work plan specified that the soil from the most impacted sample from each boring be sent to the laboratory for chemical analysis. Sample SB1 (6-8) was selected for laboratory analysis based on the presence of organic vapors detected with the PID and the visible evidence of a hydrocarbon product in the sample. The sample was determined by the RETEC geologist to be a native soil material, therefore the soil was not analyzed for TAL metals. A summary of the subsurface soil sample is presented in Table 3-1.

3.5.2 Monitoring Well Installation

The monitoring well screen was placed to intercept the water table at the time of installation. The well was constructed using 10 feet of machine-slotted, 2-inch diameter PVC well screen, with 0.010 inch slots. Blank, flush-threaded schedule 40 PVC casing was attached to the screen and extended to the ground surface. A sand pack was then installed around the length of the screen to 2 feet above the top of the screen. The grain size of the sand pack complemented the screen slot size (#1 Morie sand). A 2-foot thick, bentonite pellet subsurface seal was installed above the sand filter pack. Potable water was added to the bentonite and the seal was allowed to hydrate. A cement-bentonite grout mix was then placed to within 1 foot of ground surface. The well was completed as a flush-mount installation at the ground surface with a steel protective cover, set into a cement surface seal. The well was sealed with an air-tight well cap locked with a case-hardened steel lock to provide security. A subsurface drilling log, which includes the well construction diagram, is provided in Appendix A.

3.6 Well Development

RETEC and North Star Drilling mobilized to the site on May 16, 1997 to develop the new monitoring well. The objective of this work was to remove fine-grained sediment and fluid residue from the sandpack, to improve well efficiency, and to increase hydraulic communication between the well and the adjacent soil formation. A surge and pump method was chosen as the most suitable for the wells. A Watterra pump, equipped with a surge block, was used to actively surge and agitate the water column by forcing water back-and-forth through the well screen. Pumping was continued until the field parameters of pH, temperature, turbidity and conductivity had stabilized. Ten well volumes of water were removed from well MW1; however, slow recharge of the well made further pumping impractical and the well was developed by bailing.

3.7 Groundwater Sampling

3.7.1 Liquid Level Measurements

Following development, the new well was allowed to stabilize for a period of approximately one week. On June 3, 1997, RETEC mobilized to the site to complete the groundwater testing. The new well was opened and tested for the presence of organic vapors with the PID. A liquid level measurement was then collected with an oil-water interface probe to investigate whether light non-aqueous phase liquids (LNAPLs) or dense non-aqueous phase liquids (DNAPLs) were present. The probe was decontaminated following procedures listed in Section 3.9.

3.7.2 Groundwater Sampling

The well was purged of three volumes of well water using a peristaltic pump. The objective of the work was to ensure that laboratory samples were representative of fresh formation groundwater. The field parameters of pH, temperature and conductivity were recorded with each well volume purged by passing the water through a sealed chamber containing the three measurement probes. Turbidity measurements were collected using a hand held field meter. Groundwater samples were collected for laboratory analysis when at least three well volumes had been purged from the well and the variation between successive readings of temperature, pH and conductivity was less than 10%. All wells were sampled for VOCs, PAHs, cyanide and TAL metals. Following purging, MW1 went dry. The well was allowed to recover and samples of water for VOCs and PAHs were collected from the well. The recharge rate of the well was insufficient to obtain water for metals analysis, therefore, sampling for metals analysis was completed the following day (June 4,1997) with a disposable Teflon bailer.

3.8 In-Situ Hydraulic Conductivity Testing

According to the PSA Work plan, in-situ hydraulic conductivity ("slug") testing was to be performed on the new monitoring well after groundwater sampling was completed. Following groundwater sampling on June 3, 1997, the well was allowed to recharge; however, the well was found to recover too slowly to perform the slug testing.

3.9 Decontamination Procedures

All downhole drilling equipment used during the Geoprobe testing and monitoring well installation was hot-water pressure washed between borings. All soil and groundwater testing equipment was decontaminated with a sequence consisting of the following steps:

- removal of gross contamination (soil) by brushing, wiping, etc.;
- potable water and Alconox (detergent) solution wash;
- distilled water rinse;
- nitric acid solution rinse;
- reagent grade methanol rinse; and
- final distilled water (laboratory provided) rinse.

3.10 Waste Management

Fluids generated during the decontamination of drilling equipment were containerized on a decontamination pad consisting of a "cow trough" on a bermed area which was lined with a plastic sheeting liner. The decontamination fluids, well development and well purge water, were containerized, labeled and temporarily stored on the Clove and Maple site in 55-gallon drums.

Drill cuttings generated during the installation of Geoprobe borings and monitoring wells were containerized into 55-gallon drums and temporarily stored on the Clove and Maple site. Personal protective equipment and Macro-Core sampling tubes were containerized into drums.

The results of the soil and water sample analyses from the site were used to characterize the waste materials for disposal. All of the drums were disposed of as nonhazardous waste from the Maple and West site. Drums of solid waste were shipped to Jamaica Recycling for ultimate disposal at G.R.O.W.S. Landfill, Inc. in Falls Township, Pennsylvania. All decontamination, well development and well purge water was shipped to Bridgeport United Recycling of Bridgeport, Connecticut. All transportation was provided by O&R's spill response contractor, Miller Environmental Group.

4.0 SITE INVESTIGATION - CLOVE AND MAPLE SITE

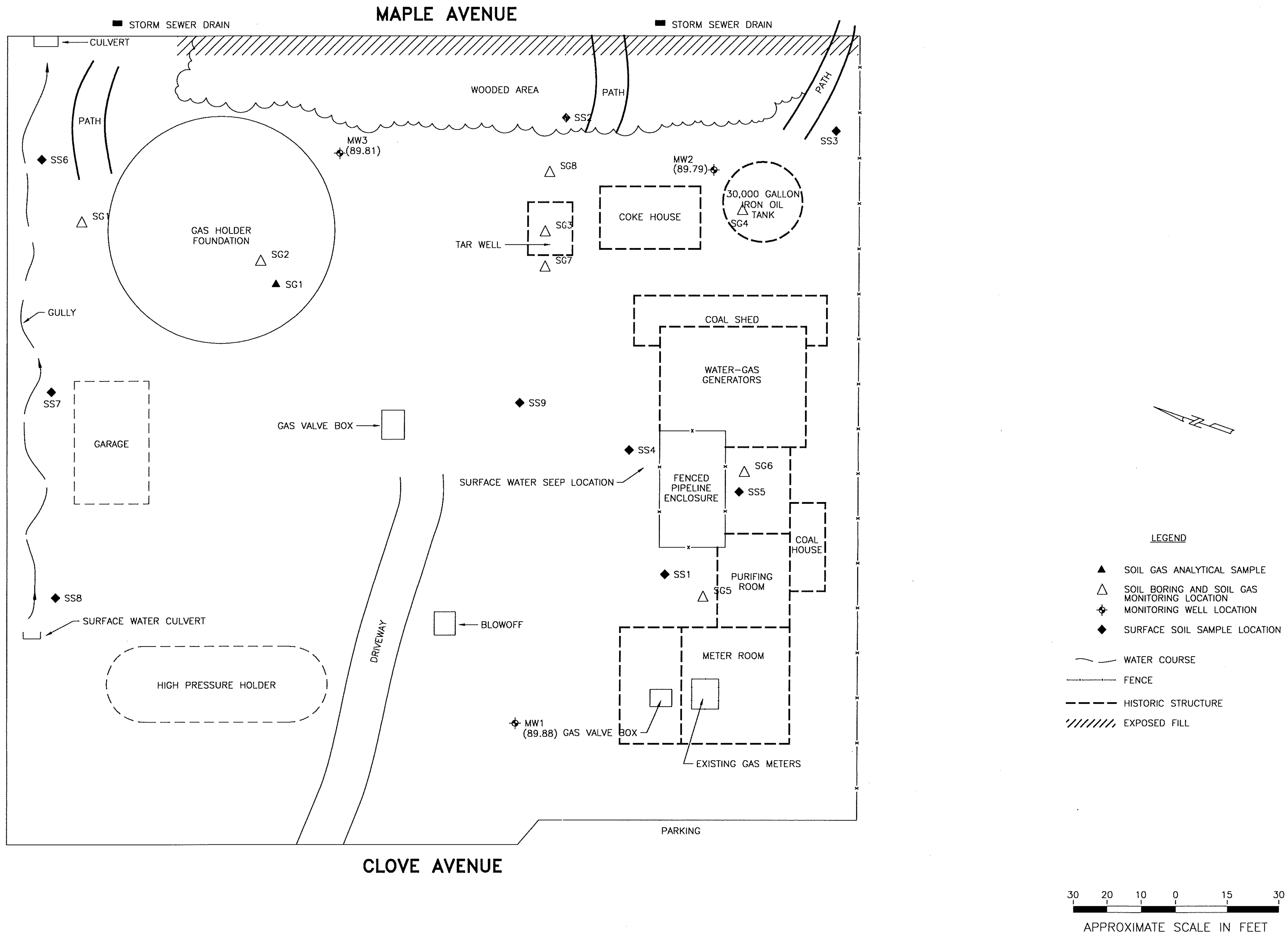
The PSA investigation activities completed at the Clove and Maple former MGP site are discussed in this section.

4.1 Underground Utility Clearance

Prior to the start of the field work at the Clove and Maple site, RETEC scheduled a site meeting on May 8, 1997, with the Underground Facilities Protective Organization. The responding utilities are listed in Section 3.1 of this report. Only O&R has active utilities (gas lines) on the Clove and Maple site.

4.2 Surface Soil Samples

Nine surface soil samples were collected from the site. The number and location of some of the soil samples was changed in the field from the locations shown in the PSA Work Plan. A decision regarding the placement of the surface soil samples was made in the field by RETEC and Mr. Bill Zeppetelli of NYSDEC. Sample SS4 was relocated to be adjacent to a surface water seep. Sample SS9 was added to investigate the concentration of COI in area of the site used by recreational users. Sample SS10 was blind duplicate sample for SS1. The soil samples were collected from a depth of between 0 and 0.5 feet bgs with a stainless steel sampling trowel using methods described in Section 3.2 of this report. Surface soil sampling locations are shown in Figure 4-1.



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REFERENCE DWG | DESCRIPTION

ORANGE & ROCKLAND UTILITIES
FORMER MANUFACTURED GAS PLANT
3-2632-400

CURRENT DATE: 08/06/97 | CAD FILE SAMPLE

SAMPLING LOCATIONS

CLOVE AND MAPLE AVE SITE
HAVERSTRAW, NEW YORK

RETEC REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 4-1 | REV. 0

4.3 Geoprobe Soil Borings

A truck-mounted Geoprobe rig was used to obtain a soil gas sample and to complete a subsurface soil boring at each of the eight locations shown on Figure 4-1. Sampling methods are discussed in Section 3.4 of this report. Table 4-1 presents a summary of the sample locations.

Table 4-1
Soil Boring Summary
Clove and Maple MGP Site

Identification	Total Depth of Boring (Feet)	Depth to Water (Feet)	Soil Gas Analytes	Soil Analytes	Rationale
Soil Gas/Geoprobe Borings					
SG1	12.0	9.90	PID Screening	Field Characterization	Adjacent to Former Holder
SG2	15.0	6.10	PID Screening Drager Tube	Field Characterization	Former Holder Location
SG3	12.0	5.55	PID Screening	Field Characterization	Former Tar Well Location
SG4	12.0	6.60	PID Screening	Field Characterization	Former Iron Oil Tank Location
SG5	16.0	14.50	PID Screening	Field Characterization	Former MGP Building Location
SG6	12.0	9.80	PID Screening	Field Characterization	Former MGP Buildings
SG7	12.0	7.20	PID Screening	Field Characterization	Former Tar Well
SG8	12.0	7.60	PID Screening	Field Characterization	Former Tar Well
SG1 (Note 1)	4.0	NT	BTEX	NT	Former Gas Holder
Soil Borings/Monitoring Wells					
SB1 (20-22)	28.0	22.50	NT	BTEX, PAH, Cyanide	Upgradient Location
SB2 (12-14)	18.0	10.10	NT	BTEX, PAH, Cyanide	Downgradient of Iron Oil Tank
SB3 (10-12)	14.0	8.00	NT	BTEX, PAH, Cyanide	Downgradient of Holder

Note: NT - Not Tested

(Note 1) - Two SG1 sample designations were used during the investigation. Soil gas sample SG1 was collected from the location shown on Figure 4-1.

4.3.1 Soil Gas Sampling

Eight soil gas samples were collected within the boundary of the former Clove and Maple MGP site (Figure 4-1). Methods used during the sampling are outlined in Section 3.4.1 of this report. The results of the field screening indicated that the greatest concentrations of soil gas were found in the vicinity of SG2. This location is within the footprint of the former gas holder. An additional borehole was advanced in the vicinity of SG2 and an analytical sample (SG1) was collected in a

Tedlar bag and sent to the laboratory for the analysis of BTEX compounds. The results of the analysis are discussed in Section 6.3.

4.3.2 Soil Borings

At each of the eight soil gas sampling locations, a Geoprobe soil boring was completed following methods outlined in Section 3.4.2 of this report. The Geoprobe boring locations are shown in Figure 4-1. The results of the classification and field screening are provided on the boring logs in Appendix B.

The total number and locations of some of the borings differ slightly from the locations presented in the PSA Work Plan. The revised locations were selected by RETEC and Mr. Bill Zeppetelli of NYSDEC. Borings SG7 and SG8 were added to further define the subsurface conditions associated with the former tar well.

4.4 Subsurface Soil Samples and Monitoring Wells

A subsurface soil sample was collected from each boring completed for the installation of the monitoring wells. The objective for the soil sampling and well installation was to investigate soil and groundwater quality upgradient of the former MGP facilities (SB1/MW1), downgradient of the gas production buildings and oil tank (SB2/MW2), and down gradient of the former gas holder (SB3/MW3). Subsurface soil sampling and monitoring well construction was completed according to specifications outlined in Section 3.5.1 and 3.5.2 of this report.

4.4.1 Soil Sampling

The PSA Work Plan specified that the soil sample from the most impacted split-spoon sample from each boring be sent to the laboratory for chemical analysis. Samples SB2 (12-14) and SB3 (10-12) were selected for analysis based on the presence of organic vapors detected with the PID and the visible evidence of hydrocarbon products in each of the soil samples. No visible or PID evidence was noted during sampling of SB1 (20-22) therefore the sample was collected above the water table. All samples were determined to be native soil material, therefore, no subsurface soil samples were analyzed for TAL metals. A summary of the subsurface soil samples is presented in Table 4-1.

4.4.2 Monitoring Well Installation

Three monitoring wells were installed into soil borings completed at the site. The wells were constructed according to specifications described in Sections 3.5.2 of this report. All the wells were completed as flush-mount installations at the ground surface with a steel protective cover, set into a cement surface seal. Table 4-2 provides a summary of the construction for each monitoring well.

4.5 Well Development

RETEC and North Star Drilling mobilized to the site on May 21, 1997, to develop the three new monitoring wells. The methods used for this task are described in Section 3.6 of this report. Approximately 20 well volumes were pumped from MW1, MW2 and MW3 with a Watterra pump. Pumping was continued until the field parameters of pH, temperature, turbidity and conductivity had stabilized.

4.6 Groundwater Sampling

4.6.1 Liquid Level Measurements

Following development, the new wells were allowed to stabilize for a period of approximately one week. On June 2, 1997, RETEC mobilized to the site to complete the groundwater testing. All of the new wells were opened and tested for the presence of organic vapors with the PID. Liquid level measurements were then collected with an oil-water interface probe to investigate whether light non-aqueous phase liquids (LNAPLs) or dense non-aqueous phase liquids (DNAPLs) were present. As a result of the testing, a two-foot thick layer of DNAPL was found in well MW2. Following each use the probe was decontaminated following procedures listed in Section 3.9.

4.6.2 Groundwater Sampling

Each of the wells was purged and sampled using procedures outlined in Section 3.7.2 of this report. All wells (MW1, MW2 and MW3) sampled during the PSA contained turbidity greater than 50 NTU and were field filtered for analysis of TAL metals. As previously discussed, well MW2 contained a layer of DNAPL in the well. During groundwater sampling for VOC, PAH, cyanide and TAL metals for this well, the intake for the peristaltic pump was kept above the DNAPL layer. The intake for the pump was then lowered to the depth of the DNAPL and a sample was pumped into

Table 4-2
Monitoring Well Construction Summary
Clove and Maple Gas Plant Site

Well Number	Ground Surface Elevation Feet (Note 1)	Top of PVC Riser Feet (Note 1)	Total Depth Drilled (Feet)	Top of Screen Elevation (Feet) (Note 1)	Bottom of Screen Interval Depth (Feet)	Bottom of Screen Elevation (Feet) (Note 1)	Depth to Water 6/2/97 (Feet)	Elevation of Water 6/3/97 (Feet) (Note 1)
New Monitoring Well Installation								
MW1	110.66	110.36	30	90.36	30	80.36	20.48	89.88
MW2	96.50	96.13	18	88.13	18	78.13	6.34	89.79
MW3	96.72	96.50	16	90.50	16	80.50	6.69	89.81

(Note 1) - Elevations for this investigation were referenced to an arbitrary benchmark (concrete slab of the fenced enclosure) established by RETEC at the site.

unpressured glass liter jars and sent to the laboratory for the analysis of surface tension, density, viscosity, hazardous waste characteristics, and IR spectral technique analysis. The results of the analyses are presented in Section 6.5 of the report.

4.7 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity ("slug") tests were performed on two of the three new monitoring wells. No conductivity testing was completed for MW2 due to the presence of the DNAPL. The objective of the testing was to assess the hydraulic conductivity of the screened interval of the aquifer underlying the site. The slug testing was performed by adding and removing a known volume to each well and timing the equilibration to the static water level. The slug testing data was recorded using an electronic data logger. The data was downloaded from the data logger to a modeling program to reduce the data, present it graphically, and calculate hydraulic conductivity values. Results of the slug tests are discussed in Section 5.3.

4.8 Decontamination Procedures

All downhole drilling equipment used during Geoprobe testing and monitoring well installation was hot-water pressure washed between borings. All soil, groundwater and slug testing equipment was decontaminated with the sequence described in Section 3.9 of this report.

4.9 Waste Management

The methods used for waste management at the Clove and Maple site were similar to methods described for the Maple and West site in Section 3.10 of this report. Drums containing nonhazardous fluids were shipped to Bridgeport United Recycling of Bridgeport, Connecticut. Drums containing nonhazardous solid waste was disposed of at the G.R.O.W.S. Landfill. One drum, containing development and purge water from well MW2, was shipped from the site as hazardous waste due to the concentration of benzene. All transportation was provided by O&R's Spill Response Contractor, Miller Environmental Group.

4.10 Survey

The ground surface and reference (well casing) elevations of the new wells were measured by differential leveling. The survey was completed by a RETEC geologist who tied elevations of the new wells into an arbitrary benchmark created for the site. The benchmark used was the northeast corner of the concrete slab in the fenced enclosure. Well locations were directly measured from existing site features such as buildings or roads using a tape measure. The survey data generated by the RETEC site survey is presented in Table 4-2 (well construction summary) and on the contour map of the water table found in Section 5 of this report.

5.0 SITE PHYSICAL CONDITIONS

This section presents a summary of measurements and observations of the physical environment at the site, including both the geology and the hydrogeology of the site, and the man-made structures. This evaluation is based on the examination of surface conditions, Geoprobe soil borings in and around subsurface structures, and monitoring well installation borings.

5.1 General Geologic Overview

The Village of Haverstraw is located in the Hudson River Valley of the Hudson Highlands Physiographic province of New York State. The valley is in a north to south trending trough which, in the vicinity of the site, is bounded by the palisade diabase, approximately ½ mile to the west. The trough of the river has been extensively filled (up to 500 feet) with glacial outwash deposits. Bedrock, not encountered during the PSA investigation, is buried beneath the thick sequence of the glacial and fluvial sediments. Bedrock beneath the site has been mapped as the Brunswick Formation, which is comprised of an arkose and mudstone.

The Clove and Maple site is located on the base of South Mountain, a steep northeast facing ridge. Maple Avenue runs along the base of the hill. The Maple and West site is located on a flat area which extends a short distance from the base of the hill to the Hudson River. The Clove and Maple site is characterized by moderate relief (approximately 20 feet) with the ground surface sloping to the east. Drainage is towards the Hudson River which lies approximately 1000 feet to the east. Surface run-off at the site is towards the storm sewer under Maple Avenue The Maple and West site is flat with no obvious surface water flow direction for storm water.

5.2 Description of Site Stratigraphy

Clove and Maple

Two stratigraphic units were identified during the drilling program for the investigation. The uppermost unit consists of a fill which was present in the majority of the soil borings and well installations. The fill was found to increase in thickness towards Maple Avenue where it was found in a thickness of approximately 8 feet. No fill was found at the upgradient well location MW1. The fill material varies in composition, but is generally a brown sand containing varying amounts of black cinders, ash, brick fragments, and coal fragments.

Underlying the fill material is a heterogeneous mixture of alluvial deposits which are comprised of discontinuous beds of sediments, primarily sands, gravels and clayey silts. Data collected during subsurface sampling was used to generate a cross-section view of the site. The location of the cross-section is shown in Figure 5-1, and the cross-section is shown in Figure 5-2.

Maple and West

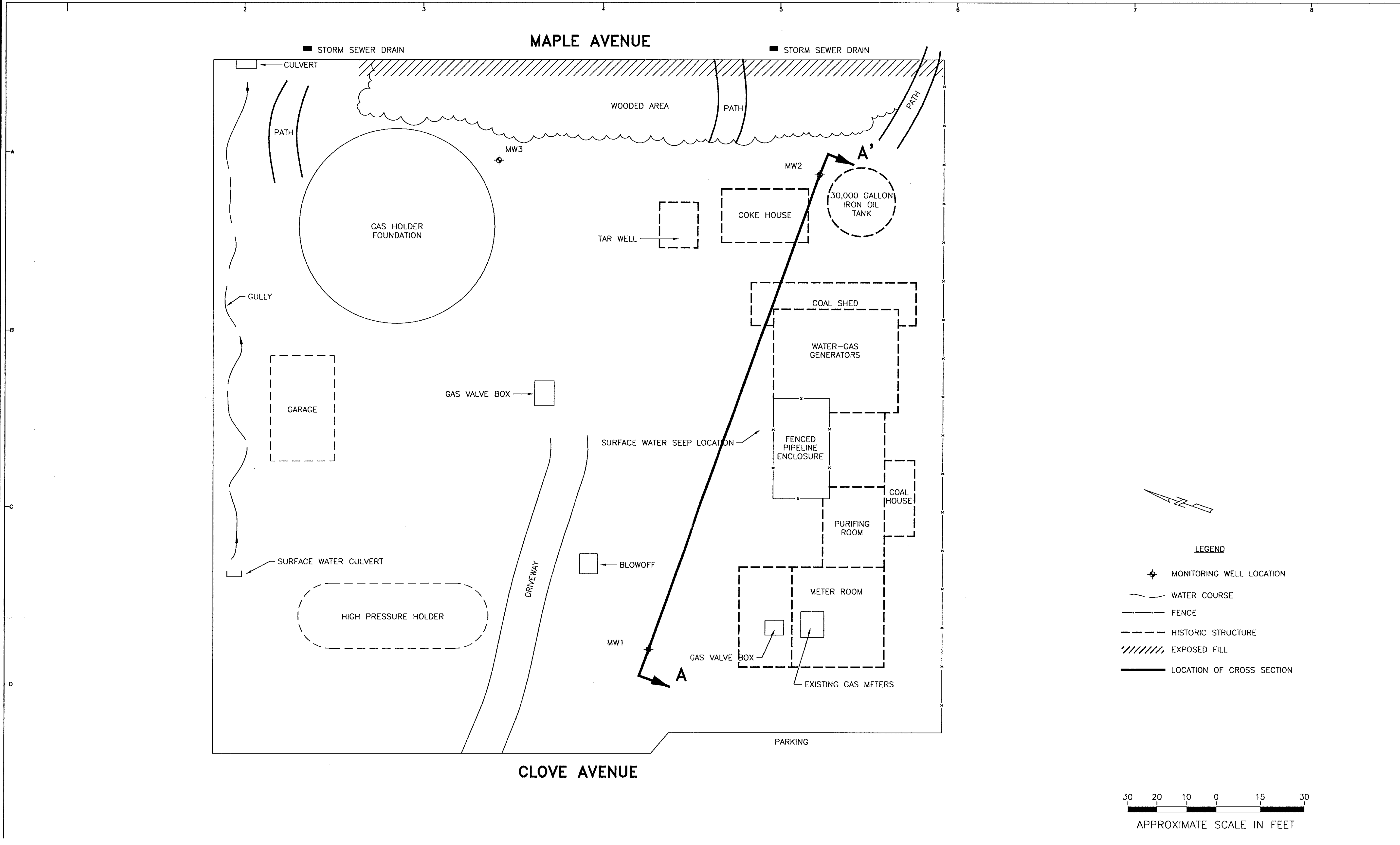
Two stratigraphic units were identified at the site during the drilling program. The uppermost consists of a fill which was present at all the boring locations. The fill ranged in thickness from 3 feet at SG2 to 8 feet in boring SG1. The fill consisted of brown sand mixed with varying amounts of cinders, coal fragments, ashes, concrete fragments, and brick fragments.

Underlying the fill is a heterogeneous mixture of alluvial deposits which are comprised primarily of a silty clay with sand, silt and gravel stringers.

5.3 Site Hydrogeology

Groundwater on the Clove and Maple site was generally found in the alluvial sediments below the fill material, approximately 20 feet below the ground surface near Clove Avenue, and approximately 6 feet below the ground surface near Maple Avenue. The surface of the water table slopes to the east towards the Hudson River. Groundwater at the Maple and West site was measured at 7.4 feet below the ground surface.

The water level measurements from the monitoring wells were used to map the potentiometric surface of the water table and infer the direction of groundwater flow (Figure 5-3). Based on this water table map, the average horizontal gradient across the MGP site (MW1 to MW3) was calculated to be 0.0006 feet/foot. A water table gradient could not be determined at the Maple and West site since only one well was installed. The gradient at Maple and West is likely to be less than that at Clove and Maple.



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FORMER MANUFACTURED GAS PLANT
3-2632-400

CURRENT DATE: 08/06/97
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CROSS SECTION
LOCATION MAP
CLOVE AND MAPLE AVE SITE
HAVERSTRAW, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

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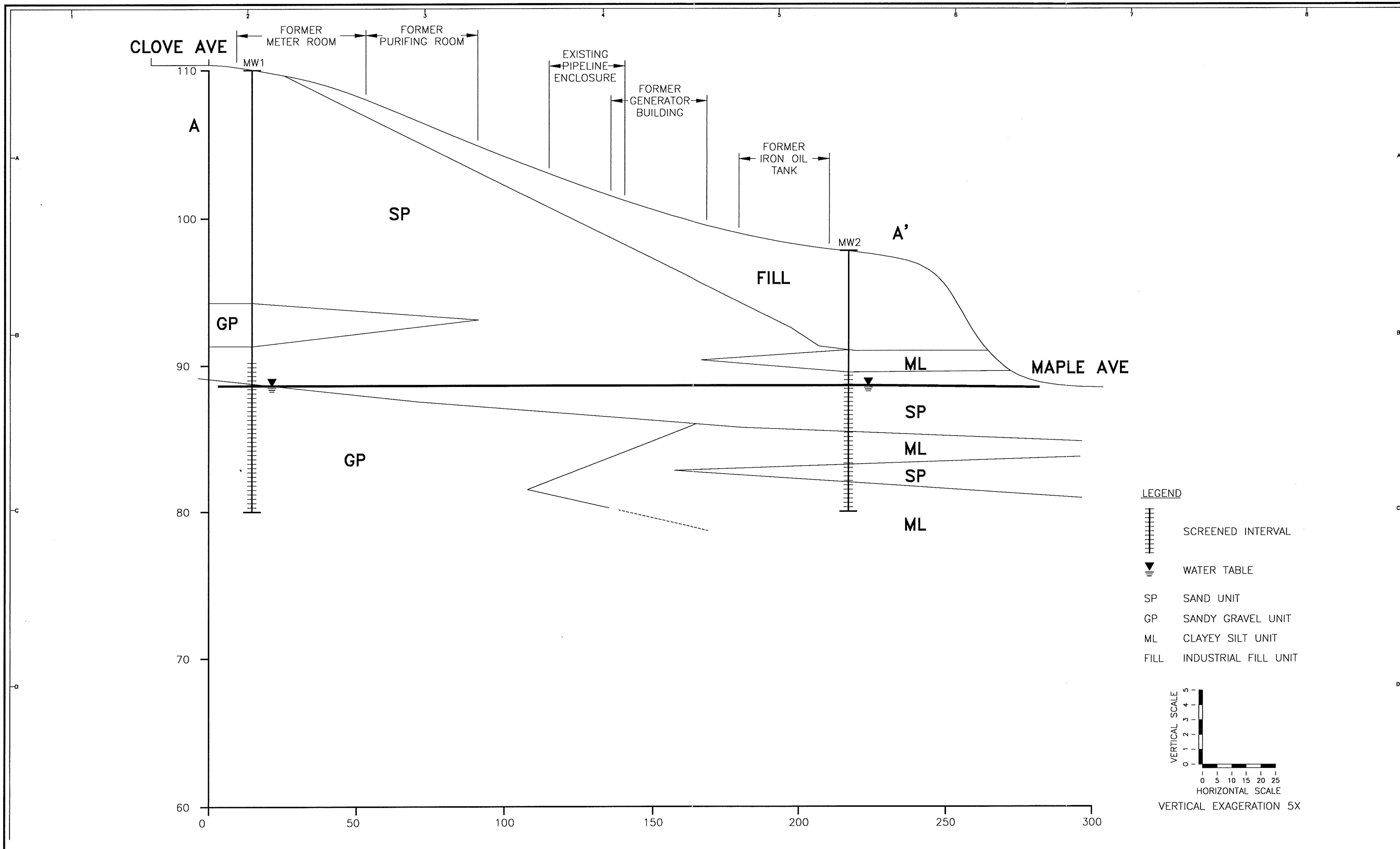

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GEOLOGIC CROSS SECTION A–A'

CLOVE AND MAPLE AVE SITE
MIDDLETOWN, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

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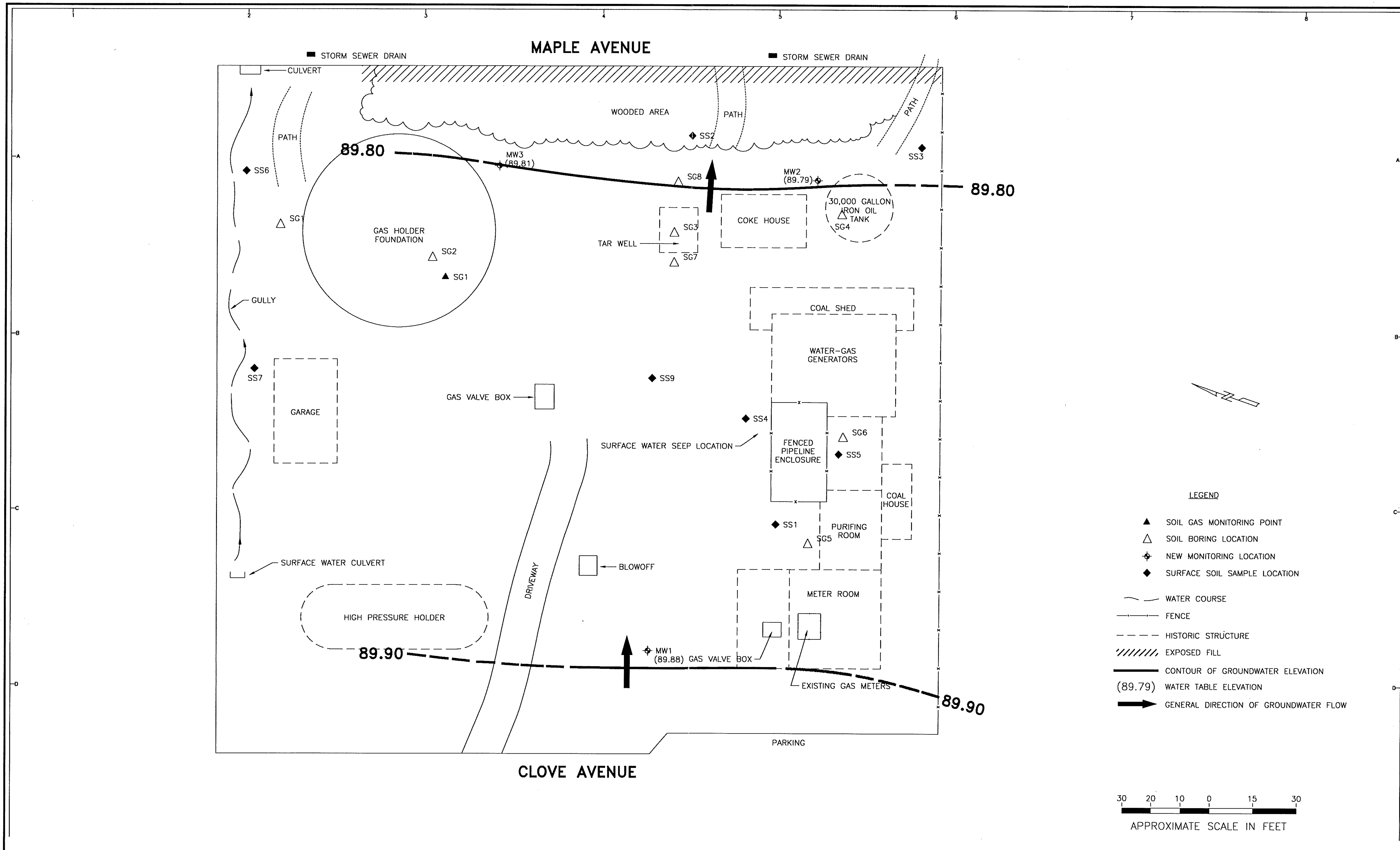

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CLOVE AND MAPLE SITE
HAVERSTRAW, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 5-3 REV. 0

Hydraulic conductivity ("slug") testing was performed in two of the three new wells installed at the Clove and Maple site. No testing was performed on MW2 due to the presence of DNAPL in the well. The data collected during the slug testing was analyzed by the Bouwer and Rice Method (Bouwer, 1989) using the AQTESOLV modeling program. A summary of the hydraulic conductivity values calculated from slug testing are presented in Table 5-1. The hydraulic conductivity (K) values for the wells ranged from 1.5×10^{-4} centimeters per second (cm/sec) at well MW3 to 1.2×10^{-2} at MW1. These values are consistent with those expected for a clayey silt (MW3) and sand (MW1) (Freeze and Cherry, 1979).

Table 5-1
Hydraulic Conductivity Results
Clove and Maple Site

Well	Hydraulic Conductivity (cm/s)	Average Linear Velocity (feet/year)
MW1	1.2×10^{-2}	3.7
MW3	1.5×10^{-4}	0.47

Based on the calculated hydraulic conductivities of the unconsolidated deposits, estimates of the average horizontal linear velocity of groundwater flow at the MGP site were calculated using the equation $V=ki/n$ (Darcy's Law), where k is the hydraulic conductivity of the formation, i is the hydraulic gradient, and n is the effective porosity of the deposits. Assuming a value of 0.20 for n, the hydraulic gradient of 0.0006 feet/foot, and the range of conductivities shown above, the horizontal linear velocity of groundwater flow ranges from 0.47 to 3.7 feet per year.

The velocity of groundwater flow at the Maple and West site is predicted to be less than that at Clove and Maple. This is due to the shallow water table gradient and the relatively impermeable soils found at the site.

5.4 Subsurface Structures - Clove and Maple

Four areas which contain buildings or subsurface structures from the former MGP were identified as a result of the investigation. A description of each structure and a summary of the environmental conditions noted by the field geologist is presented in the following sections.

5.4.1 Gas Holder

Historical Sanborn maps, a 1921 facility map, and a Geoprobe boring was used to investigate the former gas holder. The holder foundation is still present at the site. The following set of observations regarding the holder were made during the field work:

- The foundation of a 60-foot diameter gas holder was located in the northeast area of the site. The foundation is a concrete slab constructed at-grade.
- Geoprobe tools were able to advance to 15 feet bgs in undisturbed native soils below the foundation slab.
- Visible evidence of MGP constituents in boring SG2 included strong hydrocarbon odors, visible hydrocarbon product mixed with sand in a 4-inch lens, visible nodules of a tar-like material, hydrocarbon sheens and PID jar headspace results of up to 518 ppm.
- Groundwater measurements taken from boring SG2 indicate that the water table within the footprint of the holder is at a similar elevation to that found in the adjacent monitoring well MW3 (approximately 6 feet bgs).

One Geoprobe boring (SG1) and one monitoring well (MW3) were completed near the holder foundation. The objective of the testing was to further define the extent of COI in soil and groundwater adjacent to, and downgradient of the holder. A strong hydrocarbon odor and PID jar headspace readings of 727 ppm were found in SG1, the boring adjacent to (north) of the foundation. Hydrocarbon odors, hydrocarbon soil staining and jar headspace PID readings of up to 1268 ppm were noted in soil samples collected during the installation of well MW3.

5.4.2 Tar Well

A 1921 facility map and three Geoprobe borings were used to locate the footprint of the former tar well (Figure 4-1). The following set of observations were made during the field work:

- Geoprobe tools were able to advance to 12 feet bgs in all three borings in the former tar well area.

- No structures (walls or foundations) were encountered in the borings.

- Fill was found in all three borings in thicknesses of up to 7 feet.

- The fill is comprised of sand and gravel, ashes, cinders, brick fragments, broken glass, wood fragments and coal fragments.

- Hydrocarbon odors, visible hydrocarbon staining, nodules of a tar-like material and PID evidence of MGP impacts (up to 1,662 ppm by jar headspace testing) were observed in the samples taken from the borings.

- Water level measurements taken from the borings were consistent (approximately 6 feet bgs) with wells MW2 and MW3.

5.4.3 Iron Oil Tank

Historical Sanborn maps, a 1921 facility drawing, and one Geoprobe boring was used to investigate the subsurface conditions in the area of the former above-ground 30,000 gallon "Iron Oil Tank" (Figure 4-1). The following observations were recorded during the fieldwork.

- Geoprobe tools were able to advance to 12 feet below the ground surface in the boring in the tank area.

- Fill was found to a depth of 4 feet below the ground surface.

- The fill is comprised of sand, ashes, slag fragments and coal fragments.

- Hydrocarbon odors and PID evidence of MGP impacts (up to 92.1 ppm by jar headspace testing) was observed in the samples taken from the borings.

- Water level measured in the boring was consistent (approximately 6 feet bgs) with well MW2.

A monitoring well (MW2) was installed in a down gradient location from the former oil tank location. Hydrocarbon odors, visible hydrocarbon product and jar headspace results of up to 487 with the PID were observed in soil samples taken from the boring. During groundwater sampling for the well a 2 foot thick layer of DNAPL was found in the well.

5.4.4 Former MGP Building

Two soil borings were completed in close proximity to former MGP buildings: Geoprobe boring SG5 was completed next to the former purifying house, boring SG6 was completed adjacent to the former generator house. Observations recorded during the fieldwork include:

- No significant visible or field screening evidence of MGP constituents were observed in the boring adjacent to the purifying house.
- Hydrocarbon odors, visible hydrocarbon staining, and PID evidence of MGP impacts (up to 14.3 ppm by jar headspace testing) were observed in the samples taken from boring SB6.
- Visible accumulations of a tar-like material were observed at the ground surface in the vicinity of SS5 and SG6. The material was black, highly viscous, had a strong hydrocarbon odor, and was observed to become mobile (flow) with elevated temperatures at the site.

5.5 Subsurface Structures - Maple and West Site

Two structures associated with the former Maple and West MGP were investigated during the PSA. These structures were identified from historical drawings of the Village of Haverstraw. A description of each structure is presented in the following sections.

5.5.1 Former MGP Building

One soil boring (SG4) and one test pit (TP1) was completed within the footprint of the former gas production building at the Maple and West site. The boring was completed to a depth of approximately 11 feet in native soil materials. Test pit TP1 was excavated to a depth of approximately 6 feet bgs in fill and native soil material. The following observations were recorded during the fieldwork:

- Fill at the sample locations comprised of brick fragments, rock fragments and sand.
- Evidence of MGP impact in soil boring SG4 included a strong hydrocarbon odor and PID results of up to 91.2 ppm.

- No subsurface structures were found in either the test pit or soil boring completed in the area of the former building.

5.5.2 Former Holder

Two soil borings (SG3 and SG7) were completed within the footprint of the former gas holder. Observation recorded during the fieldwork include:

- Fill is present to a depth of 10.5 feet bgs. Geoprobe tools were unable to advance deeper than a brick structure, interpreted as the likely floor of the holder.
- The fill is comprised of cinders, ash and coal fragments, slag chips and brick fragments.
- Visible evidence of MGP impacts in the fill material was limited to a trace hydrocarbon sheen in one of the soil samples.
- A slight hydrocarbon odor was present in the fill; however, no PID evidence of MGP impacts was found during jar-headspace testing.

6.0 ANALYTICAL RESULTS - CLOVE AND MAPLE SITE

This section presents the analytical results for soil gas, soil, groundwater and NAPL samples collected during the PSA Investigation of the Clove and Maple MGP site. The laboratory reports which provide the results of the analyses are summarized in tables in the following sections.

The soil and groundwater samples collected during the PSA were analyzed for MGP indicator parameters which included:

- Volatile organic compounds by ASP Method 91-1;
- PAH compounds by ASP Method 91-2;
- Total cyanide by ASP Method CLP-M; and
- Target Analyte List (TAL) metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc by Method CLP-M.

To meet the data quality objectives for this project, NYSDEC Analytical Service Protocols (ASP) 1991 were used with Category B deliverables. Lancaster Laboratories of New Holland, Pennsylvania completed the laboratory analyses. Lancaster is currently listed with the New York Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) and has current CLP Certification for all analyte categories.

The evaluation of soil results in the following sections is based on a comparison to NYSDEC concentrations listed in NYSDEC Division of Hazardous Waste Remediation Technical and Guidance Memorandum (TAGM) HWR-94-4046 - Determination of Soil Cleanup Objectives and Cleanup levels (January, 1994). The results of the analysis of groundwater are compared to NYSDEC 6NYCRR Part 703 Water Quality Standards and NYSDEC Division of Water Technical and Operations Guidance Series (TOGS) Memorandum 1.1.1, (October, 1993).

6.1 Surface Soils Analysis

Nine surface soil samples (SS1 - SS9) were collected during the investigation. The sampling locations are shown on Figure 4-1. All surface soils were collected from a depth interval of between

0 and 0.5 feet bgs. The surface soils were submitted to the laboratory for the analysis of BTEX, PAHs, cyanide and TAL metals. Analytical results for the compounds detected in the surface soil samples are presented in Table 6-1.

6.1.1 Surface Soil - BTEX Analysis

The results of the analyses indicate that no BTEX compounds were detected in concentrations which were greater than the method detection limits for any of the nine samples submitted to the laboratory.

6.1.2 Surface Soil - PAH Analysis

Concentrations of individual PAH compounds exceeding the TAGM recommended cleanup objectives were found at each of the nine surface soil sample locations. Table 6-2 is a summary of the PAH compounds which were detected in the surface soil samples in concentrations exceeding the TAGM recommended cleanup objectives, the range detected and the respective sample locations.

6.1.3 Surface Soil - Metal Analysis

All TAL metals except thallium were detected in the nine samples. Table 6-3 presents a summary of the range of concentrations of all metals detected, the TAGM 4046 background value or range for eastern USA soils or New York State soils and the sample locations exceeding the background ranges.

6.1.4 Surface Soil - Cyanide Analysis

Cyanide was detected in seven out of nine surface soil samples. Concentrations of total cyanide ranged from 0.30 mg/Kg at SS9 to 32.8 mg/Kg in SS1. At the time of this report, no eastern USA background concentration range is listed in TAGM 4046. Measurements of free or amenable cyanide were not made. Cyanide at MGP sites is typically found in the form of complexed metal cyanides which are non-reactive (GRI, 1996).

Table 6-1
Soil Data Summary
Clove & Maple Street Site

	Subsurface Soils			Surface Soils										Associated Blanks (All values in µg/L)		
Sample ID	SB1 (20-22)	SB2 (12-14)	SB3 (10-12)	SS1	SS2	SS3	SS4	SS5	SS6	SS7	SS8	SS9	SS10	Equipment Blank	Trip Blank	NYSDEC Recommended Soil Cleanup Objective
Lab ID	2711767	2712436	2712435	2711759	2711761	2711762	2711756	2711755	2711764	2711765	2711766	2711763	2711760	2711768	2711769	
Sampling Date	05/14/97	05/15/97	05/15/97	05/14/97	05/14/97	05/14/97	05/13/97	05/13/97	05/14/97	05/14/97	05/14/97	05/14/97	05/14/97	05/14/97	05/14/97	
BTEX (µg/Kg)																
Benzene	11 U	4700	62000 D	12 U	1 J	12 U	13 U	11 U	11 U	13 U	11 U	11 U	12 U	10 U	10 U	60
Toluene	11 U	1700	140000 D	12 UJ	13 U	12 U	13 U	11 U	11 U	13 U	11 U	11 U	1 J	10 U	10 U	1500
Ethylbenzene	11 U	26000	65000 D	12 UJ	13 U	12 U	13 U	11 U	11 U	13 U	11 U	11 U	12 UJ	10 U	10 U	5500
Xylene (total)	11 U	62000	360000 D	12 UJ	13 U	12 U	13 U	11 U	11 U	13 U	11 U	11 U	12 UJ	10 U	10 U	1200
PAHs (µg/Kg)																
Naphthalene	350 U	560000 D	580000 D	1100 J	470	1400 J	120 J	19000 J	510 J	88 J	66 J	200 J	1000 J	11 U	-	13000
Acenaphthylene	350 U	38000	23000	1000 J	1200	7400	250 J	77000	5700	310 J	120 J	1300	880 J	11 U	-	41000
Acenaphthene	350 U	55000	12000	220 J	54 J	810 J	420 U	35000 J	580 J	130 J	70 J	710 U	180 J	11 U	-	50000
Fluorene	350 U	84000	83000 JD	240 J	190 J	4700	48 J	92000	2800	190 J	160 J	110 J	200 J	11 U	-	50000
Phenanthrene	42 J	330000 D	220000 D	3300 J	1200	69000 D	590	790000 D	50000 D	1600	1500	310 J	2400 J	11 U	-	50000
Anthracene	350 U	66000	58000 JD	680 J	1300	15000	120 J	520000 D	4000	290 J	230 J	350 J	600 J	11 U	-	50000
Fluoranthene	110 J	66000	88000 JD	5800	10000 D	100000 D	920	940000 D	46000 D	2000	2300	990	4700	11 U	-	50000
Pyrene	130 JB	140000 DB	120000 DB	5800 B	17000 DB	120000 DB	1300 B	1200000 DB	67000 DB	2400 B	2700 B	2200 B	5300 B	11 U	-	50000
Benzo(a)anthracene	51 J	37000	30000	3800	6900 D	46000 D	610	520000 D	23000 D	1200	1200	1300	3500	11 U	-	224 MDL
Chrysene	80 J	34000	28000	7500	7500 D	48000 D	890	530000 D	37000 D	1400	1500	1800	6600	11 U	-	400
Benzo(b)fluoranthene	120 J	22000	22000	10000	9800 D	55000 D	1300	450000 D	34000 D	1900	2100	3900	8900	11 U	-	1100
Benzo(k)fluoranthene	48 J	9300 J	7600	3100	3000	15000	460	120000	6900	750	790	1700	3400	11 U	-	1100
Benzo(a)pyrene	70 JB	30000 B	28000 B	2800 B	6400 DB	43000 DB	920 B	460000 DB	24000 DB	1400 B	1400 B	2000 B	2600 B	11 U	-	61 MDL
Indeno(1,2,3-cd)pyrene	66 JB	12000 B	14000 B	3700 B	7700 DB	31000 B	960 B	240000 B	14000 B	1300 B	1300 B	3100 B	3200 B	11 U	-	3200
Dibenzo(a,h)anthracene	350 U	3700 J	3900 J	1400 J	1600	7000	240 J	58000	4300	370 J	330 J	870	1200 J	11 U	-	14 MDL
Benzo(g,h,i)perylene	350 U	12000 B	8200 B	1800 B	9300 DB	24000 B	1000 B	230000 B	8500 B	1400 B	630 B	3200 B	1900 B	11 U	-	50000
METALS (mg/Kg)																
Aluminum	-	-	-	6130	6410	11300	10500	7270	10800	12800	9330	9980	7370	22.7 U	-	
Antimony	-	-	-	4.8 B	1.2 U	3.5 B	2.1 B	3.6 B	1.3 B	1.6 B	1.2 B	1.1 B	4.5 B	4.6 U	-	SB
Arsenic	-	-	-	21	8.1	18.8	13.4	37.8	6.6	10.8	4.1	4	19.2	5.1 U	-	7.5 SB
Barium	-	-	-	72.6	46 B	105	92.5	134	73.9	192	78.1	39.1 B	71.9	0.4 B	-	300 SB
Beryllium	-	-	-	0.25 B	0.52 B	0.41 B	0.53 B	0.36 B	0.47 B	1 B	0.35 B	0.36 B	0.28 B	0.98 U	-	0.16 SB
Cadmium	-	-	-	0.16 U	0.16 U	0.16 U	0.16 U	0.42 B	0.15 U	0.38 B	0.3 B	0.14 U	0.16 U	0.64 U	-	1 SB
Calcium	-	-	-	826 B	2230	1850	4070	3520	1060 B	3650	1890	859 B	911 B	618 B	-	SB
Chromium	-	-	-	14 *J	7.3 *J	23.4 *J	22.7 *J	19.9 *J	17 *J	16.9 *J	12.2 *J	11.9 *J	14.1 *J	1.1 U	-	10 SB
Cobalt	-	-	-	10.6 B	7 B	8.1 B	9.2 B	8.9 B	7.9 B	10.5 B	6.3 B	7.3 B	10.3 B	1.3 U	-	30 SB
Copper	-	-	-	153	34.6	62.8	49.4	118	21	59.6	29.9	19.1	138	1.8 U	-	25 SB
Iron	-	-	-	72600 *J	8930 *J	36500 *J	30600 *J	44100 *J	19400 *J	16500 *J	15500 *J	19100 *J	68400 *J	25 U	-	2000 SB
Lead	-	-	-	281	34.1	267	93.2	309	174	726	75.8	23.5	246	2.1 U	-	SB
Magnesium	-	-	-	1780	1920	3040	3910	3130	2940	3000	2950	3120	2350	23.6 B	-	SB
Manganese	-	-	-	322 N*J	150 N*J	363 N*J	478 N*J	358 N*J	548 N*J	382 N*J	526 N*J	443 N*J	345 N*J	0.22 U	-	SB
Mercury	-	-	-	3.3 N*J	0.1 N*J	0.9 N*J	0.9 N*J	3.1 N*J	0.1 BJ	0.15 N*J	0.2 N*J	0.036 BJ	3.2 N*J	0.054 B	-	0.1
Nickel	-	-	-	24.2	20	29.7	19.8	34.6	14.9	22.5	14.3	15.6	24	1.8 U	-	13 SB
Potassium	-	-	-	709 BJ	771 B	1170 B	1090 B	1120 B	790 B	1250 B	1060 B	1110	1140 BJ	23.8 B	-	SB
Selenium	-	-	-	4.5	1.3 B	2.9	1.9	4.7	1.3	1.7	0.87 B	1 B	4.5	3.7 U	-	2 SB
Silver	-	-	-	0.53 B	0.28 U	0.52 B	0.28 U	0.54 B	0.25 U	0.33 B	0.25 U	0.24 U	0.42 B	1.1 U	-	SB
Sodium	-	-	-	171 B	61.5 B	176 B	158 B	226 B	65.6 B	464 B	103 B	80.4 B	216 B	184 U	-	SB
Thallium	-	-	-	2.2 U	2.3 U	2.2 U	2.3 U	2 U	2 U	2.4 U	2 U	1.9 U	2.2 U	9 U	-	SB
Vanadium	-	-	-	46.6	19.2	40.1	24.9	37.5	23.3	42.4	19.5	17.9	44.4	0.7 U	-	150 SB
Zinc	-	-	-	66.4 J	34.9	180	216	337	70.8	272	133	52.3	143 J	2.9 U	-	20 SB
Cyanide	0.27 U	0.32 U	0.31 U	32.8	0.35	9.4	1.4	19.5	0.35	0.33 U	0.28 U	0.3	32.5	5 U	-	NL
GENERAL																
Moisture (% by wt.)	6.6	23.2	20.6	18.4	22	18	20.7	11	12	25.4	11.9	7.25	19.1	-	-	-

Notes:
Data Qualifiers from the data validation (Data Usability Report) are in bold text.
U - The material was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
J - The associated numerical value is an estimated quantity.
* - Duplicate analysis not within control limits. (Metals Analysis Only)
E - The reported value is estimated because of the presence of interference. (Metals Analysis Only)
B - Below the Contract Required Quantitation Limit (CRQL), but above the Instrument Detection Limit (IDL). (Metals Analysis Only)
D - Indicates an analysis at a secondary dilution.
SB - Site Background
MDL - Method Detection Limit
NL - Not Listed
- Not analyzed for

Table 6-2
PAH Surface Soil Results and TAGM Cleanup Objectives

Compound	Range in Concentration mg/Kg	TAGM 4046 Soil Cleanup Objective mg/Kg	Samples Exceeding Cleanup Objective
Napthalene	88 to 19000	13000	SS5
Acenapthylene	12 to 77000	41000	SS5
Fluorene	48 to 92000	50000	SS5
Phenanthrene	590 to 790000	50000	SS3, SS5, SS6
Anthracene	120 to 520000	50000	SS3, SS5
Fluoranthene	920 to 940000	50000	SS3, SS5
Pyrene	5800 to 1200000	50000	SS3, SS5, SS6
Benzo(a)anthracene	610 to 520000	224 or MDL	SS1, SS2, SS3, SS4, SS5, SS6, SS7, SS8, SS9
Chrysene	890 to 530000	400	SS1, SS2, SS3, SS4, SS5, SS6, SS7, SS8, SS9
Benzo(b)fluoranthene	1306 to 450000	1100	SS1, SS2, SS3, SS4, SS5, SS6, SS7, SS8, SS9
Benzo(k)fluoranthene	460 to 120000	1100	SS1, SS2, SS3, SS5, SS6, SS9
Benzo(a)pyrene	920 to 460000	61 or MDL	SS1, SS2, SS3, SS4, SS5, SS6, SS7, SS8, SS9
Indeno(1,2,3-cd) pyrene	960 to 240000	3200	SS1, SS2, SS3, SS5, SS6
Dibenzo(a,h)anthracene	240 to 58000	14 or MDL	SS1, SS2, SS3, SS4, SS5, SS6, SS7, SS8, SS9
Benzo(g,h,i)perylene	630 to 236000	50000	SS5

MDL - Method Detection Limit

Table 6-3
Surface Soil TAL Metals Results and TAGM Background Values

Metal	Range of Concentrations in Samples (mg/Kg)	TAGM 4046 Background Range (mg/Kg)	Samples Exceeding Background Range
Aluminum	6,130 to 12,800	33,000 (1)	
Antimony	1.1 to 4.8	NA	
Arsenic	4.0 to 57.8	3 to 12 (2)	SS3, SS4, SS5
Barium	39.1 to 192	15 to 600 (1)	
Beryllium	0.25 to 1.0	0 to 1.75 (1)	
Cadmium	ND < 0.160 to 0.42	0.1 to 1.0 (1)	
Calcium	826 to 2,230	130 to 35,000 (2)	
Chromium	7.3 to 22.7	1.5 to 40 (2)	
Cobalt	6.3 to 10.6	2.5 to 60 (2)	
Copper	19.1 to 153	1 to 50 (1)	SS1, SS3, SS5, SS7
Iron	8,930 to 72,600	2,000 to 550,000 (1)	
Lead	23.5 to 726	200 to 500 (3)	SS7
Magnesium	1,780 to 3,910	100 to 5,000 (1)	
Manganese	150 to 548	50 to 5,000 (1)	
Mercury	0.036 to 3.1	0.001 to 0.2 (1)	SS1, SS3, SS4, SS5, SS8
Nickel	14.3 to 34.6	0.5 to 25 (1)	SS3, SS5
Potassium	709 to 1170	8,500 to 43,000 (2)	
Selenium	0.87 to 4.7	0.1 to 3.9	SS1, SS5
Silver	0.33 to 0.54	NA	
Sodium	61.5 to 464	6,000 to 8,000 (1)	
Vanadium	17.9 to 46.6	1 to 300 (1)	
Zinc	34.9 to 337	9 to 50 (1)	SS1, SS3, SS4, SS5, SS6, SS7, SS8

NA - No range currently listed in TAGM 4046.
(1) - Background range for eastern USA soils.
(2) - Background range for New York State Soils.
(3) - Background range listed in TAGM 4046 for lead in metropolitan or suburban areas.

6.2 Subsurface Soils Analysis

Three subsurface soil samples were collected during installation of the monitoring wells. The samples represent the most impacted interval within each boring based on visual observations and

PID screening. If no impacts were observed the sample was collected immediately above the water table. Samples SB2 (12-14) and SB3 (10-12) were collected as a result of the detection of organic vapors with the PID and visible evidence of MGP constituents in soil at the specified depth. No visible or PID impacts were observed in boring SB1, therefore the sample from this boring was collected above the water table.

As specified in the work plan, the selection of subsurface soils for metals analysis was based on whether the soil represented native soil (not analyzed) or fill materials (analyzed). Subsurface soil samples selected for laboratory analysis during the PSA were all observed to be native soils, therefore no metals analyses were completed. The results of the analyses are presented in Table 6-1.

6.2.1 Subsurface Soil - BTEX Analysis

BTEX compounds were detected in concentrations which were greater than the method detection limits in two of the three subsurface soil samples. All of the BTEX detections from these samples were found to be greater than the NYSDEC TAGM 4046 Cleanup Objective values. Table 6-4 presents a summary of the BTEX detections and the TAGM Cleanup Objective concentrations.

Table 6-4
Subsurface Soil BTEX Results and TAGM Cleanup Objectives

Compound	NYSDEC TAGM Cleanup Objective (µg/Kg)	Sample Location and Concentration (µg/Kg)
Benzene	60	SB2(12-14) - 4700 SB3(10-12) - 62000
Toluene	1500	SB2(12-14) - 1700 SB3(10-12) - 140000
Ethylbenzene	5500	SB2(12-14) - 26000 SB3(10-12) - 65000
Xylene(total)	1200	SB2(12-14) - 62000 SB3(10-12) - 360000

6.2.2 Subsurface Soil - PAH Analysis

PAH compounds were detected in all three samples submitted for analysis. All PAH detections above the method detection limits for SB1(20-22) were estimated ("J" values) by the laboratory. For samples SB2 (20-22) and SB3 (10-12), fourteen of the sixteen PAH compounds were detected in concentrations greater than the NYSDEC TAGM 4046 soil cleanup objectives. Table 6-5 is a summary of the PAH compounds which were detected in the samples and the respective TAGM cleanup objective values.

Table 6-5
Subsurface Soil PAH Results and TAGM Cleanup Objectives

Compound	TAGM 4046 Soil Cleanup Objective µg/Kg	Sample Exceeding Cleanup Objective µg/Kg
Naphthalene	13,000	SB2 (20-22) - 560000 SB3 (10-12) - 580000
Acenapthene	50,000	SB2 (20-22) - 55000
Fluorene	50,000	SB2 (20-22) - 84000 SB3 (10-12) - 83000
Phenanthrene	50,000	SB2 (20-22) - 330000 SB3 (10-12) -220000
Anthracene	50,000	SB2 (20-22) -66000 SB3 (10-12) -58000
Fluoranthene	50,000	SB2 (20-22) - 66000 SB3 (10-12) -88000
Pyrene	50,000	SB2 (20-22) - 140000 SB3 (10-12) -120000
Benzo(a)anthracene	224 or MDL	SB1(120-22) - 51 SB2 (20-22) - 37000 SB3 (10-12) -30000
Chrysene	400	SB2 (20-22) - 34000 SB3 (10-12) -28000
Benzo(b)fluoranthene	1,100	SB2 (20-22) - 22000 SB3 (10-12) - 22000
Benzo(k)fluoranthene	1,100	SB2 (20-22) - 9300 SB3 (10-12) - 7600
Benzo(a)pyrene	61 or MDL	SB1(120-22) - 70 SB2 (20-22) - 30000 SB3 (10-12) -28000
Indeno(1,2,3-cd)pyrene	3,200	SB2 (20-22) - 12000 SB3 (10-12) -14000
Dibenzo(a,h)anthracene	14 or MDL	SB2 (20-22) - 3700 SB3 (10-12) - 3900

MDL - Method Detection Limit

6.2.3 Subsurface Soil - Cyanide Analysis

Cyanide was not detected in concentrations greater than the method detection limits for any of the three subsurface soil samples collected during the investigation.

6.3 Soil Gas - BTEX Analysis

One soil gas sample was sent to the laboratory from the Geoprobe soil gas survey completed at the site. Sample SG1 was taken from a location immediately adjacent to soil boring SG2, within the footprint of the gas holder. The analysis of the soil gas by Method USEPA 18 (modified), indicated that one BTEX compound was present above the method detection limits. Xylene (total sum of isomers) was found to be 4 ppm(v), a concentration slightly elevated above the method detection limit of 1 ppm(v).

6.4 Groundwater Analysis

Three groundwater samples were taken during the PSA. All samples were analyzed for VOC, PAH, cyanide and TAL metals. For all wells sampled (MW1, MW2 and MW3), turbidity could not be reduced to acceptable levels (less than 50 NTU) during sampling. A sample from each of these wells was field filtered and sent to the laboratory for TAL metal analysis. A summary of the results of the groundwater analyses are provided in Table 6-6.

6.4.1 Groundwater - VOC Analysis

Of the three groundwater samples, two samples contained volatile organic compounds in concentrations greater than the NYSDEC 6NYCRR Part 703 Water Quality Standards. For well MW2, only BTEX compounds were found to exceed the groundwater standards. For well MW3, BTEX compounds, acetone and styrene were found in concentrations greater than the groundwater standards. Table 6-7 provides a summary of the groundwater standards and the concentrations of samples which were found to be greater than the standards.

Table 6-6
Groundwater Data Summary
Clove & Maple Street Site

Sample ID Lab ID Sampling Date	MW1 2721778 06/03/97	MW1-F 2721779 06/03/97	MW2 2721780 06/03/97	MW2-F 2721781 06/03/97	MW3 2721782 06/03/97	MW3-F 2721783 06/03/97	Trip Blank 2721784 06/03/97	Groundwater Standard / Guidance Value
VOCs (μg/L)								
Chloromethane	10 U	-	100 U	-	40 U	-	10 U	NL
Vinyl Chloride	10 U	-	100 U	-	40 U	-	10 U	2 s
Bromomethane	10 U	-	100 U J	-	40 U	-	10 U	5 s
Chloroethane	10 U	-	100 U J	-	40 U	-	10 U	5 s
1,1-Dichloroethene	10 U	-	100 U	-	40 U	-	10 U	5 s
Acetone	10 U	-	100 U	-	200	-	10 U	50 g
Carbon Disulfide	10 U	-	100 U	-	40 U	-	10 U	NL
Methylene Chloride	10 U	-	100 U	-	40 U	-	4 J	5 s
1,1-Dichloroethane	10 U	-	100 U	-	40 U	-	10 U	5 g
1,2-Dichloroethene (total)	10 U	-	100 U	-	40 U	-	10 U	5 s
2-Butanone	10 U	-	100 U	-	22 J	-	10 U	NL
Chloroform	10 U	-	100 U	-	40 U	-	10 U	7 s
1,2-Dichloroethane	10 U	-	100 U	-	40 U	-	10 U	5 s
1,1,1-Trichloroethane	10 U	-	100 U	-	40 U	-	10 U	5 s
Carbon Tetrachloride	10 U	-	100 U	-	40 U	-	10 U	5 g
Benzene	10 U	-	5700 D	-	2200 D	-	10 U	0.7 s
Trichloroethene	10 U	-	100 U	-	40 U	-	10 U	5 s
1,2-Dichloropropane	10 U	-	100 U	-	40 U	-	10 U	5 s
Bromodichloromethane	10 U	-	100 U	-	40 U	-	10 U	50 g
cis-1,3-Dichloropropene	10 U	-	100 U	-	40 U	-	10 U	5 s
trans-1,3-Dichloropropene	10 U	-	100 U	-	40 U	-	10 U	5 s
1,1,2-Trichloroethane	10 U	-	100 U	-	40 U	-	10 U	5 s
Dibromochloromethane	10 U	-	100 U	-	40 U	-	10 U	50 g
Bromoform	10 U	-	100 U	-	40 U	-	10 U	50 g
4-Methyl-2-Pentanone	10 U	-	100 U	-	84	-	10 U	NL
Toluene	10 U	-	490	-	2800 D	-	10 U	5 s
Tetrachloroethene	10 U	-	100 U	-	40 U	-	10 U	5 s
2-Hexanone	10 U	-	100 U	-	40 U	-	10 U	50 g
Chlorobenzene	10 U	-	100 U	-	40 U	-	10 U	5 s
Ethylbenzene	10 U	-	680	-	700	-	10 U	5 s
Xylene (total)	10 U	-	1000	-	2800 D	-	10 U	5 s (each)
Styrene	10 U	-	100 U	-	1000 D	-	10 U	5 s
1,1,2,2-Tetrachloroethane	10 U	-	100 U	-	40 U	-	10 U	5 s
PAHs (μg/L)								
Naphthalene	9 U	-	3400 D	-	10000 D	-	-	10 g
Acenaphthylene	9 U	-	290 JD	-	320 J	-	-	20 g
Acenaphthene	9 U	-	39	-	590 U	-	-	20 g
Fluorene	9 U	-	52	-	65 J	-	-	50 g
Phenanthrene	9 U	-	60	-	71 J	-	-	50 g
Anthracene	9 U	-	13	-	590 U	-	-	50 g
Fluoranthene	9 U	-	7 J	-	590 U	-	-	50 g
Pyrene	9 U	-	9 J	-	590 U	-	-	50 g
Benzo(a)anthracene	9 U	-	2 J	-	590 U	-	-	0.002 g
Chrysene	9 U	-	2 J	-	590 U	-	-	0.002 g
Benzo(b)fluoranthene	9 U	-	1 J	-	590 U	-	-	0.002 g
Benzo(k)fluoranthene	9 U	-	12 U	-	590 U	-	-	0.002 g
Benzo(a)pyrene	9 U	-	2 J	-	590 U	-	-	0.002 MDL
Indeno(1,2,3-cd)pyrene	9 U	-	12 U	-	590 U	-	-	0.002 g
Dibenzo(a,h)anthracene	9 U	-	12 U	-	590 U	-	-	NL
Benzo(g,h,i)perylene	9 U	-	12 U	-	590 U	-	-	5 g
METALS (μg/L)								
Aluminum	1860	20.1 U	3150	869	1180	20.1 U	-	NL
Antimony	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	4.6 U	-	3 g
Arsenic	5.1 U	5.1 U	5.1 U	5.1 U	5.1 U	5.1 U	-	25 s
Barium	231	204	216	197 B	91.1 B	81 B	-	1000 s
Beryllium	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	-	3 g
Cadmium	0.64 U	0.64 U	0.64 U	0.64 U	0.64 U	0.64 U	-	10 s
Calcium	52400	52600	133000	135000	40100	39700	-	NL
Chromium	2.3 B	1.1 U	4 B	1.1 U	1.9 B	1.1 U	-	50 s
Cobalt	2 B	1.3 U	4.6 B	2.7 B	3.6 B	3.1 B	-	NL
Copper	4.3 B	1.8 U	5.9 B	1.9 B	4.4 B	1.8 U	-	200 s
Iron	3080 N* J	25 U J	4680 N* J	1250 N* J	2290 N* J	513 N* J	-	300 s
Lead	3.2	2.1 U	3.9	2.1 U	2.1 U	2.4 B	-	25 s
Magnesium	15900	15400	42600	42500	10000	9640	-	35000 s
Manganese	152	18.4	2900	2940	4310	4450	-	300 s
Mercury	0.083 B	0.09 B	0.081 B	0.065 B	0.09 B	0.069 B	-	2 s
Nickel	3.6 B	1.8 U	7.6 B	3.9 B	3.4 B	1.9 B	-	NL
Potassium	3610 B	3110 B	3170 B	2570 B	2150 B	1840 B	-	NL
Selenium	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	-	10 s
Silver	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	0.51 U	-	50 s
Sodium	83500 **J**	82700 **J**	12800 **J**	13200 **J**	17100 **J**	17200 **J**	-	20000 s
Thallium	5.2 U	5.2 U	5.2 U	5.2 U	5.2 U	5.2 U	-	4 g
Vanadium	5 B	0.7 U	5.9 B	2.3 B	2.2 B	0.7 U	-	NL
Zinc	10.9 B	4.2 B	14.8 B	7.7 B	7.7 B	5.5 B	-	300 s
Cyanide	5 U	-	129	-	7.4	-	-	100 s

Notes:
Data Qualifiers from the data validation (Data Usability Report) are in **bold** text.
U - The material was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
J - The associated numerical value is an estimated quantity.
N - Spiked sample recovery not within control limits.
* - Duplicate analysis not within control limits. (Metals Analysis Only)
B - Below the Contract Required Quantitation Limit (CRQL), but above the Instrument Detection Limit (IDL). (Metals Analysis Only)
D - Indicates an analysis at a secondary dilution.
g - Guidance
s - Standard
MDL - Method Detection Limit
NL - Not listed
\- Not analyzed for

Table 6-7
Groundwater VOC Results and Groundwater Standards

Compound	Groundwater Standard µg/L	Sample and Concentration µg/L
Acetone (Note 1)	50	MW3 - 200
Benzene	0.7	MW2 - 5700 MW3 - 2200
Toluene	5	MW2 - 490 MW3 - 2800
Ethylbenzene	5	MW2 - 680 MW6 - 700
Xylene (total sum of isomers)	5	MW2 - 1000 MW3 - 2800
Styrene (Note 1)	5	MW3 - 1000

(Note 1) - The occurance of acetone and styrene in the sample MW3 may be attributed to laboratory contamination.

6.4.2 Groundwater - PAH Analysis

Groundwater samples from two wells (MW2 and MW3) contained PAHs in concentrations greater than the method detection limits. No groundwater standards are currently listed in NYSDEC 6NYCRR Part 703 for these compounds; however, guidance values have been established. Table 6-8 summarizes the PAH detections and the NYSDEC guidance values.

6.4.3 Groundwater - TAL Metals Analysis

Three samples of groundwater were submitted to the laboratory for analysis of TAL metals. As previously discussed, at all of the well locations, turbidity could not be lowered below 50 NTU during groundwater sampling. Filtered metal samples were collected from these wells and submitted for TAL metal analysis. The results of the analyses are presented in Table 6-3.

Aluminum, barium, calcium, chromium, cobalt, copper, lead, mercury, nickel, potassium, vanadium and zinc were detected in the groundwater samples in concentrations above the method detection limits. All detections were found to be below the guidance values or standards for

Table 6-8
Groundwater PAH Results and NYSDEC Guidance Values

Compound	NYSDEC Guidance Value (µg/L)	Sample Exceeding Guidance Value (µg/L)
Naphthalene	10	MW2 - 3400 MW3 - 10000
Acenaphthylene	20	MW2 - 290 MW3 - 320
Acenapthene	20	MW2 - 39 MW3 - 590
Fluorene	50	MW2 - 52 MW3 - 65
Phenanthrene	50	MW2 - 60 MW3 - 71
Benzo(a)anthracene	0.002	MW2 - 2
Chrysene	0.002	MW2 - 2
Benzo(b)fluoranthene	0.002	MW2 - 1
Benzo(a)pyrene	0.002 or MDL	MW2 - 2

MDL - Method Detection Limit

groundwater in New York State. Note that at the time of this report, no guidance values or standards are listed for groundwater for aluminum, calcium, cobalt, nickel, potassium or vanadium.

Antimony, arsenic beryllium, cadmium, selenium, silver and thallium were not detected above the method detection limits for any of the groundwater samples taken during the investigation.

Levels of iron, magnesium, manganese and sodium were detected in concentrations exceeding the groundwater standards in several of the monitoring wells. Sodium is not typically a concern associated with MGP sites (GRI, 1996). Naturally occurring concentrations of iron and manganese frequently exceed groundwater standards due to natural hardness. Table 6-9 provides a summary of the detected metals concentrations which were found to be greater than the NYSDEC groundwater standards.

Table 6-9
Groundwater Metal Results and NYSDEC Standards

Compound	NYSDEC Groundwater Standard (s) or Guidance Value(g) (µg/L)	Sample Location and Concentration (µg/L)
Iron	300 (s)	MW1 - 3080 MW2 - 4680 MW3 - 2290
Magnesium	35000 (g)	MW2 - 42,600
Manganese	300 (s)	MW2 - 2900 MW3 - 4310
Sodium	20000 (s)	MW1 - 83500

6.4.4 Groundwater - Cyanide Analysis

Total cyanide was detected in wells MW2 and MW3 in concentrations greater than the method detection limits. The concentration in well MW2 (129 µg/L) was found to exceed the NYSDEC groundwater standard of 100 µg/L.

6.5 DNAPL Analysis

6.5.1 Hazardous Characteristics Analysis

During groundwater sampling, a two-foot thick DNAPL layer was found in MW2 well. A sample (designated MW2) was sent to the laboratory for analysis of RCRA Hazardous Characteristics including: cyanide reactivity, sulfide reactivity, corrositivity TCLP metals, TCLP pesticides/herbicides, TCLP BNA and TCLP VOC. The TCLP - benzene result of 609 mg/L was found to be above the 40 CFR Part 261 hazardous characteristic regulatory level of 0.5 mg/L. The TCLP results for arsenic (15 mg/L) and selenium (1.2 mg/L) were found to be greater than the regulatory limits of 5 mg/L and 1.0 mg/L respectively. A summary of these results is provided in Table 6-10.

Table 6-10
TCLP Data Summary
Haverstraw Site

Sample ID Lab ID Date Sampled	MW2 2739741 07/09/97	Regulatory Level
GENERAL		
Cyanide (Reactivity) (mg/Kg)	100 U	250
Sulfide (Reactivity) (mg/Kg)	50 U	500
pH	5.73	2.0 to 12.5
TCLP METALS (mg/L)		
Arsenic	15	5
Selenium	1.2	1
Barium	20 U	100
Cadmium	4 U	1
Chromium	8 U	5
Lead	20 U	5
Silver	4 U	5
Mercury	0.1 U	0.2
TCLP PEST/HERB (mg/L)		
Chlordane	30 U	0.03
Endrin	1 U	0.02
Heptachlor	1 U	0.008
Heptachlor Epoxide	1 U	0.008
Gamma BHC - Lindane	1 U	0.4
Methoxychlor	5 U	10
Toxaphene	400 U	0.5
2,4-D	1 U	10
2,4,5-TP	0.1 U	1
TCLP BNA (mg/L)		
1,4-Dichlorobenzene	100 U	7.5
2-Methylphenol	100 U	200
3-and 4-Methylphenol	100 U	200
Hexachloroethane	100 U	3
Nitrobenzene	100 U	2
Hexachlorobutadiene	100 U	0.5
2,4,6-Trichlorophenol	100 U	2
2,4,5-Trichlorophenol	100 U	400
2,4-Dinitrotoluene	100 U	0.13
Hexachlorobenzene	100 U	0.13
Pentachlorophenol	250 U	100
Pyridine	100 U	5
TCLP VOA (mg/L)		
Vinyl Chloride	50 U	0.2
1,1-Dichloroethene	50 U	0.7
Chloroform	50 U	6
1,2-Dichloroethane	50 U	0.5
2-Butanone	100 U	200
Carbon Tetrachloride	50 U	0.5
Trichloroethene	50 U	0.5
Benzene	690	0.5
Tetrachloroethene	50 U	0.7
Chlorobenzene	50 U	100

Notes:
U - The material was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.

6.5.2 Physical Characteristics Testing

A sample of the DNAPL from MW2 was sent to Southern Petroleum Laboratory in Houston, Texas for analysis of viscosity, density and surface tension. The objective of this testing was to obtain information regarding the mobility of the material. The results of the analysis are summarized in Table 6-11.

Table 6-11
SG9 - DNAPL Analysis

Analysis	Method	Results
Viscosity (at 60°F)	ASTM D-445	44.95 Centipoise
Specific gravity (at 60°F)	ASTM D-4052	1.0353
Surface Tension	ASTM D-1331	32 dynes/cm

The results of the testing and field observations indicate that the DNAPL sample from MW2 is slightly denser than water, and is a DNAPL. The material has a low viscosity, and therefore has the potential to move in the environment.

6.5.3 Infrared Spectral Analysis

A sample of DNAPL from MW2 was analyzed to determine the nature of the hydrocarbon found at that location. The sample was sent to RETEC's Pittsburgh, Pennsylvania Laboratory for analysis by the infrared spectral (FT-IR) technique. The results of the analysis indicate that the hydrocarbon present is a carburetted water gas tar.

7.0 ANALYTICAL RESULTS - MAPLE AND WEST SITE

This section presents the analytical results of soil, soil gas, groundwater samples collected during the PSA Investigation from the Maple and West site. The laboratory results are summarized in tables in the following sections.

The soil and groundwater samples collected during the PSA were analyzed for MGP indicator parameters which included:

- Volatile organic compounds by ASP Method 91-1;
- PAH compounds by ASP Method 91-2;
- total cyanide by ASP Method CLP-M; and
- Target Analyte List (TAL) metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc by Method CLP-M.

The evaluation of soil results in the following sections is based on a comparison to NYSDEC concentrations listed in NYSDEC Division of Hazardous Waste Remediation Technical and Guidance Memorandum (TAGM) HWR-94-4046 - Determination of Soil Cleanup Objectives and Cleanup levels (January, 1994). The results of the analysis of groundwater are compared to NYSDEC 6NYCRR Part 703 Water Quality Standards and NYSDEC Division of Water Technical and Operations Guidance Series (TOGS) Memorandum 1.1.1, (October, 1993).

7.1 Surface Soils Analysis

Two surface soil samples (SS1 and SS2) were collected during the investigation. The sampling locations are shown on Figure 3-1. The surface soils were submitted to the laboratory for the analysis of BTEX, PAHs, cyanide and TAL metals. Analytical results for the compounds detected in the surface soil samples are presented in Table 7-1.

Table 7-1
Soil Data Summary
Maple & West Street Site

	Subsurface Soils	Surface Soils		
Sample ID	SB1 (6-8)	SS1	SS2	NYSDEC
Lab ID	2708187	2708185	2708186	Recommended Soil
Sampling Date	05/09/97	05/08/97	05/08/97	Cleanup Objective
BTEX (µg/Kg)				
Benzene	7 J	12 U	12 U	60
Toluene	33 J	12 U	12 U	1500
Ethylbenzene	290	12 U	12 U	5500
Xylene (total)	840	12 U	12 U	1200
PAHs (µg/Kg)				
Naphthalene	40000	600 J	67 J	13000
Acenaphthylene	7600 J	820 J	290 J	41000
Acenaphthene	55000	360 J	390 U	50000
Fluorene	46000	630 J	70 J	50000
Phenanthrene	120000	5000	1000	50000
Anthracene	47000	1900 J	240 J	50000
Fluoranthene	62000	8200 **J**	1800	50000
Pyrene	75000	10000	2100	50000
Benzo(a)anthracene	34000	7600	1200	224 MDL
Chrysene	32000	7600	1500	400
Benzo(b)fluoranthene	28000 J	11000	1900	1100
Benzo(k)fluoranthene	9700 J	4500	820	1100
Benzo(a)pyrene	30000	8700	1400	61 MDL
Indeno(1,2,3-cd)pyrene	12000 J	4200	1000	3200
Dibenzo(a,h)anthracene	30000 U	1500 J	280 J	14 MDL
Benzo(g,h,i)perylene	9700 J	2400	1000	50000
METALS (mg/Kg)				
Aluminum	-	9000	7030	SB
Antimony	-	2.9 B	11.1 B	SB
Arsenic	-	4.4	7.3	7.5 SB
Barium	-	154	192	300 SB
Beryllium	-	0.36 B	0.31 B	0.16 SB
Cadmium	-	36.4	3.3	1 SB
Calcium	-	3800	6580	SB
Chromium	-	19.7 * **J**	23.2 * **J**	10 SB
Cobalt	-	8.9 B	11.4 B	30 SB
Copper	-	104	332	25 SB
Iron	-	30900	46800	2000 SB
Lead	-	289	667	SB
Magnesium	-	3840	3720	SB
Manganese	-	346 N **J**	357 N **J**	SB
Mercury	-	0.45 N **J**	1.7 N **J**	0.1
Nickel	-	21.2	30	13 SB
Potassium	-	1120 B	1010 B	SB
Selenium	-	1.7	3.4	2 SB
Silver	-	1.4 B	3.9	SB
Sodium	-	175 B	411 B	SB
Thallium	-	2.1 U	2.1 U	SB
Vanadium	-	27.8	60.3	150 SB
Zinc	-	519	1070	20 SB
Cyanide	2.2	0.75	0.39	NL
GENERAL				
Moisture (% by wt.)	17.8	15.7	15.1	-

Notes:
Data Qualifiers from the data validation (Data Usability Report) are in **bold** text.
U - The material was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
J - The associated numerical value is an estimated quantity.
* - Duplicate analysis not within control limits. (Metals Analysis Only)
N - Spiked sample recovery not within control limits.
B - Below the Contract Required Quantitation Limit (CRQL), but above the Instrument Detection Limit (IDL). (Metals Analysis Only)
SB - Site Background
MDL - Method Detection Limit
NL - Not Listed
- Not analyzed for

7.1.1 Surface Soil - BTEX Analysis

The results of the analyses indicate that no BTEX compounds were detected in concentrations which were greater than the method detection limits for the two samples submitted to the laboratory.

7.1.2 Surface Soil - PAH Analysis

Concentrations of individual PAH compounds exceeding the TAGM Cleanup Objectives were found at both of surface soil sample locations. Table 7-2 is a summary of the PAH compounds which were detected in concentrations exceeding the TAGM Cleanup Objectives and the respective sample locations.

Table 7-2
PAH Subsurface Soil Results and TAGM Cleanup Objectives

Compound	TAGM 4046 Soil Cleanup Objective (µg/Kg)	Samples Exceeding Cleanup Objective (µg/Kg)
Benzo(a)anthracene	224 or MDL	SS1 - 7600 SS2 - 1200
Chrysene	400	SS1 - 7600 SS2 - 1500
Benzo(b)fluoranthene	1100	SS1 - 11000 SS2 - 1900
Benzo(k)fluoranthene	1100	SS1 - 4500
Benzo(a)pyrene	61 or MDL	SS1 - 8700 SS2 - 1400
Indeno(1,2,3-cd) pyrene	3200	SS1 - 4200
Dibenzo(a,h)anthracene	14 or MDL	SS1 - 1500 SS2 - 280

MDL - Method Detection Limit

7.1.3 Surface Soil - Metal Analysis

Two surface soil samples were analyzed for TAL metals from the site. Table 7-3 provides a summary of the range and maximum concentrations of all metals detected, the TAGM 4046 background value or range for eastern USA soils or New York State soils and the sample locations exceeding the background ranges.

7.1.4 Surface Soil - Cyanide Analysis

Cyanide was detected in both of the surface soil samples in concentrations greater than the method detection limits. Concentrations ranged from 0.39 mg/Kg at SS3 to 0.75 mg/Kg in SS1. At the time of this report, no Eastern USA Background concentration range is listed in TAGM 4046. Measurements of free or amenable cyanide were not made. Cyanide at MGP sites is typically found in the form of complexed metal cyanides which are non-reactive (GRI, 1996).

7.2 Subsurface Soils Analysis

One subsurface soil sample was collected during installation of monitoring well MW1. The sample represented the most impacted interval within the boring based on visual observations and PID screening. As specified in the work plan, the selection of subsurface soils for metals analysis was based on whether the soil represented native soil (not analyzed) or fill materials (analyzed). The subsurface soil sample selected for laboratory analysis during the PSA was observed to be native soils, therefore no metals analyses were completed. The results of the analyses are presented in Table 7-1.

7.2.1 Subsurface Soil - BTEX Analysis

BTEX compounds were detected in concentrations which were greater than the method detection limits for sample SB1(6-8). All of the BTEX detections from these samples were found to be less than the NYSDEC TAGM 4046 Cleanup Objective values. Table 7-4 presents a summary of the BTEX detections and the TAGM Cleanup Objective concentrations.

Table 7-3
Surface Soil TAL Metals Results and TAGM Background Values

Metal	Range of Concentrations Detected in Samples (mg/Kg)	TAGM 4046 Background Range (mg/Kg)	Samples Exceeding Background Range
Aluminum	7030 to 9000	33,000 (1)	
Antimony	2.9 to 11.1	NA	
Arsenic	4.4 to 7.3	3 to 12 (2)	
Barium	154 to 192	15 to 600 (1)	
Beryllium	0.31 to 0.36	0 to 1.75 (1)	
Cadmium	3.3 to 36.4	0.1 to 1.0 (1)	SS1, SS2
Calcium	3800 to 6580	130 to 35,000 (2)	
Chromium	19.7 to 23.2	1.5 to 40 (2)	
Cobalt	8.9 to 11.4	2.5 to 60 (2)	
Copper	104 to 332	1 to 50 (1)	SS1, SS2
Iron	30,900 to 46800	2,000 to 550,000 (1)	
Lead	289 to 667	200 to 500 (3)	SS2
Magnesium	3720 to 3840	100 to 5,000 (1)	
Manganese	346 to 357	50 to 5,000 (1)	
Mercury	0.45 to 1.7	0.001 to 0.2 (1)	SS2
Nickel	21.2 to 30	0.5 to 25 (1)	SS2
Potassium	1010 to 1120	8,500 to 43,000 (2)	
Selenium	1.7 to 3.4	0.1 to 3.9	SS2
Silver	1.4 to 3.9	NA	
Sodium	175 to 411	6,000 to 8,000 (1)	
Thallium	27.8 to 60.3	NA	
Vanadium	27.8 to 60.3	1 to 300 (1)	
Zinc	519 to1070	9 to 50 (1)	

NA - No range currently listed in TAGM 4046.

(1) - Background range for eastern USA soils.

(2) - Background range for New York State Soils.

(3) - Background range listed in TAGM 4046 for lead in metropolitan or suburban areas.

Table 7-4
Subsurface Soil - BTEX Results Summary

Compound	NYSDEC TAGM Cleanup Objective (µg/Kg)	Sample SB1 (6-8) Concentration (µg/Kg)
Benzene	60	7
Toluene	1500	33
Ethylbenzene	5500	290
Xylene(total)	1200	840

7.2.2 Subsurface Soils - PAH Analysis

With the exception of dibenzo(a,h)anthracene, all PAH compounds were detected in sample SB1(6-8) in concentrations greater than the method detection limits. Concentrations of eleven of the PAH compounds were detected in concentrations greater than the NYSDEC TAGM 4046 soil cleanup objectives. Table 7-5 is a summary of the PAH compounds which were detected in the sample and the respective TAGM Cleanup Objective value.

7.2.3 Subsurface Soil - Cyanide Analysis

Cyanide was detected in SB1(6-8) in a concentrations of 2.2 mg/Kg. At the time of this report, no Eastern USA Background concentration range is listed in TAGM 4046. Measurements of free or amenable cyanide were not made. Cyanide at MGP sites is typically found in the form of complexed metal cyanides which are non-reactive (GRI, 1996).

7.3 Soil Gas - BTEX Analysis

One soil gas sample was sent to the laboratory from the Geoprobe soil gas survey completed at the site. Sample SG1 was taken from a location immediately adjacent to soil boring SG7, within the footprint of the gas holder. The analysis of the soil gas by Method USEPA 18 (modified), indicated that no BTEX compounds were present above the method detection limits.

Table 7-5
Subsurface Soil PAH Results and TAGM Cleanup Objectives

Compound	TAGM 4046 Soil Cleanup Objective µg/Kg	Concentration SB1 (6-8) µg/Kg
Naphthalene	13,000	40,000
Acenapthene	50,000	55,000
Phenanthrene	50,000	120,000
Fluoranthene	50,000	62,000
Pyrene	50,000	75,000
Benzo(a)anthracene	224 or MDL	34,000
Chrysene	400	32,000
Benzo(b)fluoranthene	1,100	28,000
Benzo(k)fluoranthene	1,100	9,700
Benzo(a)pyrene	61 or MDL	30,000
Indeno(1,2,3-cd)pyrene	3,200	12,000
Dibenzo(a,h)anthracene	14 or MDL	12,000

MDL - Method Detection Limit

7.4 Groundwater Analysis

One groundwater sample was taken during the PSA. The sample was analyzed for VOC, PAH, cyanide and TAL metals. A summary of the results of the groundwater analyses are provided in Table 7-6.

7.4.1 Groundwater - VOC Analysis

The sample of groundwater from MW1 was found to contain one volatile organic compound in a concentration greater than the NYSDEC 6NYCRR Part 703 Water Quality Standards. Benzene was detected in the well in a concentration of 550 µg/L, a concentration which is greater than the groundwater standard of 0.7 µg/L.

Table 7-6
Groundwater Data Summary
Maple & West Street Site

Sample ID Lab ID Sampling Date	MW-1 2721785 06/03/97	MW1 2721787 06/04/97	Equipment Blank 2721786 06/03/97	Trip Blank 2721788 06/03/97	Groundwater Standard / Guidance Value
VOCs (µg/L)					
Chloromethane	10 U	-	10 U	10 U	NL
Vinyl Chloride	10 U	-	10 U	10 U	2 s
Bromomethane	10 U	-	10 U	10 U	5 s
Chloroethane	10 U	-	10 U	10 U	5 s
1,1-Dichloroethene	10 U	-	10 U	10 U	5 s
Acetone	10 U	-	10 U	10 U	50 g
Carbon Disulfide	10 U	-	10 U	10 U	NL
Methylene Chloride	10 U	-	10 U	10 U	5 s
1,1-Dichloroethane	10 U	-	10 U	10 U	5 g
1,2-Dichloroethene (total)	10 U	-	10 U	10 U	5 s
2-Butanone	10 U	-	10 U	10 U	NL
Chloroform	10 U	-	10 U	10 U	7 s
1,2-Dichloroethane	10 U	-	10 U	10 U	5 s
1,1,1-Trichloroethane	10 U	-	10 U	10 U	5 s
Carbon Tetrachloride	10 U	-	10 U	10 U	5 g
Benzene	550 D	-	10 U	10 U	0.7 s
Trichloroethene	10 U	-	10 U	10 U	5 s
1,2-Dichloropropane	10 U	-	10 U	10 U	5 s
Bromodichloromethane	10 U	-	10 U	10 U	50 g
cis-1,3-Dichloropropene	10 U	-	10 U	10 U	5 s
trans-1,3-Dichloropropene	10 U	-	10 U	10 U	5 s
1,1,2-Trichloroethane	10 U	-	10 U	10 U	5 s
Dibromochloromethane	10 U	-	10 U	10 U	50 g
Bromoform	10 U	-	10 U	10 U	50 g
4-Methyl-2-Pentanone	10 U	-	10 U	10 U	NL
Toluene	2 J	-	10 U	10 U	5 s
Tetrachloroethene	10 U	-	10 U	10 U	5 s
2-Hexanone	10 U	-	10 U	10 U	50 g
Chlorobenzene	10 U	-	10 U	10 U	5 s
Ethylbenzene	10 U	-	10 U	10 U	5 s
Xylene (total)	10 U	-	10 U	10 U	5 s (each)
Styrene	10 U	-	10 U	10 U	5 s
1,1,2,2-Tetrachloroethane	10 U	-	10 U	10 U	5 s
PAHs (µg/L)					
Naphthalene	4 J	-	11 U	-	10 g
Acenaphthylene	2 J	-	11 U	-	20 g
Acenaphthene	4 J	-	11 U	-	20 g
Fluorene	3 J	-	11 U	-	50 g
Phenanthrene	8 J	-	11 U	-	50 g
Anthracene	3 J	-	11 U	-	50 g
Fluoranthene	6 J	-	11 U	-	50 g
Pyrene	6 J	-	11 U	-	50 g
Benzo(a)anthracene	4 J	-	11 U	-	0.002 g
Chrysene	3 J	-	11 U	-	0.002 g
Benzo(b)fluoranthene	3 J	-	11 U	-	0.002 g
Benzo(k)fluoranthene	1 J	-	11 U	-	0.002 g
Benzo(a)pyrene	3 J	-	11 U	-	0.002 MDL
Indeno(1,2,3-cd)pyrene	2 J	-	11 U	-	0.002 g
Dibenz(a,h)anthracene	11 U	-	11 U	-	NL
Benzo(g,h,i)perylene	2 J	-	11 U	-	5 g
METALS (µg/L)					
Aluminum	-	38900	20.1 U	-	NL
Antimony	-	6.9 B	4.6 U	-	3 g
Arsenic	-	18	5.1 U	-	25 s
Barium	-	724	0.13 U	-	1000 s
Beryllium	-	1.5 B	0.98 U	-	3 g
Cadmium	-	2.8 B	0.64 U	-	10 s
Calcium	-	194000	68.3 B	-	NL
Chromium	-	55.9	1.1 U	-	50 s
Cobalt	-	32.2 B	1.3 U	-	NL
Copper	-	142	1.8 U	-	200 s
Iron	-	72300 N* J	25 U J	-	300 s
Lead	-	188	2.7 B	-	25 s
Magnesium	-	85800	17.6 B	-	35000 s
Manganese	-	1920	0.96 B	-	300 s
Mercury	-	0.64	0.038 B	-	2 s
Nickel	-	77	1.8 U	-	NL
Potassium	-	14200	37.3 B	-	NL
Selenium	-	4.7 B	3.7 U	-	10 s
Silver	-	0.63 B	0.51 U	-	50 s
Sodium	-	53300 J	184 UE J	-	20000 s
Thallium	-	5.5 B	8.8 B	-	4 g
Vanadium	-	60.3	0.7 U	-	NL
Zinc	-	443	3.7 B	-	300 s
Cyanide	404	-	5 U	-	100 s

Notes:
Data Qualifiers from the data validation (Data Usability Report) are in **bold** text.
U - The material was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
J - The associated numerical value is an estimated quantity.
N - Spiked sample recovery not within control limits.
* - Duplicate analysis not within control limits. (Metals Analysis Only)
B - Below the Contract Required Quantitation Limit (CRQL), but above the Instrument Detection Limit (IDL). (Metals Analysis Only)
D - Indicates an analysis at a secondary dilution.
E - The reported value is estimated because of the presence of interference. (Metals Analysis Only)
g - Guidance
s - Standard
MDL - Method Detection Limit
NL - Not listed
\- Not analyzed for

7.4.2 Groundwater - PAH Analysis

A groundwater sample from MW1 contained PAHs in concentrations which were found to be lower than the method detection limits. The reported detections for this well were estimated ("J" values) by the laboratory. No groundwater standards are currently listed in NYSDEC 6NYCRR Part 703 for these compounds; however, guidance values have been established. Table 7-7 summarizes the estimated PAH concentrations which were greater than the guidance values.

Table 7-7
Groundwater PAH Concentrations and NYSDEC Guidance Values

Compound	NYSDEC Guidance Value µg/L	MW1 Result Exceeding Guidance Value µg/L
Benzo(a)anthracene	0.002	4
Chrysene	0.002	3
Benzo(b)fluoranthene	0.002	3
Benzo(k)fluoranthene	0.002	1
Benzo(a)pyrene	0.002 or MDL	3
Indeno(1,2,3-cd)pyrene	0.002	2

MDL - Method Detection Limit

7.4.3 Groundwater - TAL Metals Analysis

The sample of groundwater from MW1 was submitted to the laboratory for analysis of TAL metals. As previously mentioned, there was limited sample volume from MW1 due to slow recharge of the well. A filtered metal sample was not collected from MW1. Table 7-8 provides a summary of the detected concentrations which were above NYSDEC guidance or standard values.

7.4.4 Groundwater - Cyanide Analysis

Total cyanide was detected in well MW1 in a concentration of 404 µg/L. This concentration is greater than the NYSDEC groundwater standard of 100 µg/L.

Table 7-8
Groundwater Metal Results

Compound	NYSDEC Groundwater Standard or Guidance Value (µg/L)	Concentration in well MW1 Exceeding Standard (µg/L)
Antimony	3	6.9
Chromium	50	55.9
Iron	300	72300
Lead	25	188
Magnesium	35000	85800
Manganese	300	1920
Sodium	2000	53300
Thallium	4	5.5
Zinc	300	443

8.0 DATA USABILITY SUMMARY REPORT

This data usability report is provided for soil, water, and air samples collected from the above referenced site during the period from May 8, 1997 through June 4, 1997. Copies of the chain-of-custody forms for each sample are included as an attachment to this report. A total of 16 soil samples, 5 groundwater samples, 4 blank water samples, and 2 air samples were submitted for analysis. These samples were collected from two portions of the site identified as Haverstraw West and Maple and Haverstraw Clove and Maple. Analytical methods employed were:

1) Volatile Organics by NYSDEC ASP 91-1
2) Polynuclear Aromatic Hydrocarbons (PAHs) by NYSDEC ASP 91-2
3) Target Analyte List (TAL) Inorganics by NYSDEC ASP CLP-M
4) Volatile Organics in Air by USEPA Method 18

In order to evaluate the usability of the data, the following Quality Control (QC) operations were considered:

- Sample Collection and Preservation;
- Holding Times;
- Instrument Calibration (initial and continuing calibration);
- Instrument Tuning Criteria (GC/MS)
- Laboratory Control Sample (LCS) Recoveries;
- Surrogate Spike Recoveries (organics)
- Internal Standard Area Recoveries (organics)
- Blank Sample Results (laboratory blanks, trip blanks, field blanks, method blanks);
- Spike Sample Recoveries (analytical spikes and matrix spikes); and
- Duplicate Sample Results (matrix spike duplicates, laboratory duplicates, field duplicates)

This review is based on the USEPA National Functional Guidelines for Organic and Inorganic Data Review. Based upon this review, data are determined to be:

1) valid, useable - All QC within acceptable limits. No qualifiers added.

2) estimated, useable - Certain QC criteria not met due to matrix interferences or minor laboratory deficiencies. Result should be considered an estimated value. (J) qualifier added.

3) invalid, unusable - Data suffers from serious matrix interferences or laboratory deficiencies. Results are considered unusable. (R) qualifier added.

The following sections summarize the results of the data review.

8.1 Volatile Organics (VOCs)

Water and soil samples were analyzed for selected volatile organics according to NYSDEC-ASP method 91-1. All samples were analyzed within the holding times required by the ASP method. Instrument tuning and calibration requirements were within method specifications with the following exception: The continuing calibration standard analyzed on 06/13/97 had a %D greater than 25% for bromomethane and chloroethane. Based upon this, results for these two compounds are qualified as (J) for sample MW-2 from the Clove and Maple site. Laboratory control samples were within the acceptable ranges supplied by the laboratory. Laboratory blanks showed no contamination above the required detection limits. Surrogate, matrix spike, and internal standard recoveries were within acceptable limits with the exception of internal standard area recoveries for samples SS1 and SS10 from the Clove and Maple site. These samples showed low internal standard area recoveries for chlorobenzene - d5. The samples were reanalyzed with similar results, indicating a matrix effect. Based upon these low recoveries, toluene, ethylbenzene, and total xylenes results are qualified as (J) in these two samples.

No additional validation qualifiers were added to the VOC data.

8.2 Semivolatile Organics (SVOCs)

Water and soil samples were analyzed for polynuclear aromatic hydrocarbons (PAHs) according to NYSDEC - ASP method 91-2. All samples were extracted and analyzed within the required holding times. Instrument tuning and calibration requirements were met for all parameters of interest, with the exception of the continuing calibration standard from 5/22/97, which showed a high %D for fluoranthene. Based upon this, fluoranthene in sample SS-1 from the West and Maple site is qualified as (J). Surrogate, matrix spike, and internal standard area recoveries were within required limits except where dilutions were made do to sample concentrations. A matrix spike (identified as Dry) was analyzed with samples SB-2 (12-14) and SB-3 (10-12) and showed poor surrogate and spike recoveries. This sample, however, was a batch QC sample selected by the laboratory and was not associated with this site. Therefore, no validation qualifiers were added based upon these recoveries. Pentachlorophenol was not recovered in the matrix spike or matrix spike duplicate for the soil samples from the West and Maple site, however this was not a constituent of interest during this sampling, so no validation flags were added. Method blanks did not show contamination above the required reporting limit. Pyrene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and benzo(ghi) perylene were found at levels below the quantitation limit in the blank associated with soil samples from the Clove and Maple site. These compounds are qualified with a (B) flag in the laboratory data. Since the levels in the blank were below the quantitation limit, no additional validation qualifiers were added.

Method 91-2 requires gel permeation clean-up (GPC) for all soil samples. The resolution criteria of 90% between perylene and sulfur in the GPC check standards was not met for the soil samples from the West and Maple site. Since calibration with sulfur is optional, no validation flags were added.

No additional validation qualifiers were added to the SVOC data.

8.3 Inorganics

Analysis for target analyte list (TAL) inorganics was performed for water and soil samples according to NYSDEC ASP method CLP-M. All metals with the exception of mercury were analyzed by inductively coupled plasma (ICP) spectroscopy. Mercury was determined by cold vapor atomic absorption spectroscopy. Cyanide was determined colorimetrically.

Samples SB-1 (6-8), SB-1 (20-22), SB-3 (10-12), and SB-2 (12-14) were analyzed for cyanide only.

All analyses were performed within the method required holding times. All instrument calibration criteria were also found to meet method requirements.

Several metals results were qualified as estimated (J) due to poor matrix spike recovery or precision between sample duplicates. Chromium, iron, manganese, mercury, and iron in several soil samples and iron in the groundwater samples are so qualified. Sodium results in all groundwater samples are also qualified (J) due to matrix interferences.

No additional data qualifiers were added to the inorganics data.

8.4 Air Samples

Two air monitoring samples were analyzed for volatile organics by USEPA method 18. Data was found to be valid and no qualifiers were added.

8.5 Field Duplicates

Sample SS-10 from the Clove and Maple site is a field duplicate of sample SS-1. The criteria for the relative percent difference (RPD) between results from soil field duplicates was set at 30% for this project. With the exception of phenanthrene, potassium, and zinc, all other parameters were within the acceptable criteria for RPD between field duplicates. The results for phenanthrene, potassium, and zinc are qualified as (J) based upon an RPD greater than 30% between field duplicates.

No other validation qualifiers were added based upon field duplicate results.

Table 8-1
Data Quality Summary
Haverstraw Site (Maple and West)

Sample ID	VOC	SVOC	Inorganics
SS-1	V	**J (fluoranthene)**	**J (Cr, Mn, Hg)**
SS-2	V	V	**J (Cr, Mn, Hg)**
SB-1 (6-8)	V	V	V
MW-1	V	V	**J (Fe,Na)**
EB6W	V	V	**J (Fe,Na)**
TB	V	NA	NA
SG-1	V	NA	NA

Table 8-2
Data Quality Summary
Haverstraw Site (Clove and Maple)

Sample ID	VOC	SVOC	Inorganics
SS-5	V	V	**J (Cr, Fe, Mn, Hg)**
SS-4	V	V	**J (Cr, Fe, Mn, Hg)**
SS-1	**J (toluene, ethylbenzene, xylenes**	**J (phenanthrene)**	**J (Cr, Fe, Mn, Hg, K, Zn)**
SS-10	**J (toluene, ethylbenzene, xylenes**	**J (phenanthrene)**	**J (Cr, Fe, Mn, Hg, K, Zn)**
SB-1 (20-22)	V	V	V
SS-2	V	V	**J (Cr, Fe, Mn, Hg)**
SS-3	V	V	**J (Cr, Fe, Mn, Hg)**
SS-9	V	V	**J (Cr, Fe, Mn, Hg)**
SS-6	V	V	**J (Cr, Fe, Mn, Hg)**
SS-7	V	V	**J (Cr, Fe, Mn, Hg)**
EBCM	V	V	V
SS-8	V	V	**J (Cr, Fe, Mn, Hg)**
TB (5/14)	V	NA	NA
SB-3 (10-12)	V	V	V
SB-2 (12-14)	V	V	V
MW-1	V	V	**J (Fe, Na)**
MW-2	**J (bromomethane, chloroethane)**	V	**J (Fe, Na)**
MW-3	V	V	**J (Fe, Na)**
TB	V	NA	NA
SG-1	V	NA	NA

9.0 POTENTIAL RISKS

This section integrates the existing data gathered at the Haverstraw MGP sites and qualitatively identifies potential risks associated with impacted media. This qualitative evaluation is accomplished by identifying potential sources, migration routes, receptors and exposure pathways for the Clove and Maple and Maple and West MGP sites.

9.1 Clove and Maple MGP Site

The Clove and Maple MGP site is owned by Orange and Rockland. The site is zoned for commercial or light industrial use although it is currently unused except for a gas regulator station operated by Orange and Rockland. To the south is a vacant building formerly used to manufacture nails, while to the east, north and west are residences. While the site is largely unused by Orange and Rockland, it is used by local residents as a park where recreational activities occur such as volleyball and soccer games.

Potential sources and migration routes in this area are discussed in Section 9.1.2. Potential onsite receptors and exposure pathways are described in Section 9.1.3 and an evaluation of groundwater migration is presented in Section 9.1.4. Conclusions are presented in Section 9.1.5.

9.1.1 Potential Sources and Migration Pathways

Potential sources of MGP constituents include hydrocarbons in a small area of surface soils near the gas regulator station, and hydrocarbons in the subsurface soil along the eastern part of the site under or near the former locations of the iron oil tank, tar well and the gas holder.

Nine surface soil samples (with one duplicate) were collected from the site. There were no exceedences of TAGMs for BTEX, but there were exceedences of TAGMs for PAHs in every sample. The highest concentrations were at SS5 near the gas regulator station, SS3 at the southeastern corner of the site, and SS6 at the northeastern corner. To put the PAH concentrations in these surface soil samples in context, Menzie et al. (1992) present ranges of potentially carcinogenic PAHs (i.e., benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluorathene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene) in different settings. Table 9-1 presents the minimum, median and maximum concentrations of potentially carcinogenic PAHs

Table 9-1
Ranges of Total Potentially Carcinogenic PAHs in Different Settings

Setting	Minimum (mg/kg)	Median (mg/kg)	Maximum (mg/kg)
Urban	0.06	1.1	5.8
Road Dust	8	137	336

in a typical urban setting and in road dust. The total potentially carcinogenic PAHs in the nine samples range from 5.4 mg/kg to 2,378 mg/kg with a median of 32.3 mg/kg. These concentrations are well above those observed in a typical urban setting indicating that these concentrations are not due to the ambient conditions of an urbanized area.

In subsurface soil samples from soil borings SB2 and SB3, there were exceedences of TAGMs for all BTEX and most PAH compounds. These two borings are located along the eastern part of the site where hydrocarbons were found in subsurface soil. In subsurface soil samples from soil boring SB1, there was an exceedence of the TAGM for benzo(a)pyrene, but this exceedence was slight (70 μg/kg at SB1 as compared to the TAGM of 61 μg/kg). SB1 is located on the western part of the site which is upgradient from much of the former MGP buildings and structures. A number of soil gas samples were analyzed with a PID, but the only one with a positive reading was the sample from SG2 in the gas holder. A soil gas sample was taken from this location and analyzed for BTEX. Benzene, toluene and ethylbenzene were below detection limits in this sample and xylene was found slightly above its detection limit.

In monitoring well MW1, which is upgradient, no BTEX, PAHs or cyanide were detected. In the two downgradient wells, MW2 and MW3, all BTEX compounds were found above NYSDEC groundwater standards and several PAHs were also found above these standards. In MW2, cyanide was found above its groundwater standard. Measurable DNAPL was found in MW2.

Based on these potential sources, the potential migration routes for constituents at the Clove and Maple MGP site are summarized as follows:

- emissions to air in the form of volatilization (primarily the lower molecular weight PAHs) and fugitive dust from surface soil;

- emissions to air in the form of volatilization and fugitive dust from subsurface soil uncovered by hypothetical future excavation;

- leaching of constituents from soil and hydrocarbon-impacted materials to groundwater; and

- transfer of constituents dissolved in on-site groundwater to off-site groundwater.

Potential migration of COI in groundwater and associated receptors are addressed in Section 9.1.4.

9.1.2 Potential On-Site and Nearby Receptors and Exposure Pathways

Potential current receptors for the Clove and Maple MGP site are presented in Table 9-2. Under current site use, possible receptors include utility workers, groundskeepers, recreational users, and local residents. This site is owned by Orange and Rockland and they intend to continue the current use for the foreseeable future, so future receptors will be the same as current receptors.

Table 9-2

Current and Future On-Site and Nearby Receptors

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current and Future Land Use				
Utility Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete but direct exposure to soil is infrequent.
	subsurface soil and DNAPL	soil air	ingestion dermal inhalation.	Pathways potentially complete but excavation work is infrequent.
Groundskeeper	surface soil	soil air	ingestion dermal inhalation	Pathway potentially complete. Landscaping activities are of short duration limiting exposure.
Recreational User	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
Local Resident	surface soil	air	inhalation	Pathway potentially complete, but exposure likely to be very low.

Utility workers occasionally come onto the site to monitor, maintain and repair the gas regulators. About once a month, workers come on the site to change charts in the regulator station. They are on the site about 15 minutes to perform this activity. Two to three times a year, workers come on the site for about 3 hours to perform maintenance and two times a year workers may spend half a day changing pressures in the gas lines. During these activities, workers can potentially be exposed to constituents in surface soils through incidental ingestion, dermal contact and inhalation of volatilized constituents and fugitive dust. This work is done on a concrete pad so the opportunity to directly contact soil and be exposed via incidental ingestion and dermal contact is limited. On a very infrequent basis, subsurface utility lines may require repair. In this case, workers will excavate soil to uncover the lines and in the process can be exposed to constituents in both surface and subsurface soil. Because tarry material was observed in surface soil near the regulator station, workers have significant opportunity to contact this material during excavation.

Groundskeepers who cut the grass on the site may be potentially exposed via direct contact with surface soil including incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. The grass is cut once a month between May and October, an activity that takes about 1 hour. Once in the spring and once in the fall, groundskeepers engage in a general site cleanup that takes all day. Although the concentrations of PAHs were elevated in some surface soil samples, these workers are on the site for a short period of time so their opportunity for exposure is low.

Recreational users are individuals who use the Clove and Maple site as a park. These individuals may engage in volleyball, soccer or other recreational activities on the site. In these activities, they may be exposed to constituents through incidental ingestion, dermal contact and inhalation of volatilized constituents and fugitive dust. These individuals can be on the site frequently, particularly in the warmer months. Also, if these individuals live near the site, they can be exposed to constituents in surface soils when they are not on the site via inhalation of constituents emitted from the site as volatilized gases or on fugitive dust. Because the concentrations of PAHs were elevated in some surface soil samples and these individuals can visit the site frequently, recreational users have a significant opportunity for exposure.

Local residents who do not use the site for recreational purposes can be indirectly exposed to constituents in surface soil through the processes of volatilization and fugitive dust emission and subsequent dispersion with wind to off site areas. Exposure from these migration pathways are likely to be very low. BTEX were at or below detection limits in all surface soil samples, so the only potentially volatile constituents are the low molecular weight PAHs which have lower volatility than

BTEX and lower toxicity than benzene (i.e., the lower molecular weight PAHs are not considered carcinogenic). Exposures from fugitive dust emission are typically very low even at sites with high concentrations of constituents in surface soil. Exposures to local residents from volatilization and fugitive dust emissions are thus likely to be very low.

Potential exposures to these individuals are examined in more detail in a follow up surface soil investigation and quantitative risk assessment of the Haverstraw Clove and Maple MGP site.

9.1.3 Evaluation of Groundwater Migration

Groundwater under the site is currently not used as a source of drinking water. Since Haverstraw is serviced by a municipal water supply, groundwater under the site is not expected to be used as a source of drinking water at any time in the foreseeable future. The potential receptors of groundwater at the Clove and Maple MGP site are:

- the underground utility lines along Maple Avenue;
- buildings downgradient of the site that can potentially receive constituents volatilizing from groundwater into soil gas and subsequently intruding into the basement;
- the Hudson River to the east; and
- the public water supply reservoir of Haverstraw.

The underground utility lines along Maple Avenue could have a gravel-like base which is highly permeable and could provide a preferential flow path for DNAPL and groundwater, at least for short distances. This is possible because groundwater at this site is shallow, so all or parts of these utility lines, particularly the base, may be below the water table. If groundwater flows along utility lines, it would only be for short distances migration distances could increase if cracks in the storm sewer line are present and groundwater or DNAPL enter the piping. Overall, groundwater flows toward the Hudson River to the east. If DNAPL is found along these utility lines, utility workers could be exposed to constituents in the DNAPL during excavations conducted to repair or maintain these lines.

Groundwater in MW2 and MW3 have detectable levels of BTEX. Over time, this groundwater is expected to flow under Maple Avenue and under the houses and apartment buildings on the other side of Maple Avenue. In theory, BTEX in groundwater could volatilize into soil gas and seep into the houses or buildings. While theoretically possible, such exposures are unlikely to be significant for two reasons. First, the seepage velocity is estimated to be in the range of 1 to 10 feet/year, so groundwater flows at a low rate allowing natural attenuation to reduce concentrations before the houses or apartment buildings are reached. Second, the soil gas samples taken in impacted areas of the site had low readings on a PID and the soil gas sample with the highest PID had no detectable benzene, toluene or ethylbenzene. Thus, significant soil gas concentrations do not appear to be generated in the soil at this site. The only circumstance where these pathways might possibly be significant is if free product has migrated from the site to the groundwater under the houses or apartment buildings.

The ultimate discharge point for groundwater is the Hudson River. Groundwater is flowing at a seepage velocity of 1 to 10 feet/year and the Hudson River is about 1000 feet from the site. Thus, it will take on the order of 100 to 1000 years for groundwater to reach the river. This provides ample time for constituents to be removed by natural attenuation processes. Thus, it is unlikely that groundwater from the site will affect the Hudson River.

The other theoretical receptor of groundwater from the MGP site is the public water supply system for Haverstraw. The municipality obtains its water from a reservoir that is in the highlands west of the site. This reservoir is upgradient of the site so groundwater from the site cannot impact it. In summary, onsite groundwater cannot affect the Haverstraw public water supply reservoir.

9.1.4 Conclusions

Four potential onsite or nearby receptors were identified for the Clove and Maple MGP site. Utility workers can potentially be exposed to constituents in surface soil while servicing the gas regulator station. However, this work is done on a concrete pad, thereby limiting contact with surface soil, and these workers are on the site infrequently. The greatest potential for exposure to soil would occur during excavation activities to repair underground utility lines. Such activities are quite rare so overall exposure would be low. However, since tar has been found in the vicinity of the gas regulator station, workers could contact tar during excavation work.

Groundskeepers can potentially be exposed to constituents in surface soil while cutting the grass and performing semi-annual site cleanups. These receptors have a high potential to contact surface soil but are on the site for short durations of time. Because they are on the site for such a short period of time, their opportunity for exposure is low.

Recreational users are local residents who use the site for recreational activities such as volleyball or soccer. These individuals have a high potential to contact soil and can be on the site frequently, particularly in the warmest months of the year. Thus, these individuals have a significant opportunity for exposure.

Local residents who do not use the site for recreational purposes can be indirectly exposed to constituents in surface soil through volatilization and fugitive dust emission from onsite soils. However, since BTEX were at or below detection limits in all surface soil samples, volatilization is not likely to be significant and fugitive dust emissions are unlikely to lead to significant exposures. Thus, exposures to local residents from these pathways are likely to be very low.

Potential exposures to these four receptors are examined in more detail in a follow up surface soil investigation and quantitative risk assessment.

Four potential receptors of constituents in groundwater were identified. DNAPL in the subsurface may potentially migrate along the gravel-like base of subsurface utility lines that run along Maple Avenue. If such migration is occurring, utility workers could be exposed to DNAPL during excavations to repair or maintain these lines.

The houses and apartment buildings downgradient of the site can potentially receive constituents volatilizing from groundwater into soil gas and subsequently intruding into basements. Because (1) groundwater is moving slowly at this site, thereby providing the opportunity for natural attenuation to reduce concentrations at offsite locations, and (2) onsite soil gas data indicates that significant soil gas concentrations are not generated in these soils, migration from groundwater to houses or buildings via soil gas is unlikely to be significant. The only circumstances where these pathways might possibly be significant is if free product has migrated from the site to groundwater under the houses and apartment buildings.

The Hudson River to the east is the ultimate discharge point for groundwater. However, because groundwater moves at a slow rate relative to the distance to the Hudson River, there is ample time for natural attenuation processes to reduce constituent concentrations before groundwater reaches the river. Thus, it is unlikely that groundwater from the site will affect the Hudson River.

The final theoretical receptor of groundwater from the Clove and Maple MGP site is the public water supply system for Haverstraw. Since this reservoir is upgradient and uphill from the site, onsite groundwater cannot affect the reservoir.

9.2 Maple and West MGP Site

9.2.1 Site Setting

The Maple and West MGP site is not owned by Orange and Rockland. The site is zoned for light industrial use although it is currently a vacant lot. The site is bordered by residential properties and a commercial garage building. Access to the site is restricted by fencing along three sides, although the fence is in poor condition. The fourth side is next to a commercial establishment located in a garage.

Potential sources and migration routes in this area are discussed in Section 9.2.2. Potential on-site receptors and exposure pathways are described in Section 9.2.3 and an evaluation of groundwater migration is presented in Section 9.2.4. Conclusions are offered in Section 9.2.5.

9.2.2 Potential Sources and Migration Pathways

Potential sources of MGP constituents include hydrocarbon residuals in subsurface soil near the former MGP building and in surface soil within the footprint of the former gas holder and former MGP building. No free product or tar was observed within the gas holder, although a small amount of tarry material was found in soil boring SB1.

One subsurface soil sample (SB1) was collected from the boring for MW1, and the surface soil samples were collected from the location of the former gas holder (SS1) and former MGP building (SS2). There were no exceedence of TAGMs for BTEX, but there were exceedences of TAGMs for PAHs in all three soil samples. The highest concentrations were at SB1, in which TAGMs were exceeded for twelve PAHs. TAGMs were exceeded for seven potentially carcinogenic PAHs in SS1 and five potentially carcinogenic PAHs in SS2. The total potentially carcinogenic PAHs were 8.8 mg/kg in SS2 and 45.1 mg/kg in SS1. These values are outside the range of potentially carcinogenic PAHs observed in typical urban settings (see Table 9-1) suggesting that these concentrations are not due to ambient conditions in an urban area.

A number of soil gas samples were analyzed with a PID, but the only significant readings were taken from borings SG6 and SG7 near the former gas holder. A soil gas sample was taken in this location within the gas holder and analyzed for BTEX; however, no constituents were found above their detection limits.

Only one well (MW1) was drilled on the site in a location believed to be downgradient of the former gas holder. Benzene was the only VOC above NYSDEC water quality standards, and six carcinogenic PAHs were found above their standards. In addition, cyanide and a few metals were detected above NYSDEC water quality standards.

Based on these potential sources, the potential migration routes of constituents at the Maple and West MGP site are summarized as follows:

- emissions to the air in the form of volatilization (primarily the lower molecular weight PAHs) and fugitive dust from surface soil;
- emissions to the air in the form of volatilization and fugitive dust from soil uncovered by hypothetical future excavation;
- leaching of constituents from soil and hydrocarbon impacted materials to groundwater; and
- transfer of constituents dissolved in on-site groundwater to off-site groundwater.

Potential migration of COI in groundwater is addressed in Section 9.2.4.

9.2.3 Potential On-Site and Nearby Receptors and Exposure Pathways

Potential current receptors for the Maple and West MGP site are presented in Table 9-3. Under current site use, the only potential on-site and nearby receptors are site visitors and nearby residents. The site has been recently purchased, suggesting the potential for redevelopment of the site. As such, future receptors may include utility workers, construction workers, and future occupants.

Since Orange and Rockland does not own the site, the frequency of site visitation cannot be controlled. Although surface soils are not covered at this site, access is restricted. Visitors entering the site, whether they be owners or unauthorized visitors, may potentially be exposed via direct contact with surface soil including incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. However, since visits are likely to be infrequent due to access restrictions, exposures could be minimal.

Table 9-3

Current and Future On-Site and Nearby Receptors

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current Land Use				
Site Visitor	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete, although exposure is limited by infrequent visits.
Local Resident	surface soil	air	inhalation	Pathway potentially complete but exposure is likely to be very low.
	subsurface soil	air	inhalation	Pathway incomplete.
Future Land Use				
Utility Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
	subsurface soil	soil air	ingestion dermal inhalation	Pathways potentially complete
Construction Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
	subsurface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
Future Occupant	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.

Local residents could potentially be indirectly exposed to constituents in surface soil through the processes of volatilization and fugitive dust emission from onsite areas and subsequent dispersion with wind to offsite locations. Exposures from these pathways are likely to be very low. BTEX were below detection limits in the two surface soil samples so volatile emissions are unlikely to be significant. Fugitive dust emissions generate significant exposures only at highly impacted sites where significant dust is generated; neither condition is present at this site. Local residents can also be theoretically exposed to constituents in subsurface soil through vapor intrusion. No buildings are present on the site, so exposure from vapor intrusion into an onsite building is not a concern. Although residential structures are present in the vicinity of this site, they are of sufficient distance that vapor migration from unsaturated subsurface soil on the site is not a concern. The closest structures to the site are the concrete block building adjacent to the south side of the site, and the underground stormwater culvert along the eastern (downgradient) side of the site. These structures were observed from the outside, but neither of these structures were accessible for more detailed inspection. The floor of the building is elevated several feet above the ground surface on a thick concrete foundation, therefore it is unlikely that a migration pathway for vapors to the building exits. The storm sewer culvert is located adjacent to the site, therefore, the potential exists for vapors to impact the underground pipeline if residuals are present in the subsurface. However, since BTEX compounds were not detected in soil gas samples, such vapor intrusion is expected to be minimal.

In a future scenario in which the site is redeveloped, utility workers may excavate the on-site storm sewer or other subsurface utilities present on the site and potentially be exposed via direct contact with subsurface soil. Likewise, construction workers may be potentially exposed via direct contact with surface and subsurface soil while the site is being developed. If development resulted in the construction of a building on the site, future occupants may be potentially exposed via direct contact with surface soil. Because concentrations of BTEX compounds in the soil gas sample from this former gas holder area were below detection limits, the migration of COI to indoor air in a newly constructed building would likely be negligible.

9.2.4 Evaluation of Groundwater Migration

Groundwater under the site is currently not used as a source of drinking water. Since Haverstraw is serviced by a municipal water supply, groundwater under the site is not expected to be used as a source of drinking water at any time in the foreseeable future. The potential receptors of groundwater at the Maple and West MGP site are:

- the underground storm sewer and utility lines;
- buildings downgradient of the site that can potentially receive constituents volatilizing from groundwater into soil gas and subsequently intruding into the basement;
- the Hudson River to the east; and
- the public water supply reservoir of Haverstraw.

The underground utility lines may have a gravel-like base which is highly permeable and may provide a preferential flow path for DNAPL and groundwater, at least for short distances. However, no separate phase DNAPL was encountered at the site. In addition, the hydraulic conductivity of the clay aquifer is so low that groundwater levels in a slug test did not recover for two days. Given the absence of DNAPL and the low permeability of the aquifer, this migration pathway is not likely to be significant.

Groundwater in MW1 has detectable levels of BTEX. Over time, this groundwater will flow underneath buildings adjacent to the site. In theory, BTEX in groundwater could volatilize into soil gas and seep into the buildings. While theoretically possible, such exposures are unlikely to be significant for two reasons. First, the seepage velocity is estimated to be less than 1 foot/year, so groundwater flows at a low rate allowing natural attenuation to reduce concentrations before the off-site buildings are reached. Second, the soil gas samples taken in impacted areas of the site had low readings on a PID and the soil gas sample with the highest PID did not contain detectable BTEX. Thus, significant soil gas concentrations do not appear to be generated in the soil found at this site. The only circumstance where these pathways might possibly be significant is if free product has migrated from the site under the apartment buildings.

The ultimate discharge point for groundwater is the Hudson River. As already discussed, groundwater is flowing at a seepage velocity of less than 1 foot/year and the Hudson River is about 1000 feet from the site. Thus, it will take on the order of 1000 years or more for groundwater to reach the river. This provides ample time for constituents to be removed by natural attenuation processes. Thus, it is unlikely that groundwater from the site will affect the Hudson River.

The other theoretical receptor of groundwater from the MGP site is the public water supply system for Haverstraw. The municipality obtains its water from a reservoir that is in the highlands west of the site. This reservoir is upgradient of the site so groundwater from the site cannot impact it. In summary, onsite groundwater cannot affect the Haverstraw public water supply reservoir.

9.2.5 Conclusion

Five potential on-site and nearby receptors were identified for the Maple and West MGP site. Site visitors can potentially be exposed to constituents in surface soil, although visitation is believed to be infrequent so exposures to soil should be limited. Local residents can potentially be indirectly exposed to constituents in surface soil as a result of volatilization and fugitive dust emissions, but these migration routes are not expected to be significant at this site. Local residents and commercial businesses are sufficiently far from the site so as to minimize the potential for exposure via inhalation of vapors intruding from the subsurface into indoor air. Also, BTEX compounds were below detection limits in a soil gas sample, indicating that vapor intrusion is not likely to be a significant pathway.

Should the site undergo redevelopment, utility workers and construction workers could potentially be exposed to surface and subsurface soils. Because the concentrations of certain PAHs were elevated in the surface and subsurface soil samples, these workers have a significant opportunity for exposure even though they are on the site for a short period of time. Future occupants however, may contact surface soils for a longer duration, and so have greater opportunity for prolonged exposure.

Four potential receptors of constituents in groundwater were identified. Since separate phase DNAPL was not encountered at the site, migration of DNAPL along subsurface utility lines is unlikely to occur.

The buildings downgradient of the site can potentially receive constituents volatilizing from groundwater into soil gas and subsequently intruding into basements. Because (1) groundwater is moving very slowly at this site, thereby providing the opportunity for natural attenuation to reduce concentrations at offsite locations, and (2) onsite soil gas data indicates that significant soil gas concentrations are not generated in these soils, migration from groundwater to buildings via soil gas is unlikely to be significant.

The Hudson River to the east is the ultimate discharge point for groundwater. However, because groundwater moves at a very slow rate relative to the distance to the Hudson River, there is ample time for natural attenuation processes to reduce constituent concentrations before groundwater reaches the river. Thus, it is unlikely that groundwater from the site will affect the Hudson River.

The final theoretical receptor of groundwater from the Maple and West MGP site is the public water supply system for Haverstraw. Since this reservoir is upgradient and uphill from the site, onsite groundwater cannot affect the reservoir.

10.0 CONCLUSIONS

This section summarizes the findings of the PSA for the Haverstraw Clove and Maple site and the West and Maple site. Each site is discussed separately in the following sections. An overall view of the nature and extent of COI is presented by area of concern and by media and presents recommendations for future action.

10.1 Site Geology

The following provides a set of conclusions related to the geology of the site:

Clove and Maple Site

- A surface layer of industrial fill material was found on the majority of the site. The fill material was found to be thicker in the area of the former MGP buildings and in the area of the site which is adjacent to Maple Avenue.
- The fill consists primarily of sand and gravel, cinders, ashes, brick fragments and coal fragments.
- Underlying the fill are alluvial deposits of sand, gravel and clayey silt.
- Bedrock, consisting of an arkose or mudstone, underlies the site at an unknown depth.

West and Maple Site

- A surface layer of industrial fill material was found on the majority of the site. The fill material was found to be thicker in the area surrounding the former gas holder.
- The fill consists primarily of sand and gravel, cinders, ashes, brick fragments and coal fragments.
- Underlying the fill are alluvial deposits of which consist primarily of a dense silty clay.

10.2 Site Hydrogeology

The following provides a set of conclusions related to the hydrogeology of the site:

Clove and Maple Site

- June 1997 water level measurements indicate the depth to the water table varies across the site ranging from approximately 20 feet bgs at MW1 to 6 feet bgs at MW2 and MW3.
- Groundwater flow beneath the site is downhill (southeast) towards Maple Avenue with a gradient of 0.0006 feet/foot across the site. The water table is very flat, which minimizes the rate of off-site migration of groundwater.
- The hydraulic conductivity of the aquifer ranged from 1.2×10^{-2} cm/sec at MW1 to 1.5×10^{-4} cm/sec at MW3.
- The predicted average horizontal velocity of groundwater flow is calculated to range from 3.7 feet/year at MW1 to 0.47 feet/year at MW3.
- No monitoring wells were installed downgradient of the site. Based on the topography and depth to water at the site the water table downgradient of the site is predicted to be relatively shallow (6 to 8 feet deep).

West and Maple

- Groundwater was found at a depth of approximately 7 feet bgs at the site.

10.3 Nature and Extent of COI

Four media were observed to be of concern at the site including surface soil, subsurface soil (including soil gas), groundwater, and DNAPL. A set of conclusions related to each media is summarized in the following sections.

10.3.1 Surface Soil

The following provides a set of conclusions related to the surface soil sampling and analyses conducted at the site:

Clove and Maple

- The site is vacant except for an Orange and Rockland gas regulator station. This site is used for recreational purposes by neighboring residents.
- No BTEX compounds were detected in the nine surface soil samples.
- Concentrations of individual PAHs exceeding TAGM Cleanup Objectives were found at all nine sample locations.
- The greatest concentrations of PAHs were found in the area of SS5, where visible accumulations of the tar-like material is exposed at ground surface, and along the southeast corner of the site (SS3).
- Arsenic, copper, mercury, nickel, selenium and zinc were detected in site surface soils above TAGM background ranges.
- Cyanide was detected in the surface soil samples in concentrations up to 32.8 mg/Kg.

Maple and West

- No BTEX compounds were detected in the surface soil samples.
- Concentrations of seven individual PAH compounds were detected above TAGM 4046 Cleanup Objectives.
- Cadmium, copper, lead, mercury, nickel and selenium were detected in site surface soils above TAGM background ranges.

10.3.2 Subsurface Soil

The following provides a set of conclusions related to the subsurface soil sampling and analyses conducted at the site:

Clove and Maple

- Subsurface soil along the eastern side of the site is impacted by hydrocarbons, with both hydrocarbon-stained and saturated soils present.

- Elevated BTEX and PAH levels (above TAGM Cleanup Objectives) were found in two out of three borings, both of which are located on the downgradient (Maple Avenue) area of the site.

- No significant concentrations of soil gas were found beneath the site. No buildings which could act as receptors for soil gas are present at the site.

Maple and West

- At MW1 soils above and below the water table were observed with hydrocarbon staining, sheens, and small amounts of free product. Soil was also impacted outside the holder at boring SG6.

- BTEX compounds detected in sample SB1 were less than TAGM Cleanup Objectives.

- Eleven PAH compounds were detected in sample SB1 in concentrations greater than the TAGM Cleanup Objectives.

- No significant concentrations of soil gas were found beneath the site. No buildings which could act as receptors for soil gas are present at the site.

10.3.3 Groundwater

The following provides a set of conclusions related to the groundwater sampling and analyses conducted at the site:

Clove and Maple

- Field observation of odors and visible signs of impacts showed groundwater impacts at MW2 and MW3.

- BTEX compounds were found to exceed NYSDEC groundwater standards in the wells (MW2 and MW3) along the eastern section of the site.

- Nine PAH compounds were detected in concentrations greater than NYSDEC guidance values in wells MW2 and MW3.

- Metals exceeding the NYSDEC groundwater standards was limited to iron, magnesium, manganese and sodium.

- Cyanide was found in well MW2 in a concentration greater than the NYSDEC standard.

- Free product (DNAPL) was found in monitoring well MW2 on the downgradient side of the site.

Maple and West

- Groundwater at the site has benzene and cyanide above the NYSDEC groundwater standards. Trace concentrations of PAHs were also found, some of which exceed groundwater guidance values.

- Metals exceeding NYSDEC groundwater standards or guidance values included antimony, chromium, iron, lead, magnesium, manganese, sodium, thallium and zinc.

10.4 Areas of Concern

A summary of the areas of concern is presented in the following sections. Areas of concern were selected based on the presence of DNAPL and/or elevated COI levels (above NYSDEC TAGM Cleanup Criteria or NYSDEC 6NYCRR Part 703 Water Quality Standards) in surface and subsurface soils, or groundwater.

10.4.1 Clove and Maple

Former Gas Holder

- Visibly impacted soil is present within the footprint of the foundation of the former gas holder.

- Visibly impacted soil and groundwater was found outside of the holder to the north (SG1) and to the southeast (MW3).

Former Tar Well

- No subsurface structure was found as a result of the three soil borings completed within the footprint of the former tar well location.

- Visibly impacted fill, soil and groundwater were found in the area of the former tar well.

Former 30,000 Gallon Oil Tank

- Impacted fill, soil and groundwater were found in the area of the former oil tank.
- A 2-foot thick layer of DNAPL was found in MW2, a well considered downgradient of the former tank location.
- Analysis of the DNAPL from well MW2 indicated the material exceeds the hazardous waste characteristic limits for benzene, arsenic and selenium.

10.4.2 Maple and West

- The subsurface investigation appeared to have found the location of the gas holder. The holder contains typical MPG fill materials (bricks, ash, coal, and soil). Some of the fill exhibited a slight odor and had a slight hydrocarbon sheen. No free product or tar was observed.
- The source of the soil and groundwater impacts at the site cannot be determined. The use of the site as a gas plant, the historical indications of an adjacent railroad line, a salvage yard, a dumping ground and currently as an equipment yard for a construction business all could lead to some of the observed impacts.

10.5 Recommendations

10.5.1 Interim Remedial Measures (IRMs)

IRMs are warranted when existing site conditions pose an immediate threat to human health or the environment. Such conditions often come about due to ongoing releases of contaminants to surface water, groundwater, or soil gas; where exposure pathways allow the receptors to come into contact with the materials; and where contaminant exposure yields acute health hazards.

Clove and Maple

At the Clove and Maple site a small area of surface soil was found to be impacted by tar and PAH compounds. Although contact with tar from MGP sites is not an acute risk to receptors, this area has been covered with gravel to prevent contact with persons who may visit the site. Covering this soil was done in conjunction with an extensive surface soil sampling event to assess the distribution and concentration of PAHs and metals in the soil. The interpretation of the results is ongoing. Upon completion, an evaluation of the need for an IRM for surface soil will be made.

No IRMs are recommended for other conditions observed at the site at this time. Additional site investigation work is necessary, as described in the following section. At the completion of that work the need for IRMs should be reevaluated.

Maple and West

No IRMs are necessary at the Maple and West site. Although groundwater is slightly impacted, the low levels of constituents measured in the water, combined with the depth of water (seven feet below ground surface) and the lack of buildings with basements immediately at the site makes it unlikely that there is an immediate exposure to site residuals.

10.5.2 Additional Investigations

Additional work should be performed to complete the understanding of site conditions.

Clove and Maple

- Additional groundwater monitoring wells should be installed on-site along Maple Street, downgradient of the DNAPL and impacted groundwater observed at the site. The purpose of these wells is to assess the condition of groundwater at the property line. At least one well should be located downgradient of the DNAPL at MW2, and one well downgradient of the impacted soil and water at SG8 and MW3. If possible, these wells should be installed on the western side of Maple Street.

- Additional investigation (borings or test pits) should be performed to attempt to determine whether the tar well is present at the site.

- Additional borings should be performed around MW2 to delineate the extent of the DNAPL.

- Following delineation of the DNAPL and the installation of additional monitoring wells, a deep boring and well should be advanced immediately downgradient of the DNAPL to assess whether downward migration of the material has occurred.

Maple and West

- Additional borings should be performed to delineate the extent of soil impact at the site, and to determine whether these impacts are limited to the site. Targets for this investigation are the holder and impacted soil found to the north and east of the structure.

- At minimum of two additional monitoring wells should be installed on or off-site to define the direction of groundwater flow and whether impacted groundwater is migrating off-site. Due to the small size of the site, downgradient wells will be installed off-site. One well should be installed in the alley east of the site, and one on the south side of the garage building located along the south side of the site.

- A sample of the most impacted soil observed in the soil at MW1 should be obtained for chemical "fingerprinting" to identify the source of the hydrocarbons.

11.0 REFERENCES

Bouwer, Herman, 1989, *The Bouwer and Rice Slug Test - An Update*, Groundwater, V. 27, no. 3, May-June 1989.

Brown's Directory of North American and International Gas Companies, (1887 - 1957).

Freeze, R.A. and Cherry, J.A., 1979, *Groundwater*, Prentice - Hall, Inc., Englewood Cliff, NJ.

GRI, 1996, *Management of Manufactured Gas Plant Sites*, Amherst Scientific Publishers, Amhert, Massachusetts, 1996.

Menzie, C.A., B.B. Potocki, and J. Santodonato. *Exposure to Carcinogenic PAHs in the Environment, Environmental Science and Technology*, Vol. 26, No. 7, 1992.

New Historical Atlas of Rockland County, *A Portion of Haverstraw*, 1876.

NYSDEC, 1993, *Ambient Water Quality Standards and Guidance Values*, Division of Water Technical and Operational Guidance Series (1.1.1), October 1993.

NYSDEC, 1994. *Revised TAGM - Determination of Soil Cleanup Objectives and Cleanup Levels*, memo from Michael J.O'Toole, HWR-94-4046, January.

Peck, 1921, *Yard Piping Map*, Gas Distribution Plant, West Shore Gas Company, December 8, 1921.

RETEC, 1997a, *Preliminary Site Assessment Work Plan For Suffern, Middletown-Fulton Street, and Haverstraw, New York, Former Manufactured Gas Plant Sites*, Orange and Rockland Utilities, Inc. Pearl River, New York, April, 1996.

RETEC, 1997b, *Quality Assurance Project Plan For Suffern, Middletown-Fulton Street, and Haverstraw, New York, Former Manufactured Gas Plant Sites*, Orange and Rockland Utilities, Inc. Pearl River, New York, April, 1996.

RETEC, 1997c, *Site Specific Health and Safety Plan for Suffern, Middletown-Fulton Street and Haverstraw, New York, Former Manufactured Gas Plant Sites*, Orange and Rockland Utilities, Inc. Pearl River, New York, April, 1996.

APPENDIX A

BORING AND WELL COMPLETION LOGS
WEST AND MAPLE SITE

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-1

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 8.02
START DATE: 5-8-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 16	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	60	0-4	0.0		FILL		Fill material consisting of: 40% Sand, trace debris. 10% Gravel, angular to subround. At 3.8' becomes cinders, coal fragments, ash tar-like material in spoon tip, slight odor, moist.
5	40	4-8	0.0				Fill material consisting of: 50 % Brown sand 20% Angular gravel, trace coal fragments. Becomes Silty sand, grey, poorly sorted, trace gravel, moist, no odor.
10	20	8-12	1120				40% gray, fine sand. 30% Clayey silt, grey and brown in mottled pattern. 10% Sand stone and shale fragments, strong hydrocarbon odor, moist to wet.
15	60	12-16	446		CL		Silty clay, gray, firm, moist. 20% Rounded pebbles, strong hydrocarbon odor.
							End of boring.

REMARKS:
Soil gas results- 0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-2

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.02
START DATE: 5-8-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 16.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
0–4	75	0-4	0.0		FILL		Fill material consisting of: 10% Topsoil. 10% Silty sand, brown, loose, moist. 10% Concrete fragments Becomes black at 3.2', no odor.
4–8 (5)	30	4-8	0.0		SP		Sand, grey, coarse, wet, no odor. 10% Gravel, white granitic and grey shale, rounded.
8–12 (10)	100	8-12	0.0		CL		Clay, grey, medium plasticity, uniform, wet, no odor.
12–16 (15)	100	12-16	0.0				Clay, grey, medium, plasticity, uniform, wet, no odor. Trace silt. Becomes stiff at 14.2'
16							End of boring.

REMARKS:
Soil gas results ND < 0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-3

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.23
START DATE: 5-8-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 10.5	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	55	0-4	0.0		FILL		Fill material consisting of: 70% Ash, cinders, coal fragments. 30% Brick fragments. 10% Gravel, slight odor, moist.
5	60	4-8	0.0				Fill material consisting of: White ash, cinders, slag, chips, slight odor, moist. Becomes clayey silt, wet, trace brick fragments Slight hydrocarbon odor, trace hydrocarbon sheen.
10	75	8-10.5	0.0				Brick plug in spoon tip.
							Refusal at 10.5'. End of boring.

REMARKS:
Soil gas results- 0.0 ppm/PID.
Headspace water sample results- ND <0.0 ppm/PID.

RETEC

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-4

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORNAGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.38
START DATE: 5-8-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 11.2	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	60	0-4	0.0		FILL		Fill material consisting of: 80% sand, brown, medium, loose, poorly sorted. 10% Angular rock fragments. 10% Brick fragments, no odor, moist.
5	75	4-8	0.0		CL		Clay, grey and tan in mottled pattern. Trace angular rock fragments, no odor, moist.
10	90	8-11.2	0.0				Clay, grey, soft, uniform, no odor wet.
					SP		Sand, grey, medium, slight hydrocarbon odor.
							Refusal at 11.2' below ground surface. End of boring.

REMARKS:
Soil gas results - ND < 0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-5

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.80
START DATE: 5-8-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 11.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	30	0-4	0.0		FILL		Fill material consisting of: 30% Sand, brown, loose. 20% Cinder and ash. 10% Angular rock fragments.
5	100	4-8	0.0		CL		Clay, grey, firm, moist, uniform, no odor 0.1' of black silt at 4.8'.
					SP		At 6.8 to 7.3' sand, grey, coarse, no odor.
10	100	8-11	0.0		CL		Clay, grey, uniform, stiff, no odor, wet. Clay, grey, uniform, stiff, Parts along Horizontal. 1 inch layers, trace orange silt in seams, no odors, wet. Becomes stiff at 11.0'
							Refusal at 11' below ground surface. End of boring.

REMARKS:
Soil gas results- NO < 0.0ppm/ PID>

RETEC

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-6

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 8.02
START DATE: 5-9-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	80	0-4	133		FILL		Fill material consisting of : 60% Ash, cinders, brick fragments. 30% Silt, grey stiff, trace angular rock fragments Moist, no odor.
5		4-8	0.0		SP		Sand, brown, medium, moist, no odor.
					CL		At 6.2' Becomes clay, grey, stiff, uniform, slight odor, trace silt. Clay, grey, stiff, uniform, slight hydrocarbon odor. Trace silt in laminations. Silt is brown, very fine grained, wet.
10		8-12	0.0				
							End of boring.
15							

REMARKS:
Soil gas results- 7.2 ppm PID.
Drager tube results-ND < 0.5 ppm/ benzene.

BORING LOG
BORING SG-7

REMEDIATION TECHNOLOGIES, INC.

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.70
START DATE: 5-9-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	85	0-4	0.0		FILL		Fill material consisting of: 20% cinders and white ash. 10% coal fragments. 40% Sand, brown, moist, in 3" layers, no odor.
5	33	4-8	0.0				Fill material consisting of: 80% cinders, ash and coal fragments. 20% Silty clay at 7.7' bel;ow ground surface Becomes wet, slight hydrocarbon odor.
10	55	8-12	0.0				Fill material consisting of: 80% Cinders, ash and coal fragments. 20% Silty clay. Refusal at 10.5' below ground surface. Brick plug in spoon tip.
							End of boring.

REMARKS:
Soil gas results 10.9 ppm Hnu.
Drager tube results- ND < 0.5 ppm/PID benzene.

RETEC
REMEDIATION TECHNOLOGIES, INC.

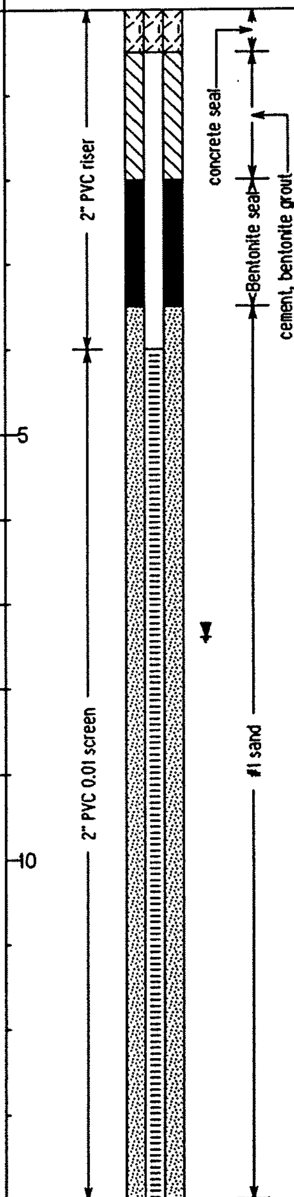
WELL INSTALLATION LOG
BORING: SB-1/MW-1

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, WEST & MAPLE	METHOD: HOLOW STEM AUGER	WATER LEVEL DURING DRILLING: 7.4
START DATE: 5-9-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 14.0	AUGER O.D./I.D. NA

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH
0–2	1018		80	0.0	
2–4	1020		80	0.0	
4–6	1027		90	4.6	
6–8	1030		100	30.2	
8–10	1033		100	41.6	X
10–12	1039		100	11.8	
12–14	1110		0	NA	

SOIL CLASS	DESCRIPTION
FILL	Fill material consisting of: 80% Gravel, grey, loose, angular. 20% Brick fragments, no odor. Fill material consisting of: 90% Gravel, angular, loose, no odor. 10% White ash and cinders. Fill material consisting of: 50% Gravel, cinders, clayey silt. 50% Brick fragments.
CL	Clay, grey, black staining, strong hydrocarbon odor. Clay, grey, black staining, strong odor.
GP	Gravel, poorly sorted, loose, visible hydrocarbon product, strong odor, moist.
CL	Clay, strong hydrocarbon odor, firm, uniform, grey, wet.
GP	Gravel, grey, rounded, 0.3' thick lens, strong hydrocarbon odor.
CL	Clay, grey, soft, uniform, strong odor, wet. Clay, grey, soft, uniform, wet, trace spots of hydrocarbon sheen, slight odor. Clay plug in spoon, very soft, poor recovery.
	End of boring.

WELL CONSTRUCTION



REMARKS: Sample SB- (8-10) analyzed for VOC, PAHs, cyanide.

TEST PIT LOG
Test Pit TP-1

REMEDIATION TECHNOLOGIES, INC.

1001 W. Seneca St.
Ithaca, NY 14850-3329
(607)277-5716

PROJECT NO: *3-2632-300*	CONTRACTOR CO.: *CREAMER ENVIRONMENTAL*	MP ELEV.: *' (MSL)*
CLIENT: *ORANGE & ROCKLAND*	CONTRACTOR:	TOTAL DEPTH: *6.0'*
SITE LOCATION: *WEST AND MAPLE*	METHOD: *Backhoe*	SURFACE ELEV.: *' (MSL)*
START DATE: *5-8-97* TIME:	LOGGED BY: *MARK HOFFERBERT*	WATER LEVEL: *NA'*
COMPLETION DATE: TIME:		
TEST PIT LOCATION: *WEST AND MAPLE*		

DEPTH (feet)	SAMPLE DEPTH	PID HEADSPACE (ppm)	LITHOLOGY	DESCRIPTION
				Fill material consisting of: 70% Gravelly sand, 205 Brick Fragments, 10% Ashes and cinders Trace Tar-like material in cobble-sized fragments. Material is black, hard, randomly distributed.
5				Silty Clay Grey and brown in mottled pattern, Trace hydrocarbon staining and slight hydrocarbon odor.
10				End of boring

REMARKS:

APPENDIX B

BORING AND WELL COMPLETION LOGS
CLOVE AND MAPLE SITE

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-1

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANG & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 9.9
START DATE: 5-13-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	75	0-4	0.0		SP		Sand, brown, loose, poorly sorted. No odor, moist.
5	90	4-8	9.5		GP		Gravel, angular to subround, poorly sorted, trace pebbles, trace cobbles, no odor. 20% Brown silty sand.
					ML		Becomes clayey silt, firm, brown, no odor. 2" lens of fine sand, no odor, moist. Clayey silt, light brown, dark brown staining in mottled pattern. 9.6 and 11.0- fine sand lens, 2" thick, strong hydrocarbon odor in sand lens, wet.
10	100	8-12	727				
15							End of boring.

REMARKS:
Soil gas results ND < 0.0 ppm/PID.

BORING LOG
BORING SG-2

REMEDIATION TECHNOLOGIES, INC.

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 6.10
START DATE: 5-13-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 15	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							0-0.8 Concrete slab.
	35	0-4	0.0		SP		Sand, brown, fine to medium, moist, poorly sorted. 30% Gravel, rounded, trace pebbles. Hydrocarbon odor in spoon tip.
5					ML		Clayey silt, brown and grey in mottled pattern. Stiff, firm, moist. Lens of sand in 1" thick layers, strong hydrocarbon odor.
	100	4-8	319		SP		Sand, grey, coarse, strong hydrocarbon odor and black hydrocarbon staining.
					ML		Clayey silt. Olive, firm, nodules of black hydrocarbon stain, strong hydrocarbon odor, wet.
					SP		4" sand lens, visible tar-like material.
10	100	8-12	518		ML		Clayey silt, brown, firm, nodules of black stain, strong hydrocarbon odor, wet.
					GP		Gravel, poorly sorted, tar-like material visible, strong odor
					SP		Sand, grey, medium, loose, wet, visible hydrocarbon sheen and trace tar-like material.
	90	12-15	319		ML		Clayey silt, grey, firm, trace brown sand in 1" lens.
15							End of boring.

REMARKS:
Soil gas Results 2.8 ppm/PID.
Drager tube results- ND < 0.5 ppm Benzene.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-3

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORNAGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 5.55
START DATE: 5-13-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	85	0-4	0.0		FILL		Fill material consisiting of: 80% Brown Sand, poorly sorted, trace black staining. 10% Angular and rounded gravel. 10% Coal fragments. trace wood debris, slight odor, moist.
5	75	4-8	401		GP		Gravel, black, rounded to subrounded. saturated with tar-like material, strong odor, low viscosity.
10	90	8-12	1662		ML		Clayey silt, firm, strong odor. Firm, grey. moist to wet. 20% Sand, brown, fine, laminations 1/8" thick in silt, hydrocarbon odor in sand laminations.
15							End of boring

REMARKS:
Soil gas results - 0.0 ppm/PID.
Headspace results fo water samples- 378 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-4

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 6.6
START DATE: 5-13-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	40	0-4	0.0		FILL		Fill material consisting of: 40% Brown sand, moist, loose, trace roots. 60% Ashes, brick fragments, slag chips, coal fragments, rounded gravel, no odor, moist.
5	90	4-8	0.0		SP		Silty sand, brown, poorly sorted, firm. 10% angular to subrounded gravel. Trace cobbles, no odor, moist.
10	80	8-12	91.2		ML		Clayey silt Brown and grey in mottled pattern. 10% Angular to subrounded gravel. 5% Sand, tan, in laminations, strong hydrocarbon odor.
							End of boring.

REMARKS:
Soil gas results- ND < 0.0 ppm/ PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-5

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 14.5
START DATE: 5-14-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 16.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	60	0-4	0.0		FILL		Fill material consisting of: 60% Gravel, angular and subrounded, poorly sorted. 40% Sand, brown, loose, trace coal fragments, slight hydrocarbon odor.
5	80	4-8	0.0		SP		Gravely sand, brown, coarse, poorly sorted, moist, no odor. 30% Gravel, subrounded to rounded, no odor.
10	75	8-12	0.0				Gravely sand, brown, coarse, poorly sorted. 20% Gravel, angular to subrounded, trace shell fragments. Becomes damp at 11.2'.
15	90	12-16	0.0				Gravely sand, brown, coarse, poorly sorted. 10% Gravel, subrounded. Becomes wet at 14.5', no odor.
							End of boring.

REMARKS:
Soil Gas results 0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-6

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GOEPROBE	WATER LEVEL DURING DRILLING: 9.80
START DATE: 5-13-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	100	0-4	0.0		FILL		0-0.4' Tar-like material, firm, slight odor. Fill material consisting of: 30% Brick Fragments 30% Concrete fragments 30% Orange and brown sand, loose, no odor, moist. Sandy silt, brown, firm, no odor.
5	90	4-8	0.0				Becomes sand, coarse, poorly sorted. 30% angular to subrounded gravel. Gravel, brown, loose, metal fragments.
10	90	8-12	14.3				Becomes grey visible hydrocarbon staining, strong odor, wet.
							End of boring.

REMARKS:
Soil gas results- ND < 0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-7

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.20
START DATE: 5-14-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	80	0-4	0.0		FILL		Fill material consisting of: 30% Sand, black, fine to medium. 70% Ash, cinders, coal fragments, moist, no odor.
					SP		Becomes sand, grey, stiff, moist, no odor.
5					GP		Sandy gravel, grey, poorly sorted, loose, strong hydrocarbon odor.
	95	4-8	15.2		ML		Becomes clayey silt, firm, grey and brown in mottled pattern. Strong hydrocarbon odor, moist.
10	100	8-12	756				Clayey silt Brown and grey in mottled pattern, stiff, moist, strong hydrocarbon odor, trace tar-like material in nodules, laminations of fine grained sand, wet.
							End of boring.

REMARKS:
Soil gas results-0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-8

PROJECT NO.: 3-2632-300	DRILLING CO.: NORHTSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERTSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 7.6
START DATE: 5-14-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	90	0-4	0.0		FILL		Fill material consisting of: Sandy gravel. Brown, loose, poorly sorted, dry, angular to subrounded, trace dark brown staining in nodules, trace coal fragments. no odor, moist.
5	90	4-8	4.0				Fill material consisting of: 60% Gravel, angular and subrounded, brown. 30% sand, brown, fine to medium, trace roots. Trace coal fragments, cobbles.
					ML		Becomes clayey silt, brown and grey in mottled pattern. slight odor, moist. Brown and grey, slight hydrocarbon odor.
					SP		Sand, light brown, poorly sorted, medium, Strong hydrocarbon odor, trace hydrocarbon staining. 10% rounded gravel.
10	95	8-12	528		ML		Clayey silt, brown and grey in mottled pattern, stiff, Laminations of sand in horizontal layers up to 1/8" thick, strong hydrocarbon odor, wet.
							End of boring

REMARKS:
Soil gas results ND < 0.0 ppm/PID.

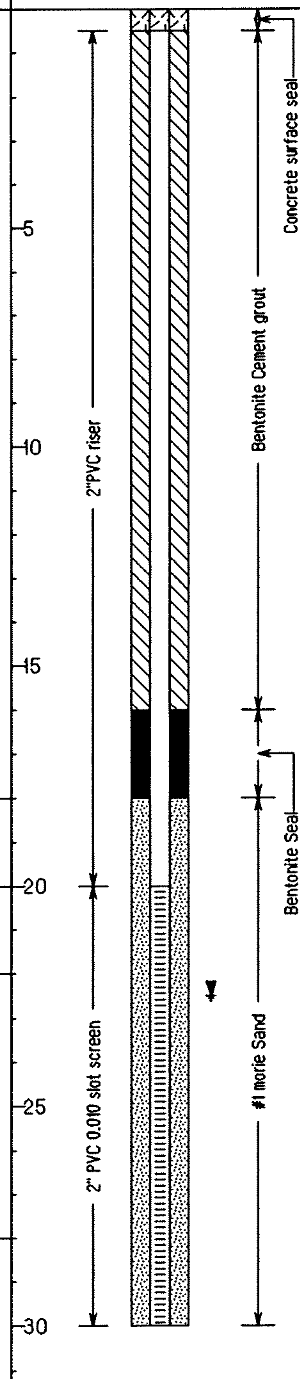
REMEDIATION TECHNOLOGIES, INC.

WELL INSTALLATION LOG
BORING: SB-1/MW-1

PROJECT NO.: 3-2632-300	DRILLING CO.: NORHTSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: HOLLOW STEM AUGER	WATER LEVEL DURING DRILLING: 22.5
START DATE: 5-14-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 30	AUGER O.D./I.D. NA

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH	SOIL CLASS	LITHOLOGY	DESCRIPTION
0–2	1430		80	0.0		SP		0-0.6 Topsoil Gravely sand, coarse, brown, loose, poorly sorted.
2–4	1437		100	0.0				Gravely sand, brown coarse, loose, poorly sorted. 30% Gravel, angular to rounded, moist, no odor.
4–6 (5)	1440		75	0.0				Brown, coarse, loose poorly sorted, 40% Gravel, brown, angular to rounded, no odor, moist.
6–8	1447		80	0.0				Brown, coarse, loose, poorly sorted 30% Gravel, moist, no odor
8–10			100	0.0				Brown, coarse, loose, poorly sorted. 40% Gravel, trace cobbles, no odor, moist.
10–12 (10)			100	0.0				Brown, coarse, loose, poorly sorted. 30% gravel, no odor, moist.
12–14			100	0.0				Brown, coarse, loose. poorly sorted, no odor, moist.
14–16 (15)	1504		100	0.0				Sand Brown, coarse, loose, poorly sorted, no odor, moist.
16–18			100	0.0				Sand Brown, coarse, loose, poorly sorted. 35% Rounded gravel, moist, no odor.
18–20	1514		100	0.0		GP		Gravel, brown,subrounded, poorly sorted. 30% Brown coarse sand.
20–22 (20)	1517		90	0.0	X	SP		Granitic, fractured, cobble Sand, brown, coarse, poorly sorted. 30% Rounded gravel, moist, no odor.
22–24	1517		100	0.0		GP		Gravel, brown, coarse, poorly sorted. 40% Sand, no odor. Becomes wet at 22.5' below ground surface.
24–26 (25)	1520		100	0.0				Gravel, brown, coarse. poorly sorted, loose. 50% sand, coarse, brown, wet, no odor.
26–28	1528		100	0.0				Gravel, brown, coarse, poorly sorted, loose, angular and subrounded wet, no odor.
28–30 (30)								End of boring.

WELL CONSTRUCTION



REMARKS:
Soil sample SB-1 (20-22) analyzed for BTEX, PAH's and Cyanide.

REMEDIATION TECHNOLOGIES, INC.

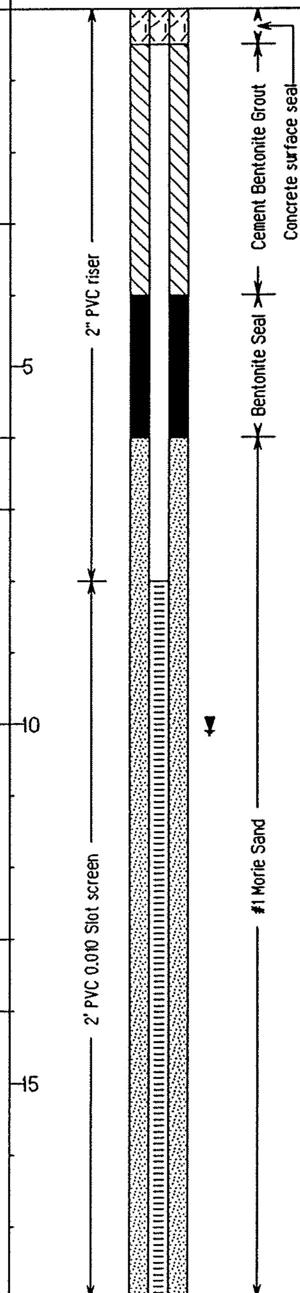
WELL INSTALLATION LOG
BORING: SB-2/MW-2

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE, HOLLOWSTEM AUGER	WATER LEVEL DURING DRILLING: 10.10
START DATE: 5-15-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 18	AUGER O.D./I.D. NA

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH
0–2	0836		90	0.0	
2–4			90	0.0	
4–6 (5)			80	0.0	
6–8	0857		90	9.2	
8–10 (10)			95	192	
10–12			90	398	
12–14			100	487	X
14–16 (15)			100	187	
16–18	0915		10	192	

SOIL CLASS	DESCRIPTION
SP	Gravely sand, Brown, loose, moist, trace roots, no odor. Gravely sand,
FILL	Becomes fill material consisting of: Ash, cinders, slag fragments, no odor. Fill material consisting of: Ash, cinders, coal fragments, brick fragments. Moist, no odor.
ML	Clayey silt Grey, stiff, trace brown sand, slight odor.
SP	Sand, grey, medium, moist, slight odor. Sand, Grey, medium, moist, slight odor. Becomes clayey silt, firm, becomes wet at 10.1'
ML	Clayey silt, Brown and grey in mottled pattern, horizontal layers of clayey silt. Angular fine brown sand in 1" laminations, strong hydrocarbon odor, wet. Brown and grey, lenses of fine brown sand.
SP	At 13.1 0.3 feet lens of sand, fine, brown saturated with hydrocarbon product.
ML	Clayey silt, Brown and grey in mottled pattern, lenses of fine brown sand, Hydrocarbon product in sand lenses, strong hydrocarbon odor, wet. Clayey silt, Brown and grey in mottled patterns, lenses of fine brown sand, Satruated with hydrocarbon product, strong odor, wet.
	End of boring

WELL CONSTRUCTION



REMARKS:
Soil sample SB-2 (12-14) analyzed for cyanide, BTEX, and PAHs.

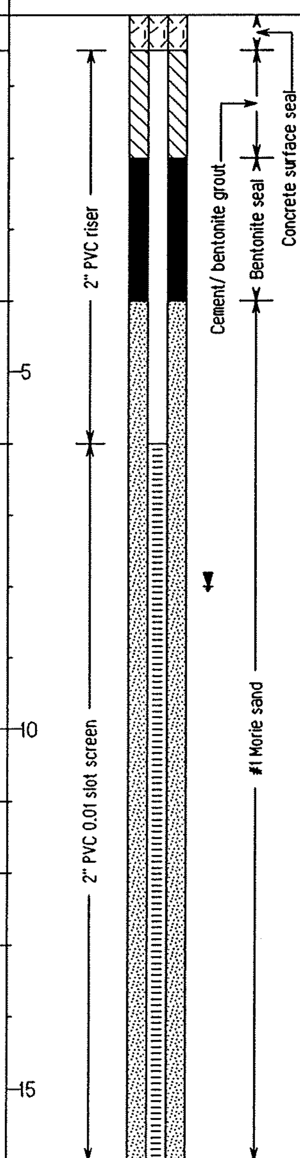
REMEDIATION TECHNOLOGIES, INC.

WELL INSTALLATION LOG
BORING: SB-3/MW-3

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: HAVERSTRAW, CLOVE & MAPLE	METHOD: GEOPROBE/ HOLLOWSTEM AUGER	WATER LEVEL DURING DRILLING: 8
START DATE: 5-15-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 16	AUGER O.D./I.D. NA

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH	SOIL CLASS	DESCRIPTION
						SP	0-0.5 Topsoil
	1358		90	2.0			Gravely sand, Brown, loose, moist, poorly sorted. 20% Gravel, angular to subrounded, granitic.
	1358		100	6.3			Gravely sand, Brown, loose, mosit, poorly sorted. 10% Angular gravel, moist, no odor.
5			100	4.7		GP	Sandy gravel, Brown. poorly sorted, angular and subrounded, moist, no odor.
	1403		100	268		ML	Clayey silt, Brown and grey in mottled pattern, medium and coarse sand in lens. Moist, no odor.
			100	1248			Clayey silt, Brown and grey in mottled pattern, laminations of fine brown sand, strong odor.
10			100	1268	10-12	SP	Sand 6" lense, fine to medium, grey, wet, black hydrocarbon staining, strong odor.
						ML	Clayey silt, Fine brown sand in horizontal lenses.
			100	624		SP	Silty sand, Poorly sorted, wet, coarse, strong hydrocarbon odor and staining
						CL	Clayey silt, Grey, soft, trace brown sand in horizontal lenses, strong odor.
15			100	434			Clay, Grey, soft, uniform, trace sand 1" thick laminations, strong hydrocarbon odor.
			100	1234		SP	Sand, Grey, medium. poorly sorted, loose, trace grey clay in nodules, strong hydrocarbon odor.
							End of Boring.

WELL CONSTRUCTION



REMARKS:
Soil sample SB-3 (10-12) analyzed for BTEX, PAHs and cyanide.