PRELIMINARY SITE ASSESSMENT REPORT

FOR

SUFFERN, NEW YORK
FORMER MANUFACTURED GAS PLANT SITE

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 Crabtree

August 26, 1997

EXECUTIVE SUMMARY

Remediation Technologies, Inc. (RETEC) conducted a preliminary site assessment (PSA) at a former Manufactured Gas Plant (MGP) site in the Village of Suffern, Rockland County, New York. The objectives of the PSA were to:

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

The former MGP site is approximately 3 acres in size and is located in an urban setting zoned for commercial and industrial use. The site itself is comprised of five parcels of land which are held by three separate owners. The site is bordered by a service road, then by the Village of Suffern athletic fields to the south, the Village of Suffern water well field to the west, by an active rail line to the east and by three properties which include a propane distribution facility, a firing range and unoccupied land to the north. The site is located in the Ramapo River floodplain with the river located immediately west of the water well field.

The parcels which make up the former MGP site are as follows: O&R owns the western parcel of the site, which currently is used to stockpile road demolition/excavation debris; O&R also owns the east/central parcel currently used as a gas regulator station; the New York State Department of Transportation owns the west/central parcel of the site, formerly a railroad right-of-way. The former MGP building and the surrounding property is owned by Econo-Truck Manufacturing Inc. which manufactures small school buses at the site.

Gas was manufactured at the site between 1902 and 1935. Following shut down of the MGP, O & R retained ownership of the western section of the site. The former MGP building was used as an electro-plating facility during the late 1940s and early 1950s. Econo-Truck took over the former MGP building in the early 1950s.

The PSA included soil gas field screening and laboratory analysis, surface soil analysis, Geoprobe probing in historic MGP structures, field and laboratory testing of subsurface soil samples, monitoring well installation, groundwater sampling, hydraulic conductivity testing and a site survey. The excavation of three test pits was added to the scope of work in the field to investigate historic MGP subsurface structures.

The site is underlain by a shallow water table aquifer. The average depth to water across the site is 13 feet. The groundwater flow direction is from northeast to southwest. The direction and velocity of groundwater flow is influenced by the pumping of the Village of Suffern drinking water production wells and by an on-site septic system leach field.

All compounds detected in groundwater which could be related to MGP site residuals were found to be below NYSDEC groundwater quality standards or guidance values. Inorganic constituents exceeding NYSDEC groundwater standards were limited to iron, manganese and sodium

Wow!

MGP residuals were found in two structures. A layer of DNAPL was observed in the base of the gas-oil house foundation. Assuming historical drawings are correct and the DNAPL is evenly distributed in the thickness observed, a maximum of 70 cubic yards may be present in the foundation. A DNAPL sample of the contents of the foundation exceeded the hazardous waste characteristic limit for benzene. Tar-like material was also found at the base of the former eastern gas holder beneath the Econo-Truck building.

Elevated levels of PAHs in subsurface soil were observed in two borings, both of which were located to the west of the eastern gas holder. Inorganic compounds detected in the subsurface soil in concentrations greater than the regulatory limits included copper, manganese, mercury and zinc. Cyanide was not found in significant concentrations. Concentrations of BTEX compounds were found in subsurface soil gas in a sample taken from within the eastern gas holder foundation beneath the Econo-Truck building. Stringers of tar-like material were observed in unsaturated subsurface soils outside of, and to the west of, the eastern holder foundation.

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 validation qualifiers were added to the data.

An evaluation of potential exposure pathways and receptors found that the potential risks to human receptors at the site and adjacent properties were low. Based on the groundwater hydrogeology and chemistry at the site no risks to the municipal water supply wells were noted.

No conditions which pose an immediate threat to human health or the environment were found to exist at the site as a result of the PSA investigation. As such, no interim remedial measures are believed to be warranted. MGP residuals identified at the site are isolated from human contact. Additional investigative work recommended at the site includes an assessment of groundwater

conditions west of the eastern gas holder foundation, hydrocarbon fingerprint testing of a tar-like material found at ground surface west of the eastern holder, and additional testing to determine the contents, structure, and impacts (if any) from the gas-oil house foundation.

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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 a former manufactured gas plant (MGP) site in Suffern, New York. 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 site.

The purpose of this PSA Investigation is 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 site;
- whether constituents identified at the site 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, 1997). 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.

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 samples;
- soil borings and collection of soil samples;
- installation of shallow (water table) monitoring wells;
- collection of groundwater samples; and
- test pit excavation and collection of DNAPL samples.

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, site history and a summary of previous investigations.
- Section 3.0 describes the field procedures used to collect the environmental data at the site.
- Section 4.0 provides a summary of the regional and local geology and field observations made at the site.
- Section 5.0 presents a summary of analytical results for soils, groundwater and dense non-aqueous phase liquid (DNAPL).
- Section 6.0 discusses the data validation results;
- Section 7.0 presents an evaluation of the risk associated with MGP constituents, pathways, and receptors found at the site;

- Section 8.0 presents a summary and evaluation of the environmental findings; and

- Section 9.0 provides a list of references cited in this report.

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

2.0 SUFFERN GAS PLANT SITE

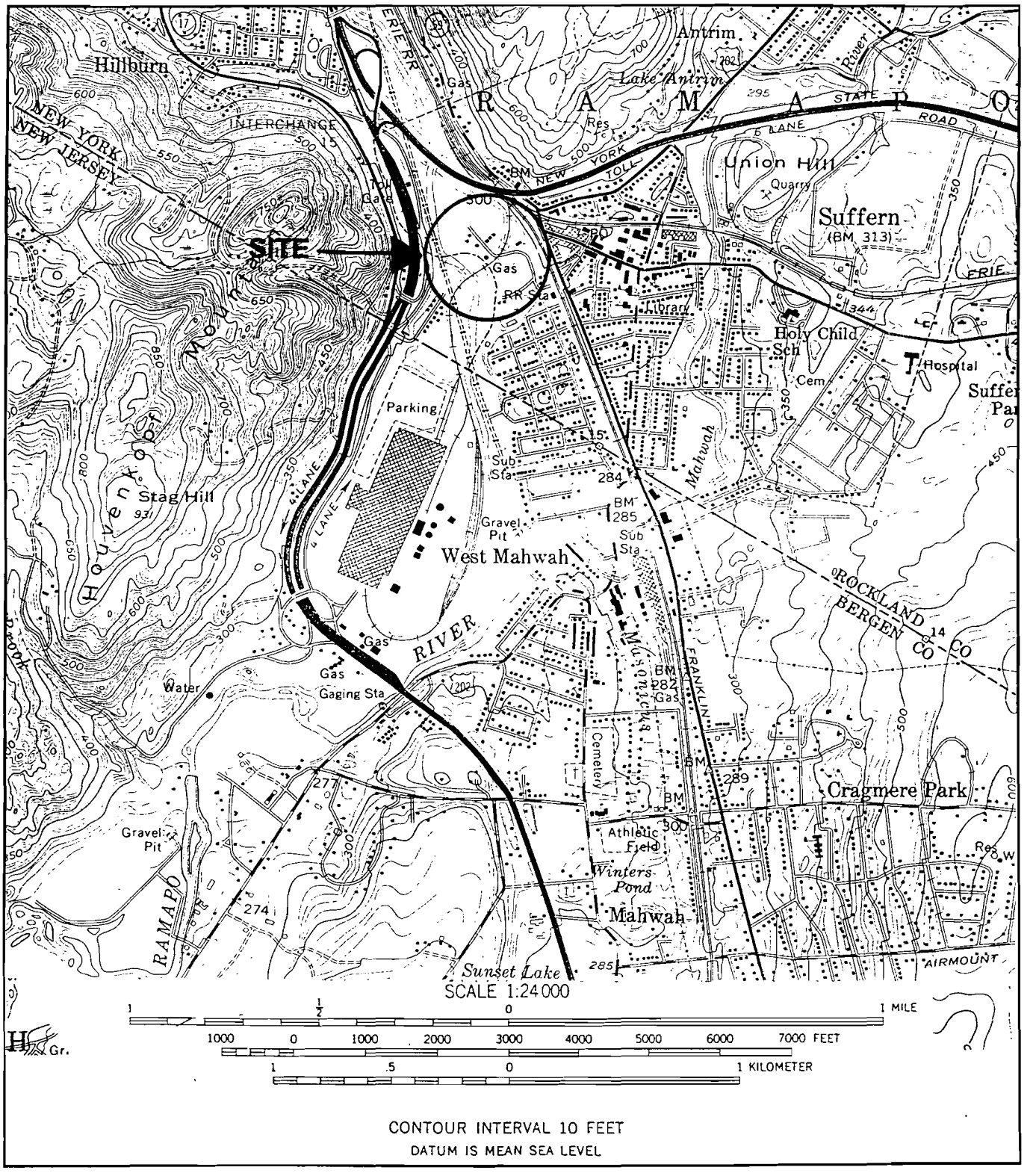
2.1 Site Description

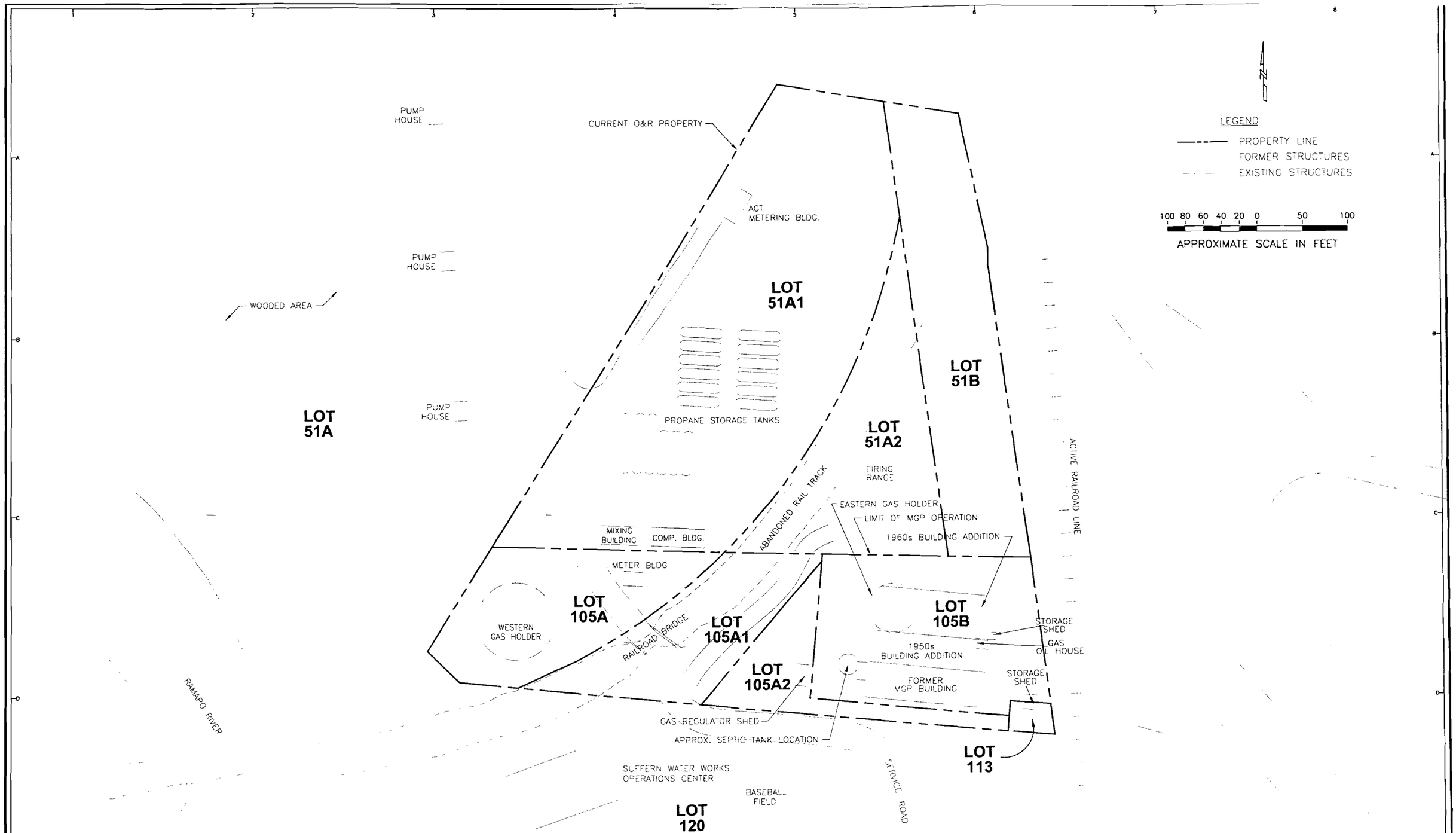
The former Suffern Gas Plant site is located off Chestnut Street on Pat Malone Drive in the northwestern portion of the Village of Suffern, Rockland County, New York as shown in Figure 2-1. The site and the adjacent properties have been zoned for commercial and industrial land use. The site, consisting of adjoining parcels of land both currently owned and formerly owned by Orange and Rockland and it predecessors, has an irregular shape and covers approximately three acres. The site is comprised of the following parcels of land:

- Lot 105A - the western holder area currently owned by Orange and Rockland and used as a soil stockpile area;
- Lot 105A2 - a area owned by Orange and Rockland and used as a gas regulator station;
- Lot 105A1 - a portion of the former railroad right-of-way, currently owned by the New York State Department of Transportation (NYSDOT); and
- Lots 105B and 113 - a one-acre area owned by Econo-Truck and Equipment, Inc. (now doing business as U.S. Bus Manufacturing, Inc.)

As shown on Figure 2-2, the abandoned rail track (Lot 105A1) and overpass crosses the central area of the site from the southwest. The railroad track is elevated by approximately 15 to 20 feet above the surrounding properties on a constructed soil berm. This berm bisects the area of former MGP operations. A service road enters the central portion of the site from the southeast. The road runs in a northerly direction to a fenced propane distribution yard and service buildings and to the northwest to property owned by the Village of Suffern, which is used as a water well field for the Village public water supply. The Ramapo River is located west of the Village property, approximately 250 feet west of the site.

FIGURE 2-1
SUFFERN SITE LOCATION MAP





REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
		6							
		5							
		4							
		3							
		2							
		1							
		0							

ORANGE & ROCKLAND UTILITIES
FORMER MANUFACTURED GAS PLANT
3-2632-200

CURRENT DATE: 07/21/97

CAD FILE 2632SA12

SITE PLAN

SUFFERN, NEW YORK

REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 2-2

REV 0

The properties which are adjacent to the site and their respective tax map lot numbers are listed as follows:

- To the west is property owned by the Village of Suffern which currently contains a municipal water supply well field (Lot 51A).

- To the south is an athletic field owned by the Village of Suffern (Lot 120).

- To the east is property owned by New Jersey Transit, currently in use as an active rail line.

- Three properties border the site to the north. To the northwest, Lot 51A1, is an active propane storage facility owned by Orange and Rockland. To the north is Lot 51A2, an area owned by The State of New Jersey and is currently used as a firing range. To the northeast, Lot 51B is also owned by The State of New Jersey. Most of this Lot is unoccupied; however, it appears that Econo-Truck may be using parts of the property for vehicle storage.

2.2 Site History

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

- The plant was constructed by the Suffern Gas Company and began initial operation by at least 1902. A 1902 Sanborn fire insurance map indicates there was a small gas holder (45,000 cubic feet) adjacent to the plant building, and a gas-oil tank at the northeast corner of the building.

- From 1903 to until 1925 the plant produced carburetted water gas for city light illumination (Browns Directory).

- In 1926 the plant was rebuilt and, until 1935, produced coal gas also for illumination for city lighting (Browns Directory). PSC annual reports, submitted from 1925 to 1935, indicate that the majority of coal tars produced by the plant during that time period were used off-site as by-products (ERM, 1987).

- A 1931 Sanborn Map suggests that the holder adjacent to the gas plant was replaced by a larger holder, located to the southwest of the plant. Following construction of the second holder, site gas storage capacity increased to 200,000 cubic feet (Browns Directory).

- The plant was closed in 1935. According to the ERM report, approximately 40,000 gallons of "coal gas tars" and 200 cubic yards of coke breeze remained at the site. ERM also notes that this material may have been marketed, as indicated in Public Service Commission records for other MGP by products (ERM, 1987).

- During the late 1940s and early 1950s an electo-plating facility was in operation at the site (ERM, 1987).

- Unconfirmed reports by citizens familiar with the site, indicate that MGP residuals may have been stored near the railroad spur and along the east side of the Econo-Truck Building (ERM, 1987).

The following site ownership table (Table 2-1) summarizes the ownership of the site property from 1902 to the present.

Table 2-1
Site Ownership Information
Former MGP Site, Suffern, New York

Property Owner	Years	Comments
Suffern Gas Company	1902-1926	entire site
Ramapo Gas Company	1927-1936	entire site
Rockland Gas Company	1937-1952	entire site
Rockland Light and Power Co.	1953-1958	entire site
Lot 51A1, Lot 105A, and Lot 105A2		
Orange and Rockland Utilities, Inc.	1958-present	western area of site
Lot 105A1		
Erie Rail Road Company	1954-Note (1)	central rail overpass
Consolidated Rail Corporation	Note (1)	central rail overpass
New York State Department of Transportation	Note (1)-present	
Lot 105B and Lot 113		
Henry Mayer	Note (1)-1967	eastern area of site
Economy Body Builders	1967-1978	eastern area of site
Econo-Truck Body & Equipment Inc.	1978-present	eastern area of site

Note (1) - transaction date unknown

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 Results of Previous Investigations

An initial investigation of the former Suffern Gas Plant site was conducted as a part of the USEPA Superfund investigation of chlorinated solvent contamination of the adjacent Suffern Well Field (NYSDEC Site #344030). The investigation was conducted by Environmental Resource Management-Northeast (ERM), under contract with the NYSDEC in May 1987. Monitoring of the site since then has been performed by NYSDEC. O&R was unaware of this aspect of the investigation and the results that were included in ERM's report until the report was reviewed in preparation for issuance of the RFP to conduct the PSAs.

During the remedial investigation three monitoring wells were installed to investigate the former MGP site (wells L1, L2 and P1). Well L1 was installed to the depth of the granitic gneiss bedrock. Soil samples from the boring for the well indicated that organic vapors were present within the soil to the final depth of 108 feet below ground surface (ERM, 1987). The recorded measurements, taken with an OVA, increased with depth from 3 ppm at 35 feet to over 85 ppm at 80 feet. Subsequent quarterly groundwater samples from the well for EPA priority pollutant parameters indicated that no semi-volatile organic compounds were present above method detection limits. A detection of 1,1,1-trichloroethane (TCEA) was the only volatile organic compound found (this compound was not associated with the MGP site).

Well L2 was a water table well which was installed to a depth of 26 feet, and was monitored from the time of installation in 1987 until it was inadvertently abandoned by NYSDEC in 1996. The boring log for this well indicates that cinders were noted at a depth of 10 feet, and "tar gas odor" was detected at a depth of 12 feet to a depth of at least 16 feet. Recent quarterly groundwater monitoring at this well location indicated that semi-volatile compounds associated with gas plant residuals have been detected. Results of the testing has been inconsistent; however, naphthalene, chrysene, acenaphthylene, 2-methylnaphthalene, benzo(f)fluoranthene and benzo(a)pyrene have been detected in concentrations greater than NYSDEC guidelines or standards. Phenanthrene and pyrene have also been detected above method detection limits in the well. BTEX compounds benzene and xylene have been detected in concentrations greater than the groundwater quality standards. Inorganic constituents antimony, manganese and cyanide have been detected in well L2 in concentrations greater than the NYSDEC guidance or standard values.

Well P1 is a shallow water table well installed to the west of the western gas holder, midway between Village of Suffern Production wells PW2 and PW3. One volatile compound was detected in the well during the RI (TCEA), however, more recent testing indicate that no volatile compounds

were detected. A total of six PAH detections were found during quarterly monitoring by ERM (ERM, 1991), however, none of the detections were greater than 7 µg/L. Inorganic constituents detected in concentrations greater than the groundwater standards included iron, manganese, sodium and cyanide.

2.4 Environmental Setting

RETEC completed a database search for the area surrounding the site. The objective of this work was to identify offsite sources of contamination which may impact the site. RETEC contacted Toxic Targeting of Ithaca, New York to generate environmental data for the Suffern site.

The results of the search indicate that only conditions associated with the contamination of the Suffern Well Field are expected to be a factor in determining site conditions.

3.0 SITE INVESTIGATION

The PSA Investigation activities focused on defining the nature and extent of constituents of interest (COI) in soil, soil gas and groundwater, and on developing a more detailed understanding of the geology and hydrogeology of the site. The investigation included: surface soil sampling; soil gas sampling; soil probing to determine the location of subsurface structures; subsurface soil sampling at the monitoring well locations, monitoring well installation and groundwater sampling.

North Star Drilling of Cortland, New York was contracted to provide drilling services during the soil boring, soil gas and monitoring well installation tasks. Creamer Environmental Inc. of Hackensack, New Jersey provided a backhoe and operator during the test pit excavation task. 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 2, 1997, with the Underground Facilities Protective Organization. Utilities responding as a result of the UFPO listing included:

- Village of Suffern Water Department - marked active water and electrical lines;
- Orange and Rockland Utilities - marked active gas lines;
- NYNEX - was not involved at the site;
- AT&T - was not involved at the site;
- Algonquin Gas - is involved at the propane property, however, was not involved in the study area;

UFPO subscribers not responding to the request were the Town of Ramapo Highway Department and TKR Cable.

3.2 Surface Soil Samples

3.2.1 Sample Locations

Four surface soil samples were collected from locations strategically located across the site. The objective of the surface soil sampling was to provide information regarding the concentrations of COI in surface soils (defined as the upper six inches of soil) from former MGP activities on both the Econo-Truck and the O&R portions of the site. Surface soil samples were completed in the following areas.

- SS1 - adjacent to the former gas-oil tank location;
- SS2 - adjacent to the eastern gas holder (in the area of weathered tar material visible at ground surface and pointed out by the property owner);
- SS3 - in an area adjacent to the athletic fields, down gradient from plant site; and
- SS4 - adjacent to the railroad bridge near the western gas holder where blue stained rock/soil was observed by NYSDEC.

The locations of some of the samples differ slightly from the locations presented in the PSA Work Plan. The revised locations were selected by Mr. James Edwards (RETEC's field geologist), and Mr. Bill Zeppetelli and Mr. Gardiner Cross of NYSDEC, based on a field inspection of the site. Surface soil sample SS2 was taken from soil adjacent to exposed tar accumulations in an area where employees of Econo-Truck observed tar-like material coming to the surface in the warmer months of the year. Surface soil sample SS4 was taken from soil which exhibited a turquoise green staining near the railroad bridge. Surface soil sampling locations are shown in Figure 3-1.

3.2.2 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 in 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 and mixed thoroughly with a stainless steel spoon. This composite sample was then placed into a one-liter, wide-mouth clear glass sample jar for analysis of PAHs, TAL metals and

PUMP HOUSE

2

LEGEND

- PROPERTY LINE
- FORMER STRUCTURES
- EXISTING STRUCTURES
- SOIL BORING-SOIL GAS FIELD SCREENING AND GEOPROBE BORING
- SOIL BORING-LABORATORY SOIL GAS SAMPLE
- SURFACE SOIL SAMPLE
- NEW MONITORING WELL
- ABANDONED MONITORING WELL
- MUNICIPAL SUPPLY WELL
- SOIL BORING CONVERTED TO MONITORING WELL

SB3/MW3

PROPANE STORAGE TANKS

MIXING BUILDING

COMP. BLDG.

METER BLDG

ABANDONED RAIL TRACK

FIRING RANGE

EASTERN GAS HOLDER

LIMIT OF MGP OPERATION

1960s BUILDING ADDITION

ACTIVE RAILROAD LINE

L1

L2

SB3/MW3

SG11

TP3

SG6

SG-SUFFERN

SG4

SG9

SG13

SG3

SG10

SS2

SG7

SG2

SG5

SG12

TP2

STORAGE SHED

TP1

GAS OIL HOUSE

SS1

1950s BUILDING ADDITION

SG1

P1

SG8

WESTERN GAS HOLDER

SS4

SB4/MW4

RAILROAD BRIDGE

DOT

OFC Res Station

FORMER MGP BUILDING

STORAGE SHED

SB1/MW1

SB2/MW2

GAS REGULATOR SHED

APPROX. SEPTIC TANK LOCATION

SS3

SUFFERN WATER WORKS OPERATIONS CENTER

SERVICE R

3

BASEBALL FIELD

50 40 30 20 10 0 25 50

APPROXIMATE SCALE IN FEET

REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
		6							
		5							
		4							
		3							
		2							
		1							
		0							

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CURRENT DATE: 07/21/97

CAD FILE 2632SA13

SITE PLAN AND SAMPLING POINTS

SUFFERN, NEW YORK

RETEC
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DRAWING NO. FIGURE 3-1

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cyanide. Following each use, the trowel and bowl was decontaminated to prevent cross-contamination between sampling locations.

3.3 Geoprobe Soil Borings

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

3.3.1 Soil Gas Sampling

Sample Locations

Thirteen soil gas samples (SG1 through SG13) were collected within the boundary of the former MGP site (Figure 3-1). The objective of these samples was to determine if historical MGP subsurface structures were potential source areas of COI. The location showing the highest field screening results was selected for collection of a laboratory sample. Sample SG9 exhibited the highest field screening results (241 ppm by PID). An additional borehole was advanced in the vicinity of SG9 and an analytical sample (SG - Suffern) was collected in a Tedlar bag and sent to the laboratory for the analysis of BTEX compounds using standard chain-of-custody procedures. The location of the sample is shown in Figure 3-1. The results of the soil gas sampling are discussed in Section 5.3.

Sampling Methodology

The samples were collected in a boring advanced with either a hydraulic Geoprobe drilling rig or by a tripod and electric jack hammer where overhead clearance was limited inside of the Econo-Truck building. When necessary, concrete or asphalt pavement was pre-drilled with an electric or rig-mounted cutting tool. 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 bgs. 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). A soil gas sample was not collected at location SG2 due to the high elevation of the water table within the gas holder foundation.

Table 3-1
Soil Boring Summary
Former Suffern MGP Site

Identification	Total Depth of Boring (Feet)	Depth to Water (Feet)	Soil Gas Analytes	Soil Analytes	Rationale
Soil Gas/Geoprobe Borings					
SG 1	12.0	4.50	PID Screening	Field Characterization	Former Gas-Oil Tank Location
SG 2	6.60	3.80	NT	Field Characterization	Former Eastern Holder Location
SG 3	6.75	3.50	PID Screening Drager Tube	Field Characterization	Former Eastern Holder Location
SG 4	6.70	3.90	PID Screening Drager Tube	Field Characterization	Former Eastern Holder Location
SG 5	6.60	3.82	PID Screening Drager Tube	Field Characterization	Former Eastern Holder Location
SG 6	5.10	NE	PID Screening	Field Characterization	Former Eastern Holder Location
SG 7	12.0	NE	PID Screening	Field Characterization	Down gradient of Eastern Holder
SG 8	12.0	6.20	PID Screening	Field Characterization	Former Western Gas Holder
SG 9	6.60	NE	PID Screening Drager Tube	Field Characterization	Upgradient of Eastern Holder
SG 10	10.2	NE	PID Screening Drager Tube	Field Characterization	Upgradient of Eastern Holder
SG 11	12.0	NE	PID Screening	Field Characterization	Upgradient of Eastern Holder
SG 12	16.0	12.0	PID Screening Drager Tube	Field Characterization	Down gradient of Eastern Holder
SG 13	12.0	NE	PID Screening Drager Tube	Field Characterization	Down gradient of Eastern Holder
SG Suffern	3.80	NT	BTEX	NT	Former Eastern Gas Holder
Soil Borings/Monitoring Wells					
SB 1 (12-14)	24.0	15.50	NT	BTEX, PAH, Cyanide, TAL Metals	Upgradient of Former MGP Plant
SB 2 (10-12)	18.0	10.84	NT	BTEX, PAH, Cyanide	Down gradient of Eastern Holder
SB 3 (2-4)	18.0	11.08	NT	BTEX. PAH, Cyanide, TAL Metals	Down gradient of Eastern Holder
SB 4 (4-6)	14.0	6.20	NT	BTEX, PAH, Cyanide, TAL Metals	Down gradient of Western Holder

Note: NT - Not Tested
NE - Not Encountered

3.3.2 Geoprobe Soil Borings

Boring Locations

At each of the thirteen 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 plant; 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 program.

Boring Methodology

Subsurface soil probing was completed using a combination of two methods. Geoprobe soil borings using a truck-mounted drill rig were used where truck access was possible (SG1, SG6, SG7, SG8, SG9, SG10, SG11, SG12 and SG13). Subsurface soil probing with an electric jackhammer was used for several borings inside of the Econo-Truck building due to limited overhead clearance (SG2, SG3, SG4 and SG5). For each method, a 2-inch outside diameter, 4-foot long Macrocore sampling tube was used to advance the 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; for any visual evidence of MGP impacts to soil; and for jar headspace analysis 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 A.

Following completion of each Geoprobe boring, the borehole annulus was filled to ground surface. Original work plan specifications called for a cement/bentonite grout to be used for each borehole; however, two different methods were employed at the site. Field modifications to the work plan for the borings within the contained subsurface structure of the eastern gas holder were made with the approval of Mr. Bill Zeppetelli of NYSDEC. Borings SG2, SG3, SG4, SG5 and SG9 were filled with a bentonite powder. This method was inadvertently used to fill the borehole completed within the western gas holder (SG8). All remaining boreholes were filled according to work plan specifications with a cement/bentonite slurry, tremied to the bottom of the borehole. All

boreholes completed at locations with concrete floors or pavement were finished to grade with a concrete mix.

3.4 Subsurface Soil Samples and Monitoring Wells

Four subsurface soil samples were collected from borings for the new monitoring wells installed within the boundaries of the former MGP. The objective for the soil sampling and well installation was to investigate soil and groundwater quality upgradient of the former MGP plant (MW1), down gradient of the former plant and eastern holder (MW2 and MW3) and in an area considered down gradient of the western holder foundation (MW4).

The PSA Work Plan originally specified the replacement of monitoring well L2, a well installed during the Suffern Well Field Investigation and inadvertently abandoned by NYSDEC in 1996. A decision regarding the replacement of the well was made in the field by RETEC and Mr. Gardiner Cross of NYSDEC. Due to the close proximity of MW3 to the former L2 well location, it was determined that one new well (MW3) would be sufficient to monitor groundwater quality in the area of interest. Therefore, the location of MW3 was modified from that shown in the Work Plan. The locations of the abandoned well L2, well L1 (abandoned bedrock well of the L-cluster) and the four new wells are shown on Figure 3-1.

3.4.1 Subsurface Soil Sampling Methodology

Subsurface soil sampling was completed with a rotary drilling rig using hollow stem auger techniques. Sampling tubes, 2-inches in diameter and 2-foot long (split-spoons) were used to continuously sample from the ground surface to the final depth of each bore hole. The blow counts required to advance the spilt spoon each six inch interval was recorded. The samples were described by the geologist in the field using the appropriate and most current 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 sample from the most impacted split-spoon sample from each boring be sent to the laboratory for chemical analysis. The samples were analyzed for BTEX compounds, PAHs and cyanide. If the most impacted interval was determined by the RETEC field geologist to be fill soil, the sample was also analyzed for TAL metals. A summary of the subsurface soil samples is presented in Table 3-1.

3.4.2 Monitoring Well Installation

The monitoring well screens were placed to intercept the water table. Each 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. Wells MW1, MW2 and MW3 were completed as flush-mount installations at the ground surface with a steel protective cover, set into a cement surface seal. Well MW4 was completed as a "stick-up" installation with a protective metal casing surrounding the PVC well riser. All wells were sealed with air-tight well caps locked with a case-hardened steel lock to provide security. Subsurface drilling logs, which include the well construction diagrams, appear in Appendix A. Table 3-2 provides a summary of the construction for each monitoring well.

Table 3-2
Monitoring Well Construction Summary
Former Suffern Gas Plant Site

Well Number	Ground Surface Elevation (Feet above MSL)	Top of Outer Casing (Feet above MSL)	Top of PVC Riser (Feet above MSL)	Total Depth Drilled (Feet)	Top of Screen Elevation (Feet above MSL)	Bottom of Screen Interval Depth (Feet)	Bottom of Screen Elevation (Feet above MSL)	Depth to Water 6/3/97 (Feet)	Elevation of Water 6/3/97 (Feet above MSL)
Wells Installed During this Investigation									
MW1	280.15	280.15	279.66	22	267.26	22	257.26	15.05	264.61
MW2	276.31	276.31	275.97	18	268.69	18	258.69	10.84	265.13
MW3	276.72	276.72	276.44	18	268.44	18	258.44	12.28	264.16
MW4	270.32	272.89	272.73	16	266.93	16	256.43	10.20	262.53

3.4.3 Well Development

RETEC and North Star Drilling mobilized to the site on May 6, 1997, to develop the four new monitoring wells. 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. Approximately 25 well volumes were pumped from each well. Pumping was continued until the field parameters of pH, temperature, turbidity and conductivity had stabilized. Several well volumes of water were removed from well MW3; however, subsurface conditions (i.e., slow recharge) made further pumping impractical and the well was developed by bailing.

3.5 Test Pits

Three test pits were excavated by Creamer Environmental Inc. of Hackensack, New Jersey, during the PSA investigation. The test pits, not part of the original scope-of-work for the project, were added at the request of O&R in response to the discovery of MGP residuals during the Geoprobe boring task. Test pits, shown on Figure 3-1, were completed in the following areas:

- TP1 - excavated within, and adjacent to, the former gas-oil house foundation wall following discovery of dense non-aqueous phase liquids (DNAPL) in soil boring SG1;

- TP2 - excavated between the rail right-of-way and the Econo-Truck garage to investigate historical information regarding the presence of MGP residuals in the area; and

- TP3 - excavated north of the eastern holder to investigate the nature of the subsurface structure (holder and foundation) and the presence of MGP residuals outside the holder foundation;

The test pits were excavated using a rubber-tired backhoe. Soils removed from TP2 and TP3 were immediately returned to the excavation. The majority of soil from TP1 was returned to the excavation; however, due to backfilling complications, NYSDEC approved the transfer of 3-4 cubic

yards of visually contaminated soil from the excavation to the O&R owned portion of the site where it was placed on, and covered by, plastic sheeting. The test pits were logged by a RETEC engineer to record field observations concerning soil characterization and correlation to other structures or locations at the site. Soil samples taken from the excavation were visually classified and screened for the presence of organic vapors with the photo-ionization detector. One DNAPL sample was collected from the gas-oil foundation and was submitted for analysis of RCRA Hazardous Characteristics. The results of the analyses are discussed Section 5.5. Test pit logs are provided in Appendix A.

3.6 Groundwater Sampling

3.6.1 Liquid Level Measurements

Following development, the new wells were allowed to stabilize for a period of approximately one week. On June 3, 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 the potential presence of any light non-aqueous phase liquids (LNAPLs) or DNAPLs. Following each use the probe was decontaminated following procedures listed in Section 3.8.

3.6.2 Groundwater Sampling

Each of the wells 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. MW1 contained turbidity in concentrations greater than 50 NTU throughout purging. A filtered sample of groundwater was taken from MW1 and analyzed for TAL metals.

3.7 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity ("slug") tests were performed on the four new monitoring wells after groundwater sampling was completed. 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 4.3.

3.8 Decontamination Procedures

All downhole drilling equipment used during the Geoprobe testing and monitoring well installation was hot-water pressure washed between borings. All soil, groundwater and slug 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.

To demonstrate the efficiency of the decontamination procedures, a rinse blank was collected during the investigation. The sample, designated as EB Suffern, was collected by pouring demonstrated analyte-free water over decontaminated split spoon samplers, directly into laboratory provided containers specific for VOC, PAH, cyanide and TAL metals analysis. The results of the analyses are presented in Table 5-3 in Section 5.2.2 of this report.

3.9 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 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 site. Personal protective equipment, plastic sheeting and Macro-Core sampling tubes were containerized into drums. Visibly impacted soil from TP1 was placed on, and covered by, plastic sheeting.

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 as nonhazardous waste. The stockpiled soil at the site was loaded into 55 gallon drums by Orange and Rockland's spill response contractor, Miller Environmental Group. 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. Transportation was provided by Miller Environmental Group.

3.10 Survey

The elevations of the new wells were measured by differential leveling. The survey was completed by the RETEC geologist to tie elevations of the new wells into the United States Geological Survey Mean Sea Level datum of 1929. Data points for the survey included the ground surface, top of outer casing and top of inner casing for each of the wells. Information regarding existing benchmarks at the site was provided by Mr. Jim Rose of the Village of Suffern Water Department. The new well elevation data points were obtained by comparison to known elevations at:

- 279.75 feet MSL - the Water Works building garage floor; and
- 276.36 feet MSL - a benchmark located on the concrete steps of the pump house for Production Well #2.

Horizontal locations were directly measured from existing site features such as buildings or the railroad bridge using a tape measure. The survey data generated by the RETEC site survey is presented in Table 3-2 (well construction summary) and on the contour map of the shallow water table (Figure 4-3).

4.0 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.

4.1 General Geologic Overview

The site is located in the Ramapo River valley of the Hudson Highlands physiographic province of New York State. The valley, formed by a north to south trending ridge, is underlain by unconsolidated glaciofluvial deposits which greatly vary in thickness. The site is situated in the floodplain of the Ramapo River, and as such, is characterized by low relief with elevations across the site varying by less than 10 feet. The regional drainage pattern in the vicinity of the site is in general, towards the Ramapo River; however, some patterns have been modified by highway construction to the north of the site.

The site is underlain by a thick sequence of unconsolidated sediment layers (approximately 110 feet). These sediments fill a granitic gneiss bedrock valley. The sediments are a combination of stratified glacial drift and post-glacial alluvial sediments which have filled the trough of the Ramapo River. The wide range of sediments which are found at the site have been subdivided into units during investigation of the Suffern Well Field site (ERM, 1987). The sediments, from top to bottom, are composed of industrial fill, alluvial deposits, stratified drift deposits of gravel and sand, and a basal ice contact deposit laid down by the glacier at the bedrock surface. Surface water and groundwater at the site flows generally to the south to the Ramapo River; however, dry conditions or heavy pumping of the adjacent Suffern Well Field production wells may induce flow from the river to the underlying aquifer (ERM, 1987).

4.2 Description of Site Stratigraphy

Information concerning the site stratigraphy was obtained from soil samples taken during the Geoprobe borings and monitoring well installations. Data collected during the subsurface sampling was used to generate a cross-sectional view of the subsurface strata. The location of the cross-

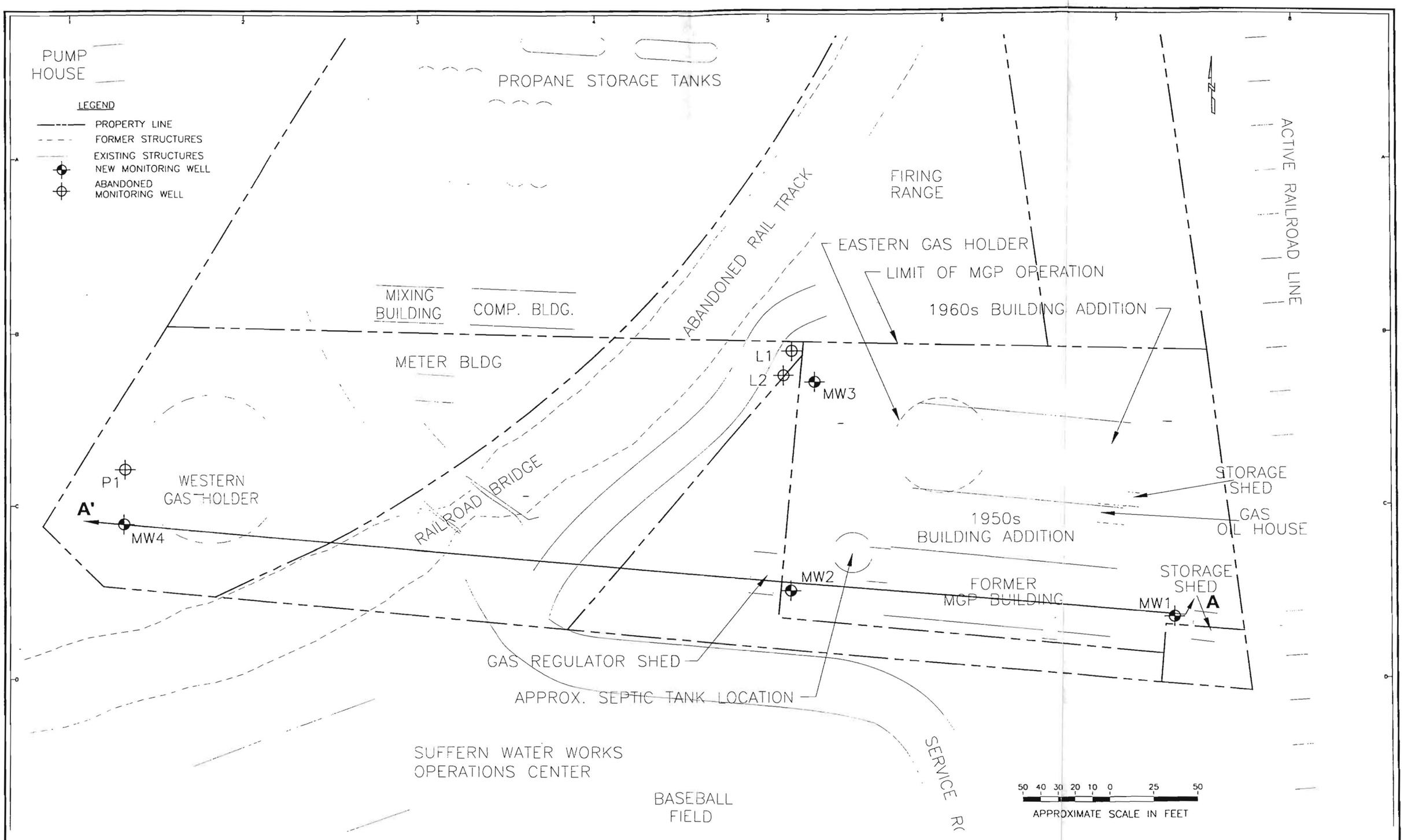
section is shown in Figure 4-1 and the cross-section is shown in Figure 4-2. Two stratigraphic units were identified during the drilling program for the investigation. The uppermost unit consists of a fill which was common in the majority of the soil borings and well installations. The fill was generally thicker in the area to the west of the Econo-Truck garage, ranging from 2 feet at SB2 to 4 feet at SB4. No fill was found at the upgradient well location SB1. The fill material varies in composition, but is generally a brown gravelly 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 gravelly sands, sands, and sandy gravels. Most of the borings contained a mixture of these soil types, and as such, show a wide range of grain size.

4.3 Site Hydrogeology

Detailed information regarding the site hydrology was obtained during the soil boring and monitoring well installation. The depth to water was defined by four new monitoring wells. Depth to water measurements were also taken at all the temporary Geoprobe borings. The soil boring measurements confirm the potentiometric measurements obtained from the wells; however, the measurements within the eastern gas holder foundation and the gas-oil house foundation identified areas of "perched" water relative to the groundwater table. A complete round of depth-to-water measurements was collected prior to the groundwater sampling completed on June 3, 1997. The results of the testing have been used to map the potentiometric surface of the water table and infer the direction of groundwater flow (Figure 4-3).

At all well locations the water table was found in the alluvial soils beneath the fill unit. The depth to water below the ground surface ranged from approximately 8 feet at well MW4, near the western gas holder, to 16 feet below the ground surface at MW1, the upgradient well location. The surface of the water table sloped towards the Ramapo River; however, the elevation of the water table was found to be slightly higher at the location of MW2. It is likely that the septic tank and leach field contribute to the slight groundwater "mound" observed in this area. The direction of flow is generally consistent with previous site studies conducted by ERM (ERM, 1987). Based on this water table map, the average horizontal gradient across the site was calculated to be 0.0035 feet/foot.



NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
6							
5							
4							
3							
2							
1							
0							

REFERENCE DWG | DESCRIPTION

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

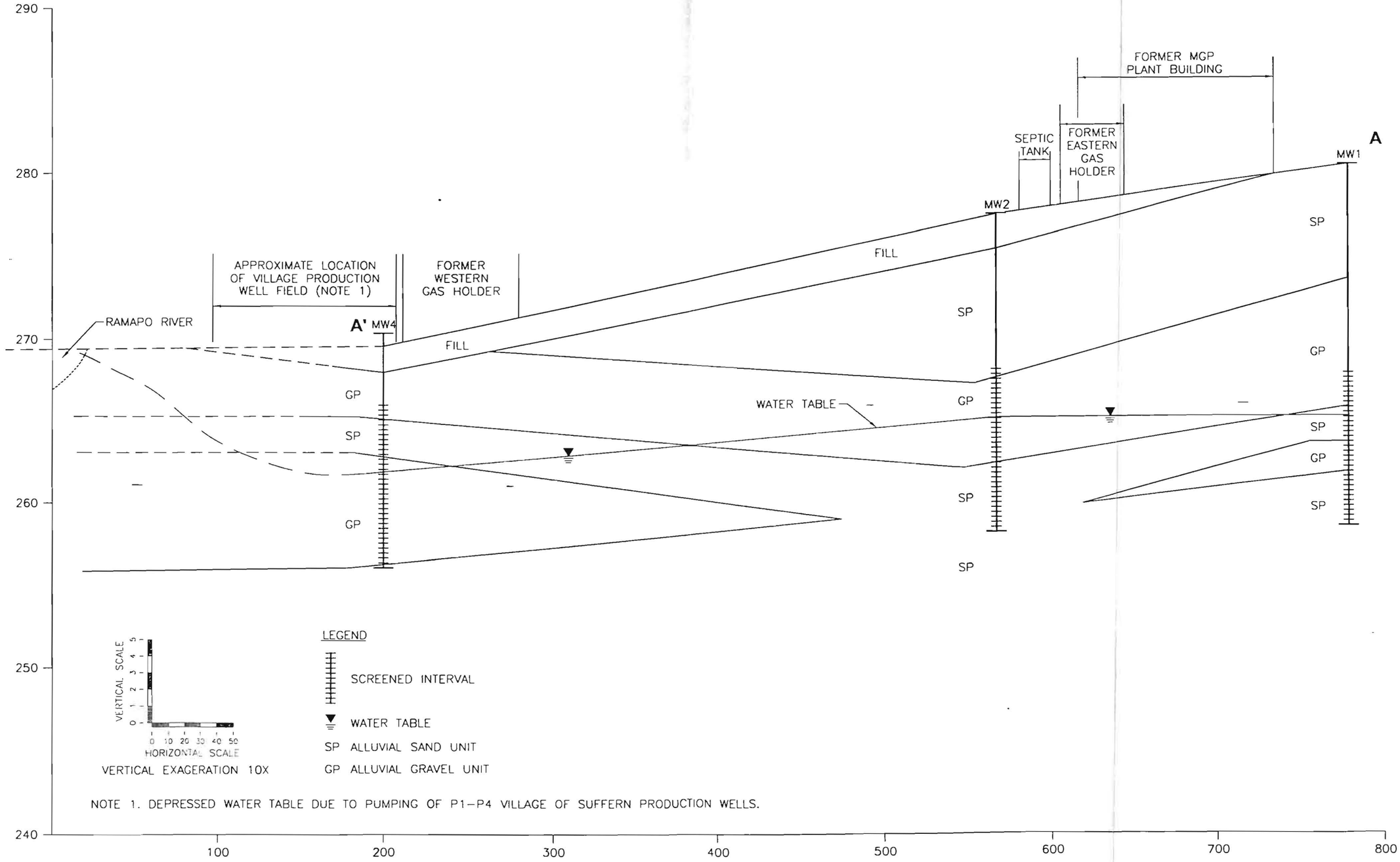
CURRENT DATE: 07/21/97 | CAD FILE 26325A16

CROSS-SECTION LOCATION MAP

SUFFERN, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 4-1 | REV. 0



NOTE 1. DEPRESSED WATER TABLE DUE TO PUMPING OF P1–P4 VILLAGE OF SUFFERN PRODUCTION WELLS.

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
0	MDC	07/21/97	DRAFT				

REFERENCE DWG | DESCRIPTION

ORANGE & ROCKLAND UTILITIES
SUFFERN GAS PLANT SITE
3-2632-200

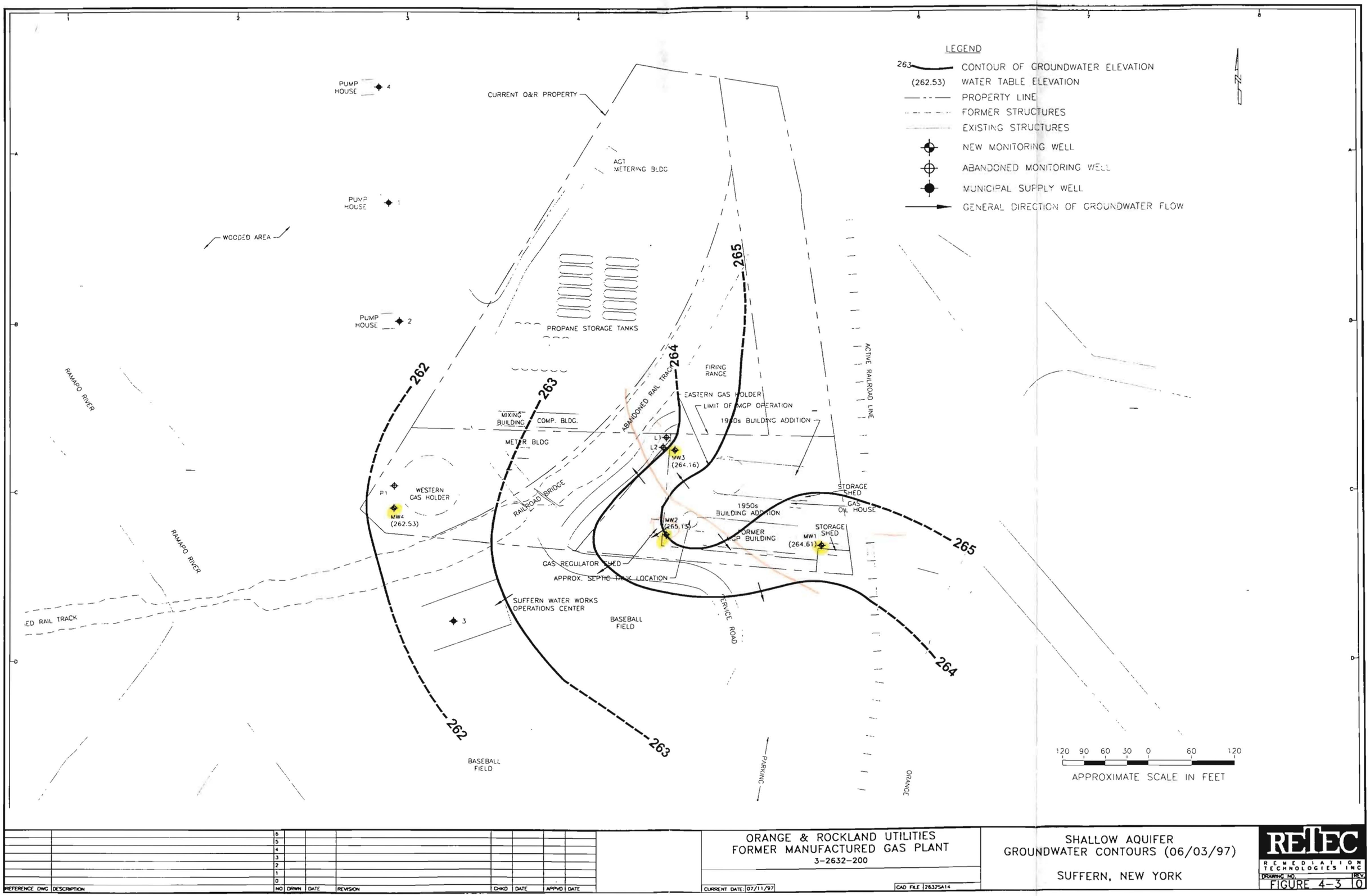
CURRENT DATE: 07/21/97
CAD FILE 2632XA01.DWG

GEOLOGIC CROSS SECTION A–A'

SUFFERN, NEW YORK

REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 4-2 | REV. 0



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
		6							
		5							
		4							
		3							
		2							
		1							
		0							

ORANGE & ROCKLAND UTILITIES
FORMER MANUFACTURED GAS PLANT
3-2632-200

CURRENT DATE: 07/11/97

CAD FILE 26325A14

SHALLOW AQUIFER
GROUNDWATER CONTOURS (06/03/97)

SUFFERN, NEW YORK

RETEC
REMEDIATION TECHNOLOGIES INC

DRAWING NO. FIGURE 4-3 REV. 0

Slug testing was performed in all four of the new wells installed at the site. 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 4-1. The hydraulic conductivity (K) values for the wells ranged from 8.8 x 1.0^{-4} centimeters per second (cm/sec) at well MW1 to 2.01 x 1.0^{-3} cm/sec at well MW4. The average hydraulic conductivity for the wells was found to be 1.44 x 1.0^{-3} cm/sec, a value which is consistent with that expected for a gravelly sand (Freeze and Cherry, 1979).

Table 4-1
Hydraulic Conductivity Results

Well	Hydraulic Conductivity (cm/s)	Average Linear Velocity (feet/year)
MW1	8.8 X 10^{-4}	12.7
MW2	1.5 X 10^{-3}	22.2
MW3	1.9 X 10^{-3}	27.5
MW4	2.0 X 10^{-3}	29.1

Based on the calculated hydraulic conductivities of the unconsolidated deposits, estimates of the average horizontal linear velocity of groundwater flow 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 0.25 for n, the hydraulic gradient of 0.0035, and the range of conductivities shown above, the horizontal linear velocity of groundwater flow is approximately 12.7 to 29.1 feet per year.

The MGP site is approximately 400 feet from municipal well 1, and 450 feet from municipal well 2. At even the slowest calculated flow rate there is ample time from the cessation of plant operations to the present day for groundwater from the site to have reached the wells.

4.4 Subsurface Structures

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.

4.4.1 Western Gas Holder

The western gas holder was an on-grade structure which was used to hold manufactured gas prior to distribution. The above-ground portion was removed after the closure of the MGP. The foundation slab for the gas holder is present in the western area of the site. Monitoring well MW4 was installed in soil boring SB4 in a location considered to be down gradient of the western holder. RETEC's field observations during surface soil sampling, soil boring and groundwater sampling within and adjacent to the holder include:

- An 80-foot diameter holder floor slab consists of a concrete slab, approximately 4 inches thick which is covered by a 4 ½-foot thick layer of recent fill material.
- Native soil, consisting of a sandy gravel was found below the concrete to a total depth of 12 feet (boring SG8).
- No visual, olfactory or PID screening evidence of MGP constituents was found in the soil borings or groundwater sample associated with the western holder.
- Surface soils between the railroad bridge and the western holder exhibit a turquoise green/blue staining which may be due to impact by purifier box waste.

4.4.2 Eastern Gas Holder

Historical Sanborn drawings, Geoprobe borings and a test pit were used to locate the footprint of the eastern gas holder shown on Figure 3-1. The following set of observations regarding the holder were made during the field work:

- The eastern gas holder was a structure approximately 40 feet in diameter. The subsurface portion of the holder currently lies partially within the

footprint of the Econo-Truck building and partially outside the building to the northwest.

- Within the Econo-Truck building, Geoprobe drill rods were unable to advance deeper than 6.6 feet below the concrete slab in borings SG2, SG3, SG4 and SG5, the likely floor of the holder.
- A similar depth to refusal was found with the Geoprobe tools at SG9, indicating the holder pit or the holder foundation may extend to that location.
- Fill material was found within the holder pit which consisted of brick and coal fragments, gravel and sand.
- The fill was observed to contain black hydrocarbon staining, hydrocarbon sheens and hydrocarbon odors.
- A black, highly viscouse tar-like material was found mixed with the fill in thin stringers at Geoprobe borings SG3, SG4 and SG9.
- The thickest of the tar stringers was approximately one foot (SG4).
- Soil gas within the fill material contained measurable amounts of organic vapors as detected by the PID (up to 241 ppm/PID).
- Concentrations of benzene in the soil gas, as measured with Drager detector tubes, were below the detection limits at all Geoprobe locations within the holder.
- A "perched" water table 8 feet above the surrounding groundwater table exists within the holder pit at a depth of approximately 3.8 feet below the floor slab of the Econo-Truck building.
- Samples of the water perched within the former holder exhibited signs of impacts, including strong odors, sheens and elevated jar headspace PID results (approximately 14 ppm/PID).

Six Geoprobe borings and one test pit were installed around the outside of the former eastern gas holder. The objective of the work was to further define the extent of COI in soil and groundwater and to confirm observations made by Mr. Irv Kushner, owner of Econo-Truck, regarding the alleged release of tar from the holder during excavation of the foundation footer for the Econo-Truck garage in the 1960s. The following observations were recorded by the field geologist during the sampling:

- No visible signs of MGP constituents were noted at upgradient location SG10, with the exception of the detection of organic vapors which were recorded with the PID in soil gas and soil samples beneath the concrete floor slab.

- Parts of a steel drum and an approximate volume of 2 to 3 cubic feet of mixed high and low viscosity tar was encountered at test pit TP3, at a depth of one foot bgs.

- Visible signs of impact from MGP residuals in soil at boring location SG7 consisted of strong hydrocarbon odors, hydrocarbon staining and the detection of organic vapors with the PID.

- Several stringers of high viscosity tar were observed in the soil samples at boring locations SG12 and SG13.

- A groundwater sample taken from downgradient Geoprobe boring SG12 had a hydrocarbon odor and a jar headspace result of 30.2 ppm/PID.

- Hardened tar was observed at ground surface in an area west of the former holder (near SS2).

4.4.3 Gas-Oil House Foundation

One Geoprobe boring, two test pits and a surface soil sample were taken in the area of the gas-oil house foundation. The following observations were recorded during the fieldwork.

- The majority of the foundation of the gas-oil house lies under the 1950s building addition; however, approximately 6 feet is outside the building footprint to the east.

- The brick foundation is 12 feet deep, 13 feet wide and contains fill material consisting of gravel, brick and coal fragments.

- Based on historical Sanborn drawings, the length of the foundation is estimated at 30 feet.

- The fill is saturated with a black, high viscosity tar (estimated at 70 cubic yards) from 7 feet bgs to the bottom of the foundation.

- No MGP constituents were observed in samples of the sand below the bottom of the foundation, based upon observations made during boring SG1.

- A perched water table at 4.5 feet bgs exists within the foundation (7.5 feet above the surrounding groundwater table).
- Slight evidence of leakage of water from the foundation was observed outside the foundation wall.
- The greatest jar headspace result from testing the soils surrounding the foundation was 14 ppm/PID.

Test pit TP2 was excavated in an area between the gas-oil house foundation and the railroad right of way, which was an area cited by historical sources to have been the site of the disposal of MGP wastes (ERM, 1987). The test pit was excavated to a depth of 12 feet bgs. No odors or visible evidence of MGP residuals was observed. No organic vapors were detected in the jar headspace testing on soil samples taken from the excavation.

4.4.4 Former MGP Building

Two soil borings were completed in close proximity to the former MGP building. Monitoring well MW1 was installed in soil boring SB1 in a location considered upgradient of the building. Monitoring well MW2 was installed in soil boring SB2 in a location considered down gradient of the former plant and eastern holder. No visible, olfactory or PID screening evidence of MGP constituents was found for soil or groundwater from MW1. During soil sampling for the installation of MW2, a slight odor and PID screening result of 481 ppm with the photo-ionization detector was observed near the elevation of the water table. No visible signs of impact were observed.

5.0 ANALYTICAL RESULTS

This section presents the analytical results of soil, soil gas, groundwater and DNAPL samples collected during the PSA Investigation. Soil samples are presented in terms of sampling depth. All samples collected between the ground surface and the 6-inch depth are designated as surface soil samples and those collected below the 6-inch depth are designated subsurface soil samples. The laboratory results which provide the results of the analyses are presented as Appendix B.

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

- Volatile compounds by ASP 91-1;
- PAH compounds by ASP 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 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 (October, 1993).

5.1 Surface Soils Analysis

Four surface soil samples (SS1 - SS4) were collected during the investigation. The sampling locations are shown on Figure 3-1. All surface soils were collected from a depth interval of between zero and 6 inches 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 5-1.

5.1.1 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 four samples submitted to the laboratory.

5.1.2 Surface Soil - PAH Analysis

PAHs were detected in all four samples submitted for analyses. For sample SS1, only one compound was detected in a concentration greater than the method detection limits. Benzo(b)fluoranthene was detected in a concentration of 0.45 mg/Kg. This concentration is below the NYSDEC TAGM 4046 Soil Cleanup Objective concentration for this compound of 1.1 mg/Kg. Total detected PAH concentration results for surface soil samples SS2, SS3 and SS4 were 117 mg/Kg, 37 mg/Kg and 118.8 mg/Kg, respectively. Concentrations of individual PAH compounds exceeding the TAGM recommended cleanup objectives were found at each of the three soil sample locations. Table 5-2 is a summary of the PAH compounds which were detected in the surface soil samples at the site in concentrations exceeding the TAGM recommended cleanup objectives.

Table 5-1
Soil Data Summary
Suffern Site

	Subsurface Soils				Surface Soils				Associated Blanks (All values in ug/L)		
Sample ID	SB1 (12-14)	SB2 (10-12)	SB3 (2-4)	SB4 (4-6)	SS1	SS2	SS3	SS4	EB Suffern	TB (5-7-97)	NYSDEC
Lab ID	2706616	2708188	2707670	2707669	2706617	2706615	2706619	2706618	2707667	2707668	Recommended Soil
Date Sampled	05/06/97	05/08/97	05/07/97	05/07/97	05/06/97	05/06/97	05/06/97	05/06/97	05/07/97	05/07/97	Cleanup Objective
BTEX (µg/Kg)											
Benzene	11 U	11 U	12 U	11 U	11 U	11 U	13 U	12 U	10 U	10 U	60
Toluene	11 U	11 U	2 J	11 U	5 J	11 U	13 U	12 U	10 U	10 U	1500
Ethylbenzene	11 U	11 U	12 U	11 U	11 U	11 U	13 U	12 U	10 U	10 U	5500
Xylene (total)	11 U	11 U	5 J	11 U	2 J	11 U	13 U	12 U	10 U	10 U	1200
PAHs (µg/Kg)											
Naphthalene	360 U	360 U	53000	370 U	120 J	3600 J	340 J	5800 U	11 U	-	13000
Acenaphthylene	360 U	92 J	43000 J	80 J	360 U	3300 J	580 J	2100 J	11 U	-	41000
Acenaphthene	360 U	360 U	7200 J	370 U	360 U	640 J	130 J	5800 U	11 U	-	50000
Fluorene	360 U	360 U	41000 J	66 J	360 U	3500 J	330 J	5800 U	11 U	-	50000
Phenanthrene	360 U	140 J	200000	460	140 J	17000	3500	3900 J	11 U	-	50000
Anthracene	360 U	130 J	55000	120 J	36 J	5100	720 J	1400 J	11 U	-	50000
Fluoranthene	360 U	560	200000	610	270 J	20000	5700	13000	11 U	-	50000
Pyrene	360 U	870	160000	710	300 J	18000	5800	13000	11 U	-	50000
Benz(a)anthracene	360 U	540	[illegible]	340 J	160 J	8200	2900	9800	11 U	-	224 MDL
Chrysene	360 U	680	[illegible]	360 J	240 J	9000	3800	13000	11 U	-	400
Benzo(b)fluoranthene	360 U	770	[illegible]	480	450	12000	5200	25000	11 U	-	1100
Benzo(k)fluoranthene	360 U	280 J	[illegible]	180 J	170 J	4700	1900	10000	11 U	-	1100
Benzo(a)pyrene	360 U	400	[illegible]	350 J	320 J	10000	3300	10000	11 U	-	61 MDL
Indeno(1,2,3-cd)pyrene	360 U	440	[illegible]	190 J	330 J	6600	2600	15000	11 U	-	3200
Dibenzo(a,h)anthracene	360 U	120 J	[illegible]	370 U	90 J	1400 J	620 J	3300 J	11 U	-	14 MDL
Benzo(g,h,i)perylene	360 U	510	[illegible]	140 J	320 J	6400	2600	10000	11 U	-	50000
METALS (mg/Kg)											
Aluminum	8180	-	4370	9300	13300	5900	9250	5480	22.7 U	-	SB
Antimony	0.7 U	-	0.78 U	0.71 U	0.69 U	0.7 U	0.82 U	0.74 U	3.2 U	-	SB
Arsenic	2.8	-	7.7	4	3.4	3.6	4.2	12	4.9 U	-	7.5 SB
Barium	31.1 B	-	95.6	151	77.5	65.6	47.4 B	124	0.66 B	-	300 SB
Beryllium	0.65 B	-	0.64 B	0.84 B	0.2 B	0.35 B	0.36 B	0.17 B	0.28 U	-	0.16 SB
Cadmium	0.074 U	-	0.57 B	0.076 U	0.074 U	0.46 B	0.087 U	0.079 U	0.34 U	-	1 SB
Calcium	1540 * J	-	2910 * J	2310 * J	19900 * J	11700 * J	5280 * J	3610 * J	1170 B	-	SB
Chromium	15	-	22.2	20.5	48	21.3	14.4	13.1	0.84 U	-	10 SB
Cobalt	6.4 B	-	5.3 B	8.6 B	20.4	7 B	10.2 B	6.9 B	0.62 U	-	30 SB
Copper	20.5	-	67.1	25.9	69.1	97	50.5	129	0.9 U	-	25 SB
Iron	19100	-	27900	21500	52000	23000	29000	38700	34.3 B	-	2000 SB
Lead	5	-	348	12	159	121	106	153	1.7 B	-	SB
Magnesium	3670	-	1530	3420	15800	3410	5600	4460	41.9 B	-	SB
Manganese	133 * J	-	215 * J	6630 * J	690 * J	239 * J	574 * J	265 * J	0.6 B	-	SB
Mercury	0.018 U	-	3.4	0.042 B	0.018 U	0.1 B	0.19	0.26	0.033 U	-	0.1
Nickel	15.8 E	-	16 E	17.9 E	19 E	17.9 E	14.7 E	12.5 E	1.2 U	-	13 SB
Potassium	827 B	-	613 B	773 B	663 B	675 B	697 B	900 B	24.8 B	-	SB
Selenium	0.65 U	-	0.77 B	2.4	0.65 U	0.65 U	0.77 U	0.69 U	3 U	-	2 SB
Silver	0.24 U	-	1.1 B	0.24 U	0.24 U	0.24 U	0.28 U	0.25 U	1.1 U	-	SB
Sodium	90.9 B	-	218 B	146 B	1570	327 B	689 B	454 B	181 B	-	SB
Thallium	1.8 B	-	1.2 B	2 B	2.7	1.5 B	1.4 B	2.3	3.7 U	-	SB
Vanadium	22.9	-	33	27.5	65.6	41.1	49.3	40	0.45 U	-	150 SB
Zinc	39	-	111	63.9	300	184	132	47.7	0.95 U	-	20 SB
Cyanide	0.27 U	0.52	8	1.8	0.31	1.1	3.7	288	5 U	-	NL
GENERAL											
Moisture (% by wt.)	8.33	7.83	17.9	10.2	7.93	8.13	21.9	14.5	-	-	-

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)
SB - Site Background
- Not analyzed for
NL - Not Listed

Table 5-2
PAH Results and TAGM Cleanup Objectives

Compound	Range and Maximum Concentrations Detected	TAGM 4046 Soil Cleanup Objective	Samples Exceeding Cleanup Objective
Benzo(a)anthracene	<0.25 to 9.8 mg/Kg	0.224 mg/Kg or method detection limits	SS2, SS3 and SS4
Chrysene	<0.25 to 13 mg/Kg	0.4 mg/Kg	SS2, SS3 and SS4
Benzo(b)fluoranthene	<0.28 to 25 mg/Kg	1.1 mg/Kg	SS2, SS3 and SS4
Benzo(k)fluoranthene	<0.25 to 10 mg/Kg	1.1 mg/Kg	SS2, SS3 and SS4
Benzo(a)pyrene	<0.25 to 10 mg/Kg	0.061 mg/Kg or method detection limits	SS2, SS3 and SS4
Indeno(1,2,3-cd) pyrene	<0.25 to 15 mg/Kg	3.2 mg/Kg	SS2 and SS4

Naphthalene, acenapthylene, acenaphthene, fluorene, and benzo(g,h,i)perylene were not detected in concentrations above the method detection limits for the surface samples. Concentrations of PAH compounds phenanthrene, anthracene, flouranthene, pyrene, and benzo(g,h,i)perylene were detected but, were found to be below the TAGM recommended cleanup objective concentrations.

5.1.3 Surface Soil - Metal Analysis

Antimony, selenium, and silver were not detected in concentrations greater than the method detection limits in all four samples. Table 5-3 presents 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 concentrations of samples exceeding the background ranges.

Table 5-3
TAL Metals Results and TAGM Background Values

Metal	Range of Concentrations Detected in Samples	TAGM 4046 Background Range	Samples Exceeding Background Range
Aluminum	5,480 to 13,300 mg/Kg	33,000 mg/Kg (1)	
Arsenic	3.4 to 12 mg/Kg	3 to 12 mg/Kg (2)	SS4 (12 mg/Kg)
Barium	47.4 to 124 mg/Kg	15 to 600 mg/Kg (1)	
Beryllium	0.17 to 0.36 mg/Kg	0 to 1.75 mg/Kg (1)	
Cadmium	ND < 0.074 to 0.46 mg/Kg	0.1 to 1.0 mg/Kg (1)	
Calcium	5280 to 19,000 mg/Kg	130 to 35,000 mg/Kg (2)	
Chromium	13.1 to 48 mg/Kg	1.5 to 40 mg/Kg (2)	SS1(48 mg/Kg)
Cobalt	7 to 20.4 mg/Kg	2.5 to 60 mg/Kg (2)	
Copper	50.5 to 129 mg/Kg	1 to 50 mg/Kg (1)	SS1(69.1 mg/Kg) SS2(97 mg/Kg) SS3(50.5 mg/Kg) SS4(129 mg/Kg)
Iron	23,000 to 52,000 mg/Kg	2,000 to 550,000 mg/Kg (1)	
Lead	106 to 159 mg/Kg	200 to 500 mg/Kg (3)	
Magnesium	3,410 to 15,800 mg/Kg	100 to 5,000 mg/Kg (1)	SS1(15,800 mg/Kg) SS3(5,600 mg/Kg)
Manganese	239 to 690 mg/Kg	50 to 5,000 mg/Kg (1)	
Mercury	0.1 to 0.26 mg/Kg	0.001 to 0.2 mg/Kg (1)	SS4(0.26 mg/Kg)
Nickel	12.5 to 19 mg/Kg	0.5 to 25 mg/Kg (1)	
Potassium	663 to 900 mg/Kg	8,500 to 43,000 mg/Kg (2)	
Sodium	327 to 1,570 mg/Kg	6,000 to 8,000 mg/Kg (1)	
Thallium	1.4 to 2.7 mg/Kg	NA	
Vanadium	40 to 65.6 mg/Kg	1 to 300 mg/Kg (1)	
Zinc	47.7 to 300 mg/Kg	9 to 50 mg/Kg (1)	SS1(300 mg/Kg) SS2(184 mg/Kg) SS3(132 mg/Kg)

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.

5.1.4 Surface Soil - Cyanide Analysis

Cyanide was detected in all four surface soil samples. Concentrations of total cyanide ranged from 1.1 mg/Kg at SS4 to 288 mg/Kg in SS4. 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).

5.2 Subsurface Soil Analysis

Four 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. Sample SB2(10-12) was collected as a result of a detection of organic vapors with the PID from the soil at the specified depth. Sample SB3(2-4) was collected as a result of the visual and olfactory observations of the industrial fill material found at the location of MW3. No impacts were observed in borings SB1 and SB4, therefore the sample from those borings was collected immediately above the water table. As specified in the work plan, not all subsurface soils were analyzed for metals. The selection of subsurface soils for metals analysis was based on whether the soil represented native soil (not analyzed) or fill materials (analyzed). The results of the analyses are presented in Table 5-4.

5.2.1 Subsurface Soil - BTEX Analysis

No BTEX compounds were detected in concentrations which were greater than the method detection limits for any of the four samples submitted to the laboratory.

5.2.2 Subsurface Soils - PAH Analysis

PAH compounds were detected in three out of the four samples submitted for analyses. No PAH compounds were detected in sample SB1(12-14). This sample was collected from the upgradient well boring for MW1.

For sample SB2(10-12), two compounds were detected in concentrations greater than the NYSDEC TAGM 4046 Soil Cleanup Objectives. Benzo(a)anthracene was detected at a concentration of 0.54 mg/Kg. This concentration is greater than the TAGM 4046 Soil Cleanup

Objective concentration of 0.224 mg/Kg (or method detection limits). Chrysene was detected at a concentration of 0.68 mg/Kg, slightly exceeding the TAGM Cleanup objective of 0.4 mg/Kg. Detected PAH compounds below the TAGM cleanup objective values included fluoranthene, pyrene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene.

Ten individual PAH compounds exceeding the TAGM recommended cleanup objectives were found at subsurface soil location SB3(2-4). As previously mentioned, this sample was taken from the industrial fill material at the northwest corner of the Econo-Truck garage. Table 5-5 is a summary of the PAH compounds which were detected at this location and the respective TAGM cleanup objective values.

Table 5-4
SB3 (2-4) PAH Results and TAGM Cleanup Objectives

Compound	Concentrations Detected	TAGM 4046 Soil Cleanup Objective
Naphthalene	53 mg/Kg	13 mg/Kg
Phenanthrene	200 mg/Kg	50 mg/Kg
Anthracene	55 mg/Kg	50 mg/Kg
Fluoranthene	200 mg/Kg	50 mg/Kg
Pyrene	160 mg/Kg	50 mg/Kg
Benzo(a)anthracene	69 mg/Kg	0.224 mg/Kg or method detection limits
Chrysene	72 mg/Kg	0.4 mg/Kg
Benzo(b)fluoranthene	84 mg/Kg	1.1 mg/Kg
Benzo(k)fluoranthene	35 mg/Kg	1.1 mg/Kg
Benzo(a)pyrene	75 mg/Kg	0.061 mg/Kg or method detection limits
Indeno(1,2,3-cd) pyrene	51 mg/Kg	3.2 mg/Kg

5.2.3 Subsurface Soils - Metals Analysis

Three subsurface soil samples were collected during the monitoring well program and analyzed for TAL metals. As previously mentioned, SB2(10-12) was not analyzed for metals. The

results indicate that five of the detected metals concentrations were greater than the TAGM 4046 background range for Eastern USA or New York State soils. The concentrations and their respective background concentrations are summarized in Table 5-5:

Table 5-5
Subsurface Soil TAL Metal Results

TAL Metal	Sample SB3(2-4)	Sample SB4(4-6)	TAGM 4046 Background Concentrations
Copper	67.1 mg/Kg	NA	1 to 50 mg/Kg
Manganese	NA	6630 mg/Kg	50 to 5,000 mg/Kg
Mercury	3.4 mg/Kg	NA	0.001 to 0.2 mg/Kg
Zinc	111 mg/Kg	63.9 mg/Kg	9 to 50 mg/Kg

NA - not applicable (detected concentration less than TAGM background range)

5.2.4 Subsurface Soil - Cyanide Analysis

Cyanide was detected in three of four subsurface soil samples. Total cyanide concentrations ranged from 0.52 mg/Kg in SB2(10-12) to 8 mg/Kg in soil from sample SB(2-4). At the time of this report, no Eastern USA Background concentration range is listed in TAGM 4046. As discussed in Section 5.1.4 the cyanide is expected to be in the form of non-reactive complex metal cyanide.

5.3 Soil Gas - BTEX Analysis

One sample was sent to the laboratory from the Geoprobe soil gas survey completed at the site. Sample SG-Suffern, shown on Figure 3-1, was taken from a location immediately adjacent to the boring where the highest field readings (PID) were found. The results of the analysis of the soil gas by Method USEPA 18 Modified, indicated that all of the BTEX constituents were detected above the method detection limits. Total BTEX was found to be 164 milligrams per cubic meter (mg/m3). Individual BTEX compounds, followed by the respective result are as follows:

- benzene 120 mg/m^3

- toluene 4 mg/m^3
- ethylbenzene 7 mg/m^3
- xylene(total) 23 mg/m^3

5.4 Groundwater Analysis

A total of four groundwater samples were collected from the four new monitoring wells and sent to the laboratory for analysis of VOC, PAH, cyanide and TAL metals. Original specifications listed in the work plan indicated that only the BTEX compounds would be analyzed for volatile organic analyses, however, at the request of O&R, the full TAL list of volatile organic compounds and the analysis of Freon R-11 and Freon R-12 was completed for the groundwater samples. The extension of the volatiles analyte list was due to concerns that current on-site activities may have had an impact on groundwater conditions. The inclusion of Freon was to help the Rockland County Department of Health to delineate a groundwater plume north of, and unrelated to, the MGP site.

For monitoring well MW1, turbidity could not be reduced to acceptable levels (less than 50 NTU) during sampling. A sample from this well was submitted to the laboratory for both total and dissolved metals analysis. A summary of the results of the groundwater analyses are provided in Table 5-6.

5.4.1 Groundwater-VOC Analysis

Of the four groundwater samples, only one well contained volatile organic compounds in concentrations above the method detection limits. The sample from MW2 contained chlorobenzene at a concentration of 19 µg/L. This concentration is greater than the NYS 6NYCRR Part 703 Water Quality Standard of 5 µg/L.

5.4.2 Groundwater-PAH Analysis

None of the four groundwater samples taken during the investigation contained concentrations of PAHs above the method detection limits. One well, MW3 contained four semivolatile compounds detected below the method detection limit but above the instrument detection limit ("J-values"). Monitoring well MW3 was installed to replace the abandoned well L2. The estimated detections of these compounds is consistent with the results of the previous monitoring for L2. The compounds and estimated concentrations are as follows:

- acenaphthylene 4 µg/L
- acenapththene 2 µg/L
- fluorene 1 µg/L
- pyrene 1 µg/L

5.4.3 Groundwater-TAL Metals Analysis

A total of five groundwater samples were submitted to the laboratory for analysis of TAL metals. At sample location MW1, the turbidity could not be lowered below 50 NTU during groundwater sampling. A filtered metal sample was collected from this well and submitted for TAL metal analysis. The results of the metal analyses are presented in Table 5-6.

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

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

Levels of iron, manganese and sodium were found to exceed the standards in several of the monitoring wells. Iron was detected in all of the wells and the filtered sample from MW1 in concentrations exceeding the groundwater standard of 300 µg/L. Iron concentrations ranged from 41,200 µg/L at well MW1 to 582 µg/L at MW4. Manganese was detected in wells MW1, the filtered sample from MW1, MW2 and MW3 in concentrations exceeding the groundwater standard of 300 µg/L. The concentrations of manganese ranged from 10,500 µg/L at MW1 to 214 µg/L at MW4. Sodium was detected in wells MW2, MW3 and MW4 in concentrations greater than the groundwater standard of 20,000 µg/L. Concentrations of sodium ranged from 9,260 µg/L in MW1 to 123,000 µg/L in well MW4.

Table 5-6
Groundwater Data Summary
Suffern Site

Sample ID	MW1	MW1-F	MW2	MW3	MW4	Groundwater
Lab ID	2721744	2721745	2721746	2721747	2722608	Standard /
Date Sampled	06/03/97	06/03/97	06/03/97	06/03/97	06/02/97	Guidance Value
VOCs (µg/L)						
Dichlorodifluoromethane	10 U	-	10 U	10 U	10 U	5 s
Chloromethane	10 U	-	10 U	10 U	10 U	NL
Vinyl Chloride	10 U	-	10 U	10 U	10 U	2 s
Bromomethane	10 U	-	10 U	10 U	10 U	5 s
Chloroethane	10 U	-	10 U	10 U	10 U	5 s
Trichlorofluoromethane	10 U	-	10 U	10 U	10 U	5 s
1,1-Dichloroethene	10 U	-	10 U	10 U	10 U	5 s
Acetone	10 U	-	10 U	10 U	10 U	50 g
Carbon Disulfide	10 U	-	10 U	10 U	10 U	NL
Methylene Chloride	10 U	-	10 U	10 U	10 U	5 s
1,1-Dichloroethane	10 U	-	10 U	10 U	10 U	5 s
1,2-Dichloroethene (total)	10 U	-	10 U	10 U	10 U	5 s
2-Butanone	10 U	-	10 U	10 U	10 U	NL
Chloroform	10 U	-	10 U	10 U	10 U	7 s
1,2-Dichloroethane	10 U	-	10 U	10 U	10 U	5 s
1,1,1-Trichloroethane	10 U	-	10 U	10 U	10 U	5 s
Carbon Tetrachloride	10 U	-	10 U	10 U	10 U	5 g
Benzene	10 U	-	10 U	10 U	10 U	0.7 s
Trichloroethene	10 U	-	10 U	10 U	10 U	5 s
1,2-Dichloropropane	10 U	-	10 U	10 U	10 U	5 s
Bromodichloromethane	10 U	-	10 U	10 U	10 U	50 g
cis-1,3-Dichloropropene	10 U	-	10 U	10 U	10 U	5 s
trans-1,3-Dichloropropene	10 U	-	10 U	10 U	10 U	5 s
1,1,2-Trichloroethane	10 U	-	10 U	10 U	10 U	5 s
Dibromochloromethane	10 U	-	10 U	10 U	10 U	50 g
Bromoform	10 U	-	10 U	10 U	10 U	50 g
4-Methyl-2-Pentanone	10 U	-	10 U	10 U	10 U	NL
Toluene	10 U	-	10 U	10 U	10 U	5 s
Tetrachloroethene	10 U	-	10 U	10 U	10 U	5 s
2-Hexanone	10 U	-	10 U	10 U	10 U	50 g
Chlorobenzene	10 U	-	19	10 U	10 U	5 s
Ethylbenzene	10 U	-	10 U	10 U	10 U	5 s
Xylene (total)	10 U	-	10 U	10 U	10 U	5 s (each)
Styrene	10 U	-	10 U	10 U	10 U	5 s
1,1,2,2-Tetrachloroethane	10 U	-	10 U	10 U	10 U	5 s
PAHs (µg/L)						
Naphthalene	9 U	-	9 U	9 U	10 U	10 g
Acenaphthylene	9 U	-	9 U	4 J	10 U	20 g
Acenaphthene	9 U	-	9 U	2 J	10 U	20 g
Fluorene	9 U	-	9 U	1 J	10 U	50 g
Phenanthrene	9 U	-	9 U	9 U	10 U	50 g
Anthracene	9 U	-	9 U	9 U	10 U	50 g
Fluoranthene	9 U	-	9 U	9 U	10 U	50 g
Pyrene	9 U	-	9 U	1 J	10 U	50 g
Benzo(a)anthracene	9 U	-	9 U	9 U	10 U	0.002 g
Chrysene	9 U	-	9 U	9 U	10 U	0.002 g
Benzo(b)fluoranthene	9 U	-	9 U	9 U	10 U	0.002 g
Benzo(k)fluoranthene	9 U	-	9 U	9 U	10 U	0.002 g
Benzo(a)pyrene	9 U	-	9 U	9 U	10 U	0.002 s
Indeno(1,2,3-cd)pyrene	9 U	-	9 U	9 U	10 U	0.002 g
Dibenzo(a,h)anthracene	9 U	-	9 U	9 U	10 U	NL
Benzo(g,h,i)perylene	9 U	-	9 U	9 U	10 U	5 g
METALS (µg/L)						
Aluminum	4960	20.1 U	1740	1110	222	NL
Antimony	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	25 s
Barium	58.9 B	26 B	164 B	33.5 B	70.8 B	1000 s
Beryllium	0.98 U	0.98 U	0.98 U	0.98 U	0.98 U	3 g
Cadmium	0.79 B	0.64 B	1.1 B	0.64 U	2.1 B	10 s
Calcium	23900	22600	73600	28700	55200	NL
Chromium	7.1 B	1.1 U	2.7 B	2.3 B	1.1 U	50 s
Cobalt	28.9 B	25.6 B	3.8 B	5.2 B	1.5 B	NL
Copper	17 B	1.8 U	12.8 B	4.6 B	3.3 B	200 s
Iron	41200 N*J	32600 N*J	3490 N*J	2810 N*J	582 N*J	300 s
Lead	2.9 B	2.1 U	2.1 U	2.1 U	2.1 U	25 s
Magnesium	6040	5080	16100	5100	8000	35000 s
Manganese	10500	9910	2700	1120	214	300 s
Mercury	0.075 B	0.064 B	0.078 B	0.079 B	0.06 B	2 s
Nickel	60.2	48.3	11.2 B	13.4 B	3.8 B	NL
Potassium	1900 B	1360 B	16000	1890 B	2950 B	NL
Selenium	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	50 s
Sodium	9260 J	9170 J	90300 J	28800 J	123000 J	20000 s
Thallium	5.2 U	5.2 U	5.2 U	5.2 U	6.2 B	4 g
Vanadium	11.4 B	0.7 U	5.1 B	3.4 B	1.8 B	NL
Zinc	34.9	23.1	62.4	17.2 B	16.6 B	300 s
Cyanide	5 U		5 U	22.7	87.1	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)
NL - Not Listed
s - Standard
g - Guidance
- Not analyzed for

5.4.4 Groundwater-Cyanide Analysis

Total cyanide was detected in two of the four new monitoring wells installed in the site. The concentrations detected were 22.7 µg/L for MW3 and 87.1 µg/L for well MW4. These concentrations are below the New York State groundwater standard of 100 µg/L.

5.5 Test Pit - DNAPL Analysis

During the excavation of test pit TP1, a brick foundation for the former gas-oil house was found to contain DNAPL. One DNAPL sample, designated TP1, was collected from the foundation and sent to the laboratory for analysis of RCRA Hazardous Waste Characteristics including: cyanide reactivity, pH, sulfide reactivity, TCLP metals, TCLP Pesticides/Herbicides, TCLP BNA and TCLP VOC. The TCLP-benzene result of 7.1 mg/L was found to be above the hazardous waste characteristic limit regulatory level of 0.5 mg/L. A summary of these results is provided in Table 5-7.

Table 5-7
TCLP Data Summary
Suffern Site

Sample ID	TP-1	Regulatory
Lab ID	2708189	Level
Date Sampled	05/08/97	
GENERAL		
Cyanide (Reactivity) (mg/Kg)	98 U	250
pH	10.8	2.0 to 12.5
Sulfide (Reactivity) (mg/Kg)	50 U	500
TCLP METALS (mg/L)		
Arsenic	0.1 U	5
Selenium	0.2 U	1
Barium	0.52	100
Cadmium	0.033	1
Chromium	0.03 U	5
Lead	0.1 U	5
Silver	0.02 U	5
Mercury	0.0002 U	0.2
TCLP PEST/HERB (mg/L)		
Chlordane	0.0075 U	0.03
Endrin	0.00025 U	0.02
Heptachlor	0.00025 U	0.008
Heptachlor Epoxide	0.00025 U	0.008
Gamma BHC - Lindane	0.00025 U	0.4
Methoxychlor	0.0013 U	10
Toxaphene	0.1 U	0.5
2,4-D	0.02 U	10
2,4,5-TP	0.002 U	1
TCLP BNA (mg/L)		
1,4-Dichlorobenzene	0.02 U	7.5
2-Methylphenol	0.47	200
3-and 4-Methylphenol	0.89	200
Hexachloroethane	0.02 U	3
Nitrobenzene	0.02 U	2
Hexachlorobutadiene	0.02 U	0.5
2,4,6-Trichlorophenol	0.02 U	2
2,4,5-Trichlorophenol	0.02 U	400
2,4-Dinitrotoluene	0.02 U	0.13
Hexachlorobenzene	0.02 U	0.13
Pentachlorophenol	0.05 U	100
Pyridine	0.02 U	5
TCLP VOA (mg/L)		
Vinyl Chloride	0.05 U	0.2
1,1-Dichloroethene	0.05 U	0.7
Chloroform	0.05 U	6
1,2-Dichloroethane	0.05 U	0.5
2-Butanone	0.1 U	200
Carbon Tetrachloride	0.05 U	0.5
Trichloroethene	0.05 U	0.5
Benzene	7.1	0.5
Tetrachloroethene	0.05 U	0.7
Chlorobenzene	0.05 U	100

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

6.0 DATA USABILITY SUMMARY REPORT

RETEC performed a review of all soil and water analyses conducted by Lancaster Laboratories. The results of this review have been organized into a data usability summary report (DUSR). A summary of the findings discussed below is presented in Table 6-1.

6.1 Quality Assurance Audit Overview

This data usability report is provided for soil and water samples collected from the Suffern site during the period from May 6, 1997, through June 3, 1997. Copies of the chain-of-custody forms for each sample are included in Appendix B of this report. A total of 9 soil samples, 4 groundwater samples, 3 blank water samples, and 1 air sample were submitted for analysis. Analytical methods employed were:

1) Volatile Organics (BTEX) by NYSDEC ASP 91-1
2) Polynuclear Aromatic Hydrocarbons (PAHs) by NYSDEC ASP 91-2
3) Target Analyte List (TAL) Metals by NYSDEC ASP CLP-M
4) Volatile Organics in Air by USEPA Method 18
5) RCRA Hazardous Waste Characteristics by USEPA SW-846 Protocols

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) qualified 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.

6.2 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. Laboratory control samples were within the acceptable ranges supplied by the laboratory. An aqueous laboratory control sample was not analyzed with the blanks submitted with the soil samples. The solid laboratory control sample passed criteria and the aqueous laboratory control samples with the groundwater samples passed criteria. Laboratory blanks showed no contamination above the required detection limits. Surrogate, matrix spike, and internal standard recoveries were within acceptable limits.

Based upon this review, no validation qualifiers were added to the VOC data.

6.3 Semivolatile Organics (PAHs)

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. Surrogate, matrix spike, and internal standard area recoveries were within required limits except where dilutions were made do to sample concentrations. Pentachlorophenol was not recovered in the matrix spike or matrix spike duplicate for the soil samples, 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.

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 these samples. Since calibration with sulfur is optional, no validation flags were added.

Based upon this review, no validation qualifiers were added to the SVOC data.

6.4 Inorganic Analyses

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.

Sample SB2 (10-12) was 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. Calcium and manganese in all 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.

6.5 Air Samples

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

6.6 Field Duplicates

There were no field duplicates collected for this site. Work plan specifications listed field duplicates to be taken at a rate of one for every twenty samples. Field duplicates for this project

were taken from separate sites which were investigated during the same mobilization, however, are reported under a separate cover.

Table 6-1
Data Quality Summary
Suffern Site

Sample ID	VOC	SVOC	Inorganics
SS2	V	V	**J (Ca, Mn)**
SB1 (12-14)	V	V	**J (Ca, Mn)**
SS1	V	V	**J (Ca, Mn)**
SS4	V	V	**J (Ca, Mn)**
SS3	V	V	**J (Ca, Mn)**
EB(Suffern)	V	V	V
TB(5/7/97)	V	NA	NA
SB4 (4-6)	V	V	**J (Ca, Mn)**
SB3 (2-4)	V	V	**J (Ca, Mn)**
SG Suffern	V	NA	NA
SB2 (10-12)	V	V	V
MW4	V	V	**J (Na, Fe)**
TB (6/2/97)	V	NA	NA
MW1	V	V	**J (Na, Fe)**
MW2	V	V	**J (Na, Fe)**
MW3	V	V	**J (Na, Fe)**

V - Valid Data J - Estimated Value

NA - Not Analyzed

7.0 POTENTIAL RISKS

This section integrates the existing data gathered at the Suffern MGP site and qualitatively identifies potential risks associated with the impacted media. This qualitative evaluation is accomplished by identifying potential sources, migration routes, receptors and exposure pathways for the site. This section begins with a review of the site setting and divides the site into on-site and off-site areas of interest according to historical and current land uses. The potential receptors and exposure pathways associated with each area are then discussed.

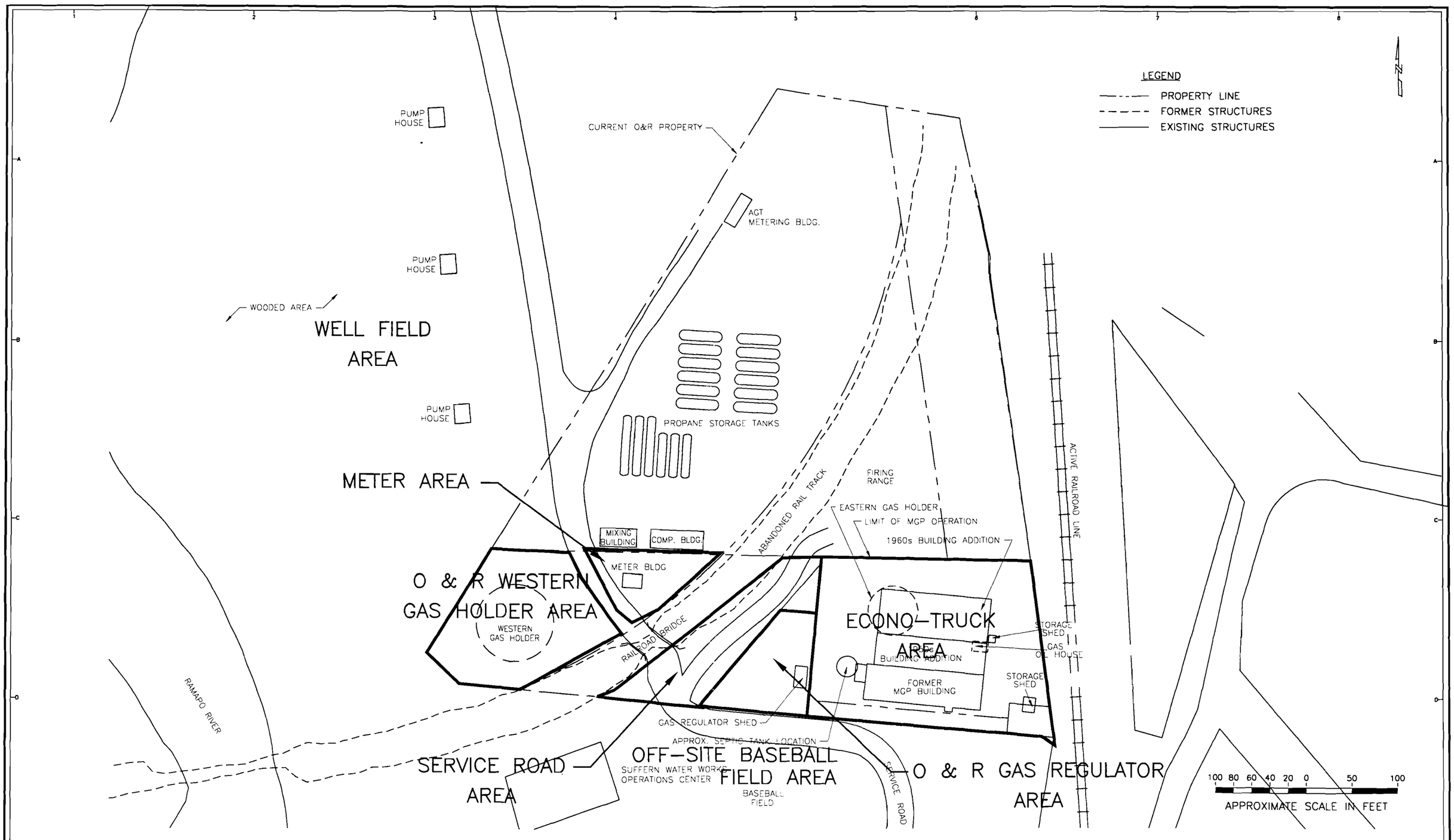
7.1 Site Setting

The site and surrounding properties are currently zoned for commercial and industrial land use. The onsite area is defined as the original property for the MGP site. This property has been divided into five parcels according to historical and current land use as follows:

- Econo-Truck Bus Manufacturing Area;
- O&R Gas Regulator Area;
- Service Road Area;
- Meter Area; and
- O&R Western Gas Holder Area.

These on-site parcels are identified in Figure 7-1. The rationale for defining these five on-site parcels or areas is described below.

The Econo-Truck Manufacturing Area consists of the Econo-Truck manufacturing facilities where small buses are built. This is the location of the former MGP operation and most of the site investigation has occurred in this parcel of the site. Potential risks associated with this area are discussed in Section 7.2.



REFERENCE DWG	DESCRIPTION	NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
		6							
		5							
		4							
		3							
		2							
		1							
		0							

ORANGE & ROCKLAND UTILITIES
FORMER MANUFACTURED GAS PLANT
3-2632-200

CURRENT DATE: 07/21/97 | CAD FILE 26325A12

ONSITE & OFFSITE AREAS

SUFFERN, NEW YORK

REMEDIATION TECHNOLOGIES INC

DRAWING NO: FIGURE 7-1 | REV: 0

The O&R Gas Regulator Area is the part of the O&R property which is occupied by a gas regulator station. Potential risks associated with this area are discussed in Section 7.3.

The Service Road Area is primarily occupied by a service road and entrance drive for the firing range. Potential risks associated with this area are discussed in Section 7.4.

The Meter Area is the part of the O&R property which is used for propane storage, which is located west of the abandoned railroad right-of-way, and north of the service road. This area has not been investigated and is presumed to be unaffected by MGP activities. This presumption is based on observations of current site conditions, a lack of any historic gas production activity on this parcel, and on the presence of the bermed railroad grade which has presumably acted as a barrier to off-site migration of residuals to the northwest.

The O&R Western Gas Holder Area is the part of the O&R property which was used in the past for storage of manufactured gas, and which is used currently as a storage area for soil, and other non-hazardous debris by O&R generated from utility line maintenance. The wooded area to the west of the holder is used by the Village of Suffern for disposal of wood, leaves, and similar debris. A sample of surface soil, subsurface soil, and groundwater was taken near the former gas holder in this area of the site, and the potential risks are discussed in Section 7.5.

The site is bounded to the west by a water well field, owned by the Village of Suffern, by a baseball field to the south owned by the Village of Suffern, to the east by an active railroad facility owned by New Jersey Transit, and to the north by a firing range and abandoned railroad right-of-way owned by the State of New Jersey. The two off-site parcels of interest located down gradient of the site, as indicated on Figure 7-1, are as follows:

- Off-site Baseball Field Area; and
- Off-site Well Field Area.

The Off-Site Baseball Field Area is a small grove of trees and a grassy area between the baseball field and the O&R Gas Regulator Area south of the service road. One surface soil sample was taken in this area, and the potential risks associated with this area are discussed in Section 7.6.

The Well Field Area is the water supply well field for the Village of Suffern which is located immediately down gradient of the site and along the river. The potential risks associated with the

migration of impacted on-site groundwater to the public water supply wells is discussed in Section 7.7.

7.2 Econo-Truck Area

Most of the sampling at the Suffern site was conducted in this area because it was the location of the production facilities of the former MGP. Constituents were detected in surface soil, subsurface soil, groundwater and DNAPL. The potential sources and migration pathways and potential receptors and exposure pathways are discussed in the following sections.

7.2.1 Potential Sources and Migration Pathway - Econo-Truck Area

Potential sources of constituents in the Econo-Truck Area include DNAPL and other hydrocarbon residuals in the surface and subsurface soils. A 5-foot thick DNAPL layer was discovered at the bottom of the subsurface gas-oil house foundation, and tar-like stringers (less than 1 foot thick) were found within the eastern gas holder. Both structures lie primarily underneath the Econo-Truck building. A sample of DNAPL from the gas-oil house failed TCLP for benzene.

The surface soil samples were taken from this area. SS1 was collected from a gravel covered area near the former gas-oil house. There were no exceedences of TAGM soil cleanup levels in this sample. SS2 was collected near an area where a tarry material occasionally oozes to the surface. The area near SS2 is covered with gravel and broken up asphalt. TAGM soil cleanup levels for 6 PAHs were exceeded in surface soil sample SS2, near the eastern gas holder.

Vehicles are constantly moving into and out of the manufacturing facility so the surfaces at SS1 and SS2 receive considerable vehicle traffic. To provide a perspective on the PAH results in these samples, the total 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) were calculated and compared to ranges of potentially carcinogenic PAHs compiled by Menzie, et al. (1992). Table 7-1 presents the minimum, median and maximum concentrations of potentially carcinogenic PAHs in a typical urban setting and in road dust. The total potentially carcinogenic PAHs in SS1 is 1.76 mg/Kg which is well within the range PAHs in an urban setting. The total potentially carcinogenic PAHs in SS2 is 51.9 mg/Kg which is outside the range for a typical urban area, but within the range for road dust. TAGM levels for 10 PAHs were exceeded in subsurface soil sample SB3, also near the eastern gas holder. A soil gas sample

taken from this holder revealed a concentration of benzene of 120 mg/m^3. BTEX and PAHs were not detected in any of the three groundwater wells (MW1, MW2 and MW3) in this area of the site, although tar-like material was detected outside of the MGP structures in borings SG9, SG12, and SG13. Cyanide was detected in MW3, but was less than the NYSDEC water quality standard.

Table 7-1
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

Based on these potential sources, the potential migration routes of the COI in the Econo-Truck Area are summarized as follows:

- volatilization from soil and tarry materials to outdoor air;
- volatilization from soil and tarry materials to the soil gas to indoor air;
- emissions in the form of fugitive dust from soil to air;
- leaching of constituents from soil and tarry materials to groundwater; and
- transfer of constituents dissolved in on-site groundwater to off-site groundwater.

Potential migration of constituents in groundwater is addressed in Section 7.7.

7.2.2 Potential On-Site Receptors and Exposure Pathways - Econo-Truck Area

Potential current and future on-site receptors for the Econo-Truck Area are presented in Table 7-2. Under current site use, possible receptors include Econo-Truck workers, site visitors, and

subsurface utility workers. It is anticipated that the future use will be similar to the current use, so the future receptors are the same as the current receptors.

Table 7-2
Current and Future On-Site Receptors - Econo-Truck Area

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current and Future Land Use				
Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially incomplete due to site cover and infrequent outdoor activity.
	subsurface soil and DNAPL	air	inhalation	Pathways potentially incomplete due to solid foundation and sufficient ventilation.
Site Visitor	surface soil	soil air	ingestion dermal inhalation	Pathways potentially incomplete due to site cover and access restrictions and infrequent visits to site.
Subsurface Utility Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
	subsurface soil and DNAPL	soil air	ingestion dermal inhalation	Pathways potentially complete.

Workers and site visitors may potentially be exposed via direct contact with surface soil including incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. In addition, the Econo-Truck Area is fenced and locked after hours to restrict access by unauthorized visitors. Site workers are constantly moving vehicles in out of buildings, so these workers have an opportunity to contact soil, although the type of work does not require significant soil contact. As discussed previously, the concentrations of potentially carcinogenic PAHs in SS1 and SS2 are consistent with values found in road dust so the PAHs found may be due to vehicular emissions rather than MGP residuals. In short, their exposures are likely to be the same as those from any parking area that receives high vehicle traffic. The tarry material that seeps to the surface is in an area that receives considerable vehicle traffic, so the potential exists for this material to be carried into the buildings on vehicle wheels and for workers to be exposed to it during their work.

The tar seeps are in a small area so the potential for material to be tracked into the buildings is small, but the potential for exposure exists none the less. Visitors to the site have lower potential for exposure because they are on the site less frequently than workers and because they are less likely to contact tarry material on the wheels.

Workers may also be potentially exposed via inhalation of volatilized constituents that may seep into the building through conduits, drains, or cracks in the foundation. No conduits or drains in the foundation were found during site work which would facilitate the migration of soil gas to indoor air. Although cracks in the foundation may exist, the foundation is constructed of thick concrete. In addition, this building is used for the manufacturing of buses and, as such, may receive frequent releases of VOCs and PAHs via paint, lubricants, solvents, adhesives, welding gases, and vehicle emissions. During the performance of the PSA, the large doors of the building were open, which promoted good ventilation. The building is well ventilated and the air volumes change frequently, limiting the potential for accumulation of vapors and subsequent exposure.

Utility workers may be potentially exposed via direct contact with surface soil and subsurface soil. There are no known utility lines near the locations of subsurface DNAPL, but it is possible that exposure could occur to utility workers particularly if new utility lines are installed.

7.3 O&R Gas Regulator Area

The gas regulator area is a trapezoidal property owned by O&R which is enclosed by a fence and covered with gravel. Within the fence is a gas regulator station in a shed on a concrete foundation.

This area was not investigated, but monitoring well MW2 is close to the shed. There were no visual indications of MGP residuals in the soil boring for this well and no BTEX or PAHs were detected in this well.

Potential current receptors for the O&R Gas Regulator Area are presented in Table 7-3. Under current site use, possible receptors include utility workers and unauthorized visitors. 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 7-3
Current and Future On-Site Receptors - O&R Gas Regulator Area

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current and Future Land Use				
Utility Worker	surface soil	soil	ingestion dermal	Pathways potentially complete but direct exposure to soil is infrequent.
		air	inhalation	
	subsurface soil and DNAPL	soil	ingestion dermal	Pathways potentially complete but excavation work is infrequent.
		air	inhalation.	
Unauthorized Visitors	surface soil	soil	ingestion dermal	Pathway potentially complete, but access restrictions limit exposure.
		air	inhalation	

Utility workers occasionally come onto the site to monitor, maintain and repair the gas regulators. 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. Some of 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. Additionally, there is no visual indication that soil is impacted. 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 this part of the site has not been investigated, it is not possible to ascertain if workers have significant opportunity to contact this material during excavation.

Unauthorized visitors are individuals who scale the fence and visit the site. Such visitors can potentially be exposed to constituents in the soil. However, since the fence restricts access to the site and there is little on the site to attract multiple visits, it is unlikely that such exposures would be significant.

7.4 Service Road Area

The Service Road Area is a strip of land between the O&R Gas Regulator Area and the abandoned railroad track. This area includes part of the service road running along the southern part

of the site and an access road that runs along the abandoned railroad tracks to a firing range north of the site.

This area was not investigated, but there were no known gas manufacturing activities on this parcel. Discolored rocks or stones have been observed along the access road but it has not been determined if these are associated with the MGP operations.

The only receptors for this area are individuals who walk along the roads or park on the roads and walk elsewhere. Since such activities are likely to be of short duration, the potential for exposure to soil is low.

7.5 O&R Western Gas Holder Area

Samples were taken from surface soil, subsurface soil, and groundwater in this area of the site, because it was the location of an above-ground gas holder and because of the presence of turquoise green/blue colored soil. Visually impacted soil of this nature at MGP sites indicates the possibility that purifier residuals containing cyanide were disposed of in this area. In fact, cyanide was detected in surface soil and groundwater. The potential sources and migration pathways and potential receptors and exposure pathways are discussed further in the following sections.

7.5.1 Potential Sources and Migration Pathways - Western Gas Holder Area

Potential sources of constituents in the Western Gas Holder Area include hydrocarbon residuals in surface soils. TAGM soil cleanup levels for 6 PAHs were exceeded in surface soil sample SS4, between the abandoned railroad and the location of the former western gas holder. The potentially carcinogenic PAHs in this sample totaled 86.1 mg/Kg. While vehicles come onto the site routinely to deposit material, this sample was taken away from the areas with vehicular traffic. Thus, this concentration cannot be attributed to vehicular emissions. Although cyanide was detected at an elevated concentration of 228 mg/kg, there are no available TAGM soil cleanup levels or reference background concentrations for cyanide. No PAHs were above TAGM soil cleanup levels in subsurface soil sample SB4 and cyanide was detected at a lower concentration of 1.8 mg/kg. While no soil samples were taken within the gas holder foundation, one soil gas sample was taken here but no volatile organics were detected with a PID. BTEX and PAHs were not detected in the one groundwater well (MW4) in this area of the site. Cyanide was detected in MW4 (0.0871 mg/L), although it is less than the NYSDEC water quality standard of 0.1 mg/L. No DNAPL was observed in SB4 or in this area of the site.

Based on these potential issues, the potential migration routes of the COI in the Western Gas Holder Area are summarized as follows:

- volatilization from soil to soil gas to outdoor air;
- emissions in the form of fugitive dust from soil to air;
- leaching of constituents from soil to groundwater; and
- transport of constituents dissolved in on-site groundwater to off-site groundwater.

Potential migration of constituents in groundwater is addressed in Section 7.7.

7.5.2 Potential On-Site Receptors and Exposure Pathways - Western Gas Holder Area

Potential current and future receptors for the Western Gas Holder Area are presented in Table 7-4. Under current site uses, possible receptors include O&R outdoor workers, Village of Suffern outdoor workers, site trespassers, and subsurface utility workers. Indoor workers are not identified as current receptors since no buildings are currently present in this area of the site.

The outdoor workers and trespassers may be exposed via direct contact with surface soil including incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. The potential for exposure to MGP residuals is reduced since the holder area has been covered by soil and other nonhazardous debris due to the use of this area as a disposal grounds for such materials. There is, however, an area of surface soil which is impacted by cyanide-bearing MGP residuals and that is not currently covered. Access to the Western Gas Holder Area is controlled by a gate, though it has been reported by site personnel that teenagers sometimes use this area to ride their motorized vehicles and/or bikes. Such activities could generate fugitive dust emissions. Because BTEX compounds were below detection limits in both surface and subsurface soil samples, volatilization is limited to the semi-volatile PAH compounds. None of the more volatile 2- and 3-ring PAHs, including naphthalene and acenaphthene, were detected at significant concentrations in surface soil sample SS4. The Western Gas Holder Area is accessed daily by O&R or Village of Suffern workers. It is uncertain how often trespassers visit the site, but it is believed to be sporadic and infrequent. Subsurface utility workers may potentially be exposed to constituents in surface and subsurface soil during excavation activities. The low levels of constituents in the subsurface soil sample suggests that such exposures are unlikely to be significant.

Table 7-4
Current and Future On-Site Receptors - Western Gas Holder Area

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current Land Use				
O&R/Village of Suffern Outdoor Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete*
Site Trespasser	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete, but visits to site are infrequent*
Subsurface Utility Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete*
	subsurface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
Future Land Use				
Construction Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete*
	subsurface soil	soil air	ingestion dermal inhalation	Pathways potentially complete.
O&R Outdoor Worker	surface soil	soil air	ingestion dermal inhalation	Pathways potentially complete*
O&R Indoor Worker	air	air	inhalation	Pathway potentially complete, but exposure likely to be very low.

* Sample SS4 may not be representative of the area.

The future use of this area of the site is likely to stay the same as its current use. However, should O&R decide to develop this area of the site, potential future receptors would include construction workers, subsurface utility workers, O&R outdoor workers, and possibly O&R indoor workers if a building was constructed. Construction workers and utility workers may potentially be exposed via direct contact with surface and subsurface soils. Outdoor workers may potentially be exposed via direct contact with surface soils. Exposure to indoor air should be insignificant because no BTEX compounds or DNAPL were detected in this area of the site and because any new buildings could be constructed in such a way as to minimize vapor intrusion.

To summarize, the O&R Western Gas Holder Area receptors include utility workers, municipal workers and trespassers. The surface soil sample collected from this area had the highest levels of PAHs and cyanide found in the four surface soil samples collected in this investigation. Since visits to the site are for short durations, exposures to constituents in surface soil are unlikely to be significant. Also, SS4 is located away from the part of the O&R Western Gas Holder Area that is typically accessed by workers and trespassers. If future redevelopment occurs, exposures to future outdoor workers could be significant based on this one sample, but this sample may not be representative of constituent concentrations in this area. No DNAPL was observed in this area of the site and constituents were at low levels in the one potential subsurface soil sample collected from this area so potential exposures to constituents in subsurface soil as a result of excavation should not be significant. Finally, exposure to constituents possibly volatilizing into soil gas and intruding into a building constructed in the future should be insignificant because DNAPL was not found in this area and neither BTEX nor naphthalene were found in soil or groundwater samples from this area. Also, a new building could be constructed in a manner to minimize the potential for vapor intrusion.

7.6 Off-Site Baseball Field Area

One sample was taken from surface soil in this area adjacent to the site, because of its proximity to the area of the former MGP operations and because it is a baseball field. The sample, SS3, was taken from an area that is used by people visiting the baseball field to park their cars. No BTEX compounds were found above detection limits. Potential sources of constituents in the Off-Site Recreation Area include surface soils. TAGM soil cleanup levels for 5 PAHs were exceeded in surface soil sample SS3. Total potentially carcinogenic PAHs were 20.32 mg/Kg in this sample, but these concentrations are well within the range of potentially carcinogenic PAHs found in road dust. Cyanide was also detected at a concentration of 3.7 mg/kg, although there are no TAGM soil cleanup levels or reference background concentrations for comparison. Subsurface soil and groundwater were not sampled in this area since it was not part of the MGP operation area.

Potential current and future receptors for the Off-Site Baseball Field are presented in Table 7-5. Under current site uses, possible receptors include recreational users, such as baseball players, spectators, and children. These receptors may be exposed via direct contact with surface soil including incidental ingestion, dermal contact, and inhalation of volatilized constituents and fugitive dust. Since individuals visit this part of the baseball field principally when they are leaving or returning to their cars, the potential for exposure to constituents in soil is low.

The future use of this area is presumed to be the same as the current use. As such, future receptors will be the same as current receptors.

Table 7-5
Current and Future Off-Site Receptors - Off-Site Baseball Field Area

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current and Future Land Use				
Recreational Users	surface soil	soil	ingestion dermal inhalation	Pathways potentially complete, but infrequent.

7.7 Well Field Area

The nearest water supply wells are 400 to 450 feet downgradient from the former MGP operations area. While the majority of water is probably drawn from the Ramapo River, there is a potential for the wells to draw in water from the MGP site which is naturally upgradient from and hydraulically connected to the well field. As shown in Table 7-6, the potential current and future receptors of on-site groundwater are the municipal groundwater users (i.e., Village of Suffern residents).

Table 7-6
Current and Future Off-Site Receptors - Well Field Area

Receptor	Source Medium	Exposure Medium	Intake Route	Comments
Current and Future Land Use				
Municipal Groundwater Users	on-site groundwater	groundwater air	ingestion dermal inhalation	Pathways potentially incomplete because of natural attenuation processes and carbon filtration system which exists.

There is no evidence that groundwater at the municipal wells has been affected by groundwater from the site. No MGP constituents (i.e., BTEX, PAHs and cyanide) have been detected in the public water supply wells and this observation is consistent with the fact that very few MGP constituents have been detected in monitoring wells on the site. BTEX, the most mobile

MGP constituents, were not detected in any wells. The only VOC detected was chlorobenzene which is not an MGP constituent. Of the PAHs, only acenaphthylene, acenaphthane, flourene and pyrene were found. These were found in MW3 at levels ranging from 1 μg/L to 4 μg/L. None of these compounds were found at MW2 which is closer to the municipal wells and none of these compounds are considered potentially carcinogenic. Cyanide was detected in two wells, MW3 and MW4, but was found below NYSDEC water quality standards. For the organic compounds, the distance from the site to the municipal wells allows for natural attenuation to occur before groundwater from the site reaches the municipal wells, further reducing concentrations at these wells. In conclusion, there is no evidence that municipal groundwater has been affected by groundwater from the site.

7.8 Conclusions

This section evaluated potential receptors and exposure pathways for five on-site and two off-site areas. The on-site areas are the Econo-Truck Area, the O&R Gas Regulator Area, the Service Road Area, the Meter Area and the O&R Western Gas Holder Area. The off-site areas are the Baseball Field Area and the Well Field Area.

In the Econo-Truck Area, the receptors included workers, site visitors and utility workers. Exposures to constituents in surface soils are unlikely to be significant because PAH concentrations in surface soils were consistent with PAH concentrations found in road dust and the surface of this site receives considerable vehicle traffic. In small areas of the surface, tar is seeping up from below. If this tar is tracked into the buildings, workers could be exposed to the tar material. Since the manufacturing operations are build over a subsurface gas holder, the potential for vapor intrusion from the soil to the building exists. However, the building floor appears to have few cracks or drains and is well ventilated since paints, lubricants, solvents and adhesives are used in the manufacturing process. Consequently, vapor intrusion is unlikely to be significant. If subsurface excavations are performed to repair or install utility lines, exposure to DNAPL in the subsurface could occur.

In the O&R Gas Regulator Area, the receptors include utility workers and unauthorized visitors. While this area has not been investigated so conclusions are not definitive, these receptors are unlikely to have significant exposures to constituents in surface soil because visits to the site are infrequent and for short duration. The lack of subsurface data makes it difficult to determine if utility workers have a significant potential to be exposed to constituents during excavation to repair or install underground utility lines.

In the Service Road Area, the receptors are individuals who walk along the service road and access road, or park on the roads and walk elsewhere. This area has not been investigated so definitive conclusions cannot be formed. There were no known gas manufacturing activities on this parcel although discolored rocks of unknown origin have been observed in this area. However, since receptors are likely to be in this area for very short periods of time, the potential for exposure to constituents that might be present in the soil is low.

The Meter Area has not been investigated and is presumed to be unaffected by MGP activities. There were no known gas production activities on the site and there were no visual indications of impacts.

The O&R Wester Gas Holder Area receptors include utility workers, municipal workers and trespassers. The one surface soil sample had the highest levels of PAHs and cyanide found in surface soil samples. However, this sample was obtained from a location adjacent to the railroad grade where contact by site visitors is unlikely. Since visits to the area are currently for short durations, exposures to constituents in surface soil are unlikely to be significant. If redevelopment occurs, exposures to future occupants could be significant based on this one sample. No DNAPL was observed in this area of the site and constituents were at low levels in the one subsurface soil sample so exposures to constituents in subsurface soil as a result of excavation should not be significant.

In the Baseball Field Area, potential receptors are individuals who park their cars along the service road and use the baseball fields. The subsurface soil samples from this area was collected near where cars park and the PAH concentrations in this sample are consistent with PAH concentrations in road dust. Thus, exposure to this soil would be comparable to exposure to road dust at other locations in Suffern. Even so, since individuals visit this part of the baseball field primarily when they are leaving or returning to their cars, the potential for exposure to constituents in soil is low.

For the Well Field Area, the receptors are the residents of Suffern who obtain their water from this well field. No BTEX were detected in the monitoring wells. Four noncarcinogenic PAHs were found in one monitoring well (MW3) but not in a monitoring well (MW2) closer to the well field. Cyanide was found in two wells (MW3 and MW4), but was found below NYSDEC Groundwater Standards. Additionally, the distance from the site to the municipal wells allows organic compounds to undergo natural attenuation before groundwater from the site reaches the

municipal wells, further reducing already low concentrations. In conclusion, there is no evidence that municipal groundwater has been affected by constituents in groundwater at the site.

8.0 CONCLUSIONS

This section summarizes the findings of the PSA. An overall view of the nature and extent of Constituents of Interest is presented by area of concern and by media. Known and potential source areas are identified.

8.1 Site Geology

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

- A thin veneer (2 to 4 feet thick) of industrial fill material was found at the majority of the site (predominantly on the west side of the Econo-Truck building).
- The fill consists primarily of gravelly sand, cinders, ashes, brick fragments and coal fragments.
- Underlying the fill are alluvial deposits of stratified glacial drift which consist of a mixture of poorly sorted sands and gravels.
- The bedrock unit present below the unconsolidated deposits (approximately 110 feet) is the Byram Formation which consists of a granitic gneiss.

8.2 Site Hydrogeology

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

- June 1997 water level measurements indicate the water table was approximately 12 feet below the ground surface at the site.
- The water level elevations in the shallow monitoring wells indicate that horizontal groundwater flow is generally in a southwest direction with a gradient of 0.0035 feet/foot across the site. The hydraulic conductivity of the aquifer ranged from 8.8×10^{-4} to 2.0×10^{-3} cm/sec, values within the normal range for a gravelly sand. The predicted average horizontal velocity of groundwater flow is calculated to be approximately 21 feet per year based on the observed hydraulic gradient.

- The direction and velocity of groundwater flow beneath the site is influenced by the pumping frequency and the rates of withdrawal from the adjacent Village of Suffern drinking water production wells. The slope of water table and groundwater flow rates are expected to vary in response to the production well activity. The elevation of the water table in the vicinity of MW2 is likely to be influenced by the amount of flow into the septic system from the Econo-Truck facility.

8.3 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 NAPL. A set of conclusions related to each media is summarized in the following sections.

8.3.1 Surface Soil

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

- No BTEX compounds were detected in the four surface soil samples.
- PAHs were detected in all four surface soil samples at total concentrations which ranged from 450 to 117,000 µg/Kg.
- PAH concentrations in surface soil samples SS2, SS3 and SS4 contained elevated levels (above TAGM Cleanup Objectives) of benzo(a)pyrene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and benzo(a)anthracene.
- Indeno(1,2,3-cd)pyrene was detected in a concentration above TAGM Cleanup Criteria in samples SS2 and SS4.
- Elevated levels (above TAGM Cleanup Objectives) of arsenic, chromium, copper, magnesium, mercury and zinc were detected in site surface soils. Elevated concentrations of arsenic, copper and zinc are frequently detected at MGP sites (GRI, 1996). Concentrations of copper, zinc, chromium, magnesium and mercury may be attributed to historical electro-plating operations conducted at the site during the late 1940s and early 1950s.
- A cyanide concentration of 288 mg/Kg was detected in sample SS4. This sample was taken from soil where blue staining was evident in an area

adjacent to the service road and former railroad right-of-way. This is likely due to past contact with purified box waste. No box waste was observed at that location or in subsurface borings. No groundwater impacts from box waste were detected.

8.3.2 Subsurface Soil

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

- Elevated PAH levels (above TAGM Cleanup Objectives) were found in two out of four borings, both of which were located to the west of the eastern gas holder. The greatest concentrations of PAHs were observed in the industrial fill material at boring location SB3 (2-4), which is located adjacent to the north west corner of the 1960s building addition. These fill soils are within the unsaturated zone.

- Inorganic compounds detected in subsurface soil in concentrations greater than the TAGM Cleanup Objectives included copper, manganese, mercury and zinc. These detections were also in the area west of the eastern gas holder.

- Cyanide was not detected in significant concentrations in the subsurface.

- BTEX was detected in a soil gas sample taken from within the eastern gas holder foundation.

8.3.3 Groundwater

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

- Field measurements of temperature, pH, specific conductance and oxygen reduction potential and the observation of odors and visual signs of MGP impacts did not indicate any groundwater impacts for the new wells.

- All compounds detected in groundwater which could be related to MGP site residuals are below NYSDEC groundwater standards or guidance values.

- The chlorobenzene detected in MW2 is not normally associated with MGP operations (GRI, 1996). The presence of this compound is likely related to

industrial activity following the shut down of the MGP. The source of the chlorobenzene may be the water from the adjacent septic system.

- The presence of the four PAHs with estimated (J) values in groundwater at MW3 are consistent with previous groundwater quality results from abandoned monitoring well.

- Metals exceeding NYSDEC groundwater standard or guidance values was limited to iron, manganese and sodium.

- The presence of cyanide in wells MW3 and MW4 may be related to former MGP operations and/or plating operations; however, the concentrations are below groundwater standards.

- One sample of groundwater from Geoprobe boring SG12 was found to be visibly impacted and to contain strong hydrocarbon odors. Organic vapors were detected in a jar headspace sample taken from the boring.

8.3.4 Tar-Like Material and NAPL

Stringers of tar-like material were observed in unsaturated surface soils immediately west of, and north of, the eastern gas holder. The majority of the material was found north of a test pit excavated adjacent to the northwest corner of the 1960s garage. The source of this material is believed to be the eastern gas holder. No information regarding piping associated with the gas holder is currently available. The tar-like material occurs in small, discrete layers and lens and does not appear to be mobile.

A maximum of 70 cubic yards of DNAPL was estimated to be present in the gas-oil house foundation, assuming historical drawings are correct and the DNAPL is evenly distributed in the thickness observed in the Geoprobe boring SG1. A DNAPL sample from the foundation was above the hazardous waste characteristic limit for benzene.

8.4 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 tar-like materials and/or elevated COI levels (above NYSDEC TAGM Cleanup Criteria or NYS 6NYCRR Part 703 Water Quality Standards) in surface and subsurface soils, or groundwater.

8.4.1 Eastern Gas Holder

The contents or former contents of the eastern gas holder are a likely potential source of impacts to soil and groundwater at the site. Observations concerning the holder include:

- Visibly impacted fill material and soil, water and trace amounts of tar-like material are present within the foundation of the former gas holder, located primarily beneath the Econo-Truck garage.
- Visibly impacted soil and groundwater (at SG12) are present outside of the northern and western wall of the eastern holder foundation, likely as a result of the demolition of parts of the holder foundation wall during the 1950s and 1960s building additions or seepage from the holder foundation.
- Soil gas containing detectable amounts of BTEX was found in the fill associated with the eastern holder beneath the Econo-Truck garage floor slab.

8.4.2 Former Gas-Oil House Foundation

- DNAPL and impacted fill and soil were found within the foundation of the gas-oil house.
- Analysis of a sample of the DNAPL from with the structure indicated the material exceeds the hazardous waste characteristic limit for benzene.
- No significant evidence of MGP residuals was found in a test pit outside the subsurface structure. The soil beneath the floor of the structure showed no indications of impact by MGP residuals in a boring (SG1) inside the east end of the foundation.

8.4.3 Western Gas Holder

- Elevated levels of PAHs and cyanide were found in a surface soil sample adjacent to the railroad grade. The sample location is not at a location where site workers or trespassers would generally come in contact with the soil.

8.4.4 General Site Conditions

The Econo-Truck property is currently used to fabricate small school buses. The use of typical industrial and automotive paints and chemicals was noted at the site.

8.5 Recommendations

8.5.1 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. These conditions were not encountered at the Suffern MGP site.

- MGP residuals within structures are capped and do not pose an immediate risk to receptors as they are isolated from human contact and they are not leaking or in contact with groundwater. The eastern gas holder foundation is capped, by the floor of the 1960s garage and by pavement outside of the building. Groundwater, based on measurements inside the holder foundation, does not appear to be in contact with the contents of the holder. The majority of the footprint of the gas-oil house foundation is capped by the floor slab of the 1950s building. The contents of the structure are believed to be contained and not in contact with surface receptors or groundwater.

- Groundwater associated with the MGP was not found to exceed groundwater standards.

- No migration pathways were found for the release of impacted soil gas beneath the Econo-Truck fabrication building.

Although the focus of this investigation was the former MGP site operations, conditions associated with current operations which may have an immediate environmental impact should be addressed. A wastepile consisting of paint cans, rags, and other debris north of the Econo-Truck building should be placed in a covered container and properly disposed of. Solvents, paints, and other chemicals adjacent to the eastern side of the Econo-Truck building should be kept capped.

8.5.2 Additional Investigations

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

- One additional groundwater monitoring well should be installed at the western side of the former MGP operations site between wells MW2 and

MW3. The purpose of this well is to monitor groundwater which may be migrating due-west from the vicinity of the eastern holder.

- The hydrocarbon product found near SS2 should be sampled and analyzed to determine whether it is a petroleum (asphalt) or MGP (tar) product. This material should then be covered by gravel to prevent contact with site workers and to prevent tracking by vehicles.

- Additional water level measurements should be made at the site to assess the effects of groundwater pumping on the flow direction from the former MGP. A round of water levels should be obtained when municipal well 3 is pumping, and when well 2 is pumping. The water level measurements should be made when the aquifer has reached steady-state flow conditions under these pumping regimes. The results should be plotted on the site map to show the range in groundwater flow directions from the site.

- Additional borings in, and around, the gas-oil house should be completed to assess whether leakage from the gas-oil house foundation has occurred.

- Additional surface soil samples should be obtained in the vicinity of the Western Holder to determine the extent of PAH and cyanide impact found at SS4.

Following the conclusion of these supplemental investigation tasks, an evaluation should be made as to whether additional monitoring of site conditions is warranted. If no off-site groundwater impacts are observed or predicted, it will not be necessary to continue to monitor the wells on a regular basis.

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APPENDIX A

BORING AND WELL INSTALLATION LOGS

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: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 4.5
START DATE: 5-6-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 12	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: 90% Gravel. Dark brown, angular, moist, no odor. 10% Brick fragments, trace coal fragments.
5	50	4-8	2332				Fill material consisting of: 50% Gravel. Dark brown, angular, strong odor, visible hydrocarbon sheen 50% Brick fragments. At 7.1' Fill becomes saturated with tar-like material, black, high viscosity, strong odor.
10	75	8-12	1119				Fill Material consisting of: Gravel and Brick Fragments. 11.0-11.5' 100% Tar-like material, black, high viscosity. 11.5-11.7' Becomes broken brick fragments
					SP		At 11.7 Becomes sand, brown, uniform, no visible MGP constituents. End of boring.
15							

REMARKS:
Headspace water sample results- 26.1 ppm/PID.
Soil Gas Results- ND <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: SUFFERN NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 3.80'
START DATE: 5-3-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 6.6	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							6" Concrete slab.
	85	0.5-2	6.5		FILL		0.5-2.0' Gravel. Brown, compact, moist, angular, no odor. 30% brown sand. 10% brown silt.
	75	2-4	17.8				Gravel. Brown, trace brick fragments, rounded. 45% Brown coarse sand.
5	65	4-6	432		SP		At 4.0' Black staining and slight hydrocarbon odor. Sand, black, loose, coarse, wet, trace angular gravel. Strong hydrocarbon odor.
							Refusal at 6.6' below ground surface. End of boring.

REMARKS:
Headspace water sample results- 14.1 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: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 3.5'
START DATE: 5-4-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 6.7	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							0-0.5' Concrete.
	70	0.5-2	268		FILL		Gravel. Angular and rounded, black, trace coal fragments. 1.6-2.0' Tar-like material 10% of gravel, strong hydrocarbon odor.
	65	2-4	76.1				Gravel, angular and rounded, brown, moist, hydrocarbon odor, trace tar -like material. Angular and rounded, brown moist, hydrocarbon odor, trace tar-like material in nodules. 40% brown sand, medium to coarse.
5	80	4-6.7	467				Gravel. Angular and rounded, grey, trace brick fragments, strong odor. At 6.1' 40% tar-like material, solid, hard
							Refusal at 6.75' below ground surface. End of boring.

REMARKS:
Headspace water sample- 14.0 ppm/PID.
Soil Gas results- 54.5 ppm/PID
Drager tube results- ND < 0.5 ppm benzene.

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: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 3.9
START DATE: 5-4-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 6.7	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							0-0.5' Concrete.
	60	0.5-2	11.2		FILL		Gravel. Brown, loose, angular, moist, no odor. At 1.8' Becomes dark brown. Gravel, dark grey, loose, angular and rounded, nodules of brown sand, Dark grey, loose, angular and rounded, nodules of brown sand, moist, slight hydrocarbon odor. 10% Ash and cinders.
	75	2-4	21.2				
5	40	4-6.7	45.5		SP		Sand. Dark grey, loose, coarse, wet. At 5.8' becomes 60% tar-like material, Black, dense, hard, strong odor. Granite plug in spoon tip.
							Refusal at 6.7' below ground surface. Solid drill rod driven to confirm depth. End of Boring.

REMARKS:
Soil Gas results- 45.2 ppm/PID.
Drager tube results- NO < 0.5 ppm/PID.
Water Sample headspace results- 17.0 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: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 3.82
START DATE: 5-3-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 6.6	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							0-0.5' Concrete.
	50	0.5-2	22.0		GP		Gravel Brown/grey, loose, angular, no odor. 30% brown coarse sand.
	65	2-4	20.9				Gravel. Dark brown, loose, moist, angular and rounded. 50% sand, brown, coarse, moist, nodule of tar-like material at 1.8'.
5	75	4-6.6	37.5		SP		Sand. Dark brown, loose, coarse. 20% rounded and angular gravel. Strong hydrocarbon odor.
							Refusal at 6.6' below ground surface. Confirmed with solid drill rod. End of boring.

REMARKS:
Soil gas results- 12.2 ppm/PID.
Draeger tube results ND < 0.5 ppm benzene.
Headspace water sample- 8.2 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: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: NA
START DATE: 5-5-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 5.1	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	95	0-2	0.0		FILL		Fill material consisting of: 40% Gravel, rounded to angular. 40% Sand, coarse, brown, trace coal fragments and bricks, slight hydrocarbon odor, moist.
	75	2-4	422		SP		Sand. Dark grey, coarse, poorly sorted. 30% gravel, angular, moist.
5	95	4-5.1	1142		GP		At 4.8' tar-like material mixed with gravel. 75% tar, black, dense, hard, strong odor.
							Refusal at 5.1' below ground surface. 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: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: NA
START DATE: 5-5-97	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
	55	0-4	107		GP		0-0.2' Asphalt roadway. Gravel. Angular and rounded, poorly sorted, moist. Black hydrocarbon staining from 3.2' to 3.8', strong hydrocarbon odor.
5	75	4-8	62.1				Gravel and sand. Very coarse. poorly sorted, trace rounded pebbles Moist, slight hydrocarbon odor.
10	90	8-12	9.5		SP		Sand. Brown, medium to coarse, poorly sorted. 30% pebbles, rounded. At 11.0' below ground surface-horizontal layers of orange and brown fine to medium sand, slight hydrocarbon odor, moist.
							End of boring.

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

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-8

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 6.20
START DATE: 5-5-97	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
		0-2	0.0		FILL		Fill material consisting of: Gravel. Angular, brown, moist, poorly sorted. 50% Sand, brown, coarse, no odor.
		2-4					
		4-4.5					4.0 to 4.5' concrete.
5	65	4.5-8	0.0		SP		Gravel. Dark Brown. poorly sorted, trace organic debris, angular and rounded. 35% Sand, brown coarse, no odor.
10	60	8-12	0.0				Gravel. Orange/brown, poorly sorted angular and rounded. 20% Sand, coarse, wet. No odor.
							End of boring.

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

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-9

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: NA
START DATE: 5-4-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 6.6	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							0-0.5' Concrete.
					GP		Gravel. Brown, angular and rounded, moist, slight hydrocarbon odor, poorly sorted.
	75	1-4	8.8				
							Gravel. Brown, angular, moist.
5	65	4-6.6	132				At 5.6' Black Hydrocarbon staining, 20% tar-like material mixed with gravel, Black, dense, hard, in nodules, strong hydrocarbon odor.
							Refusal at 6.6' below ground surface. End of boring.

REMARKS:
Soil gas results- 241.0 ppm/PID.
Draeger tube results ND < 0.5 ppm benzene.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-10

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLLING	MP ELEVATION: NA
CLIENT: ORNAGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: NA
START DATE: 5-4-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 10.2	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
							0-0.5' Concrete.
	80	0.5-4	200		GP		Gravel. Tan and light brown, loose, dry, angular, subrounded and rounded. Nodules of black sand/silt. Slight odor. 50% Poorly sorted brown sand. 10% Tan silt.
5	90	4-8	151				Gravel. Tan and light brown. loose, dry, angular, subrounded and rounded, granitic, poorly sorted, slight odor. 45% Coarse to medium sand.
10	90	8-10.2	108				Gravel. Tan and light brown, loose, angular and subrounded. Dry. At 9.7 becomes dense, moist. 30% Silt, brown.
							End of boring.

REMARKS:
Soil gas results- 43.6 ppm/PID.
Drager tube results- ND < 0.5 ppm/ Benzene.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-11

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 13.0
START DATE: 5-5-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 13.0	AUGER O.D./I.D.: NA

DEPTH (feet)	RECOVERY	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW COUNTS 6	SOIL CLASS	LITHOLOGY	DESCRIPTION
	65	0-4	0.0		SP		Sand Brown, uniform, coarse to medium, trace gravel. rounded, no odor. Poorly sorted, moist.
5	70	4-8	0.0				Sand. Lightbrown, coarse, poorly sorted. 10% Granitic cobbles and pebbles, no odor, moist.
10	98	8-13	0.0				Sand. Light brown, poorly sorted, coarse. 10% Granitic cobbles. Becomes wet at 11.7' no odor.
15							End of boring.

REMARKS:
Soil gas results- 0.0 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-12

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: 12.0
START DATE: 5-5-97	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
	20	0-4	10.4		FILL		Fill material consisting of: Gravel. Poorly sorted, brown and olive, angular and rounded. 20% rounded cobbles. 20% Brick fragments. Moist, slight Hydrocarbon odor.
5	75	4-8	8.6		GP		Gravel. Dark grey to black, moist. From 5.4-7.2' Gravel mixed with 10% tar-like material. Black, dense. At 7.7 to 7.9' broken granitic rock fragments, white. 7.9 to 8.0' Tar-like material lens, black, soft, strong hydrocarbon- like odor. Gravel. Grey, poorly sorted, angular and rounded at 9.6'- 0.1' of tar-like material, strong odor.
10	80	8-12	80.3		SP		Becomes sand. Fine grained, tan, moist. At 11.0' Sand becomes, coarse, wet, strong hydrocarbon odor. Sand. Olive, grey and orange in Horizontal layers 4-6" thick, medium to coarse, poorly sorted, slight hydrocarbon odor, wet.
15	90	12-16	18.9				End of boring.

REMARKS:
Soil gas results- 92.0 ppm/PID.
Draeger tube results-ND < 0.5 ppm benzene.
Headspace water sample results- 30.2 ppm/PID.

REMEDIATION TECHNOLOGIES, INC.

BORING LOG
BORING SG-13

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: NA
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION:
LOCATION: SUFFERN, NY	METHOD: GEOPROBE	WATER LEVEL DURING DRILLING: NA
START DATE: 5-5-97	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	8.2		FILL		Fill material consisting of: 30% Gravel-angular and rounded. 20% Coal fragments and cinders. 30% Dark brown sand. At 2.0' 0.2' of tar-like material, solid, dense, slight odor, coarse
5	80	4-8	0.0		SP		Sand. Orange/brown, poorly sorted, medium to coarse grained. 20% Pebbles and cobbles. Pebbles are granitic, some broken, slight hydrocarbon odor.
10	93	8-12	0.0		GP		Gravel. Brown, 30% pebbles and cobbles, angular and subrounded. 20% coarse sand. 10% Silt, slight hydrocarbon odor, moist.
15							End of boring.

REMARKS:
Soil gas results- 48.9 ppm/PID.
Drager tube results- ND < 0.5 ppm.

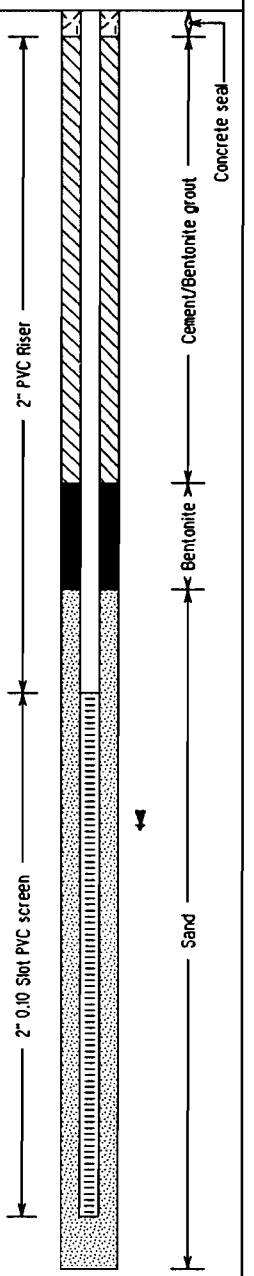
REMEDIATION TECHNOLOGIES, INC.

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

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: 279.66
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION: 280.15
LOCATION: SUFFERN, NY	METHOD: HOLLOW STEM AUGER	WATER LEVEL DURING DRILLING: 15.5
START DATE: 5-6-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 23.0	AUGER O.D./I.D. 4.25"

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH	SOIL CLASS	LITHOLOGY	DESCRIPTION
	1510		15					0-0.5' Asphalt and sub pavement.
		6 7 10		0.0		SP		Sand, coarse, brown, dry, no odor. 40% Gravel, rounded.
	1513	6 3 3 4	15	0.0				Sand, brown, coarse, loose, dry, no odor. 40% Gravel, rounded.
5	1535	4 4 2 2	25	0.0				Sand, brown, medium to coarse. 40% rounded gravel. At 6.0' becomes fine to medium, dense, moist, no odor.
	1539	4 3 3 2	10	NA				Sand, brown, fine to medium. 20% rounded gravel. Poor recovery, plug spoon tip.
	1547	8 9 14 15	1	NA		GP		Gravel plug in spoon tip. No recovery.
10	1553	12 22 22 20	45	0.0				Gravel,brown, angular and rounded. 40% coarse sand, no odor.
	1558	12 15 17 15	65	0.0				Gravel, brown, angular and rounded, poorly sorted, moist, slight odor.
15	1604	12 15 17 30	65	0.0				Gravel, brown angular to subrounded, poorly sorted, wet, slight odor.
	1610	11 17 12 11	75	0.0		SP		Sand, very coarse, brown. 40% Angular to subrounded gravel, Slight odor, wet.
	1623	11 11 11 12	55	0.0		GP		Gravel, brown and grey mottling, angular to subrounded. Slight odor, wet.
20	1632	2 3 2 1	85	0.0		SP		Sand, medium to coarse, poorly sorted. Trace pebbles, slight odor, wet.
	1640	5 8 16 16	90	0.0				Sand, light brown to grey, poorly sorted. Coarse, trace pebbles, wet, slight odor.
25								End of boring.

WELL CONSTRUCTION



REMARKS:
Soil sample SB-1 (12-14) Analyzed for BTEX, PAHs, Cyanide and TAI Metals.

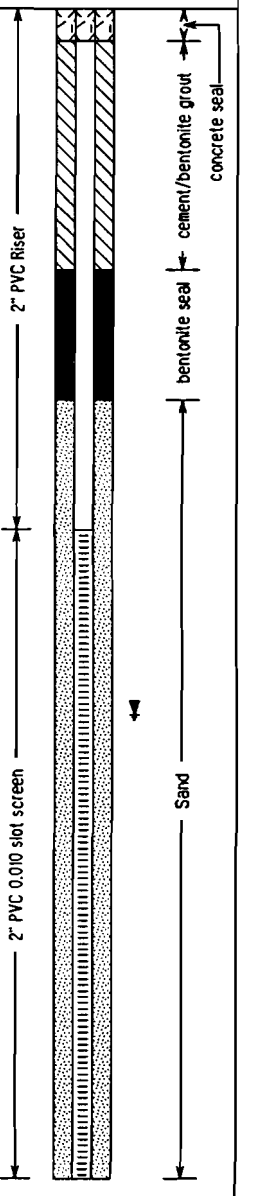
REMEDIATION TECHNOLOGIES, INC.

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

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: 275.97
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION: 276.30
LOCATION: SUFFERN, NY	METHOD: HOLLOW STEM AUGER	WATER LEVEL DURING DRILLING: 10.84
START DATE: 5-8-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 18	AUGER O.D./I.D. 4.25" ID

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH	SOIL CLASS	LITHOLOGY	DESCRIPTION
								0-0.5' Asphalt driveway.
	0758	4 5 5 5	45	0.0		FILL		Fill material consisting of: Cinders, ash and coal fragments, moist, no odor.
	0759	10 10 8 5	35	0.0		SP		Sand, brown, medium to coarse, moist, no odor. 20% Granitic cobbles.
5	0805	6 5 4 3	15	0.0				Sand, brown, medium to coarse, moist, no odor, trace granitic pebbles, rounded.
	0820	2 2 14 15	33	0.0				Sand, brown, coarse, poorly sorted. 40% Granitic pebbles and cobbles, trace dark brown silt at 7.4', moist no odor.
	0824	21 19 23 23	55	131				Sand, brown, coarse, poorly sorted, moist no odor. 50% Granitic pebbles and cobbles, rounded and subrounded.
10	0832	18 21 16 9	60	461		GP		Gravel, brown, coarse. poorly sorted, no odor. Becomes wet at 11.0'.
	0837	8 10 9 7	75	22.6				Gravel, brown, coarse, poorly sorted, wet, no odor, angular to subrounded. 50% Brown sand.
15	0849	6 5 5 7	75	0.0		SP		Gravel, brown, coarse, poorly sorted. At 15.0' becomes sand, medium, uniform, wet.
	0906	2 4 5 6	100	0.0				Sand, brown, medium, poorly sorted, trace gravel, wet, no odor.
20								End of boring.

WELL CONSTRUCTION



REMARKS:
Soil sample SB-2 (10-12) analyzed for BTEX, PAHs, cyanide.

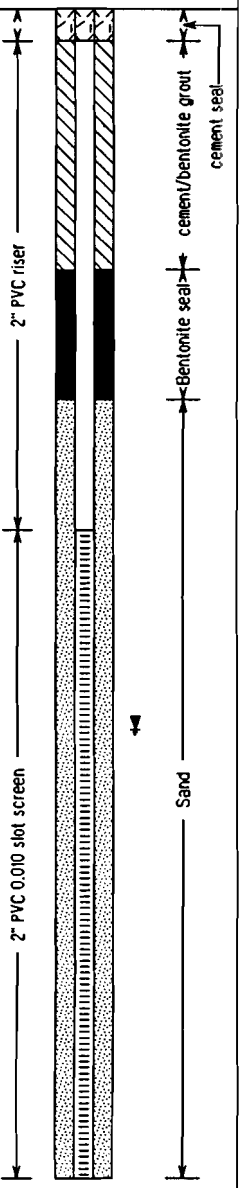
REMEDIATION TECHNOLOGIES, INC.

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

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: 276.44
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION: 276.72
LOCATION: SUFFERN, NY	METHOD: HOLLOW STEM AUGER	WATER LEVEL DURING DRILLING: 11.08
START DATE: 5-7-97	CASING I.D.: NA	PVC STICK-UP: NA
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 18.0	AUGER O.D./I.D. 4.25" ID

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH	SOIL CLASS	LITHOLOGY	DESCRIPTION
	1425	7 4 3 3	10	79		FILL		Fill material consisting of: 30% Brown sand, coarse, loose. 40% Black cinders, ash and coal fragments, strong odor, moist.
	1431	3 3 3 3	50	65				Fill material consisting of: Sand, brown, coarse. 50% cinders and ash, strong hydrocarbon odor, moisL
5	1434	5 4 5 4	20	12.3		SP		Sand, brown, coarse, poorly sorted, trace pebbles, no odor.
	1436	4 3 4 6	70	32.1				Sand, brwown, fine to medium, moist, uniform, trace pockets of dark brown silt, no odor.
	1440	14 15 14 18	85	36.1		GP		Gravel, brown, angular to subrounded, moist. Trace granitic pebbles, poorly sorted. 40% Brown sand, coarse, hydrocarbon odor.
10	1453	5 15	1	17.5				Gravel plug in spoon tip. poor recovery, slight hydrocarbon odor. wet. Cobble at 11.0 ' below ground surface.
	1458	5 15 17 10	20	23.5				Gravel, angular to subround, wet, slight hydrocarbon odor, poorly sorted. 30% Brown coarse sand.
15	1507	6 9 9 9	40	26.7				Gravel, angular to subround, wet, poorly sorted, brown. 40% Brown coarse sand, slight hydrocarbon odor, wet.
	1513	4 4 4 5	60	23.9				Gravel, brown, angular and subrounded, poorly sorted, wet. 30% Brown sand, coarse, wet, slight hydrocarbon odor.
								End of boring.
20								

WELL CONSTRUCTION



REMARKS:
Soil sample SB-3 (2-4) analyzed for BTEX, PAHs, cyanide and TAL metals.

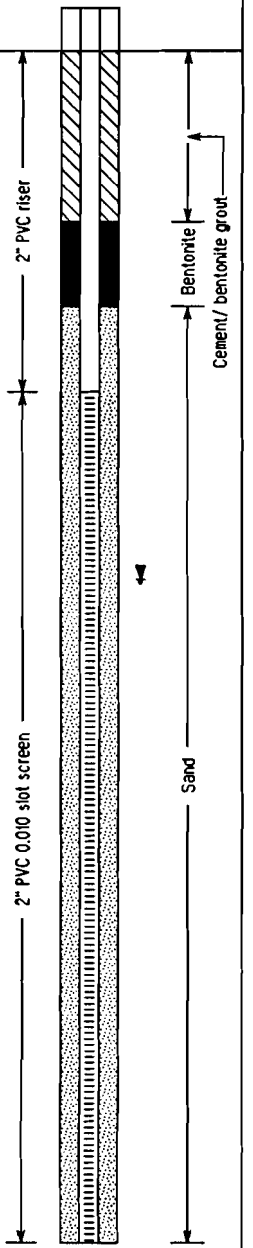
REMEDIATION TECHNOLOGIES, INC.

WELL INSTALLATION LOG
BORING: SB-4/MW-4

PROJECT NO.: 3-2632-300	DRILLING CO.: NORTHSTAR DRILLING	MP ELEVATION: 272.73
CLIENT: ORANGE & ROCKLAND	DRILLER: JEFF THEW	SURFACE ELEVATION: 270.32
LOCATION: SUFFERN, NY	METHOD: HOLLOW STEM AUGER	WATER LEVEL DURING DRILLING: 6.2
START DATE: 5-7-97	CASING I.D.: NA	PVC STICK-UP: 2'
GEOLOGIST: JAMES EDWARDS	TOTAL DEPTH: 14.0	AUGER O.D./I.D. 4.25"

DEPTH (feet)	SAMPLE TIME	BLOW COUNTS	RECOVERY	PID Headspace (ppm)	SAMPLE DEPTH	SOIL CLASS	LITHOLOGY	DESCRIPTION
	0909	10 9 4 3	10	0.0		FILL		Fill material consisting of: Concrete fragments and brown sand. Gravel plug in spoon tip.
	0912	8 12 20 90	40	0.0		GP		Gravel, brown, angular to suborunded, moist, no odor. 30% Sand, coarse, trace silt.
5	0917	20 20 17 17	45	3.7				Gravel, brown, pockets of dark brown, angular to subrounded, moist, no odor. 30% Brown sand, coarse, trace fractured granite pebbles.
	0935	15 17 23 18	45	0.0		SP		Sand, brown, fine to medium, no odor, moist. Poor recovery due to pebble in spoon tip.
	0940	20 29 18 18	75	0.0		GP		Gravel, brown, poorly sorted, loose, angular to subrounded, wet. 30% Brown coarse sand, no odor.
10	1000	10 11 11 10	65	0.0				Gravel, brown, poorly sorted, angular to subrounded, trace cobbles, wet, no odor. 20% Brown caorse sand.
	1005	10 11 11 16	75	0.0		SP		Sand, brown, very coarse, wet, no odor, poorly sorted. 10% Pebbles.
15								End of Boring.

WELL CONSTRUCTION



REMARKS:
Soil sample SB-4 (4-6) analyzed for BTEX, PAHs, cyanide and TAL metals.

REMEDIATION TECHNOLOGIES, INC.	TEST PIT LOG Test Pit TP-1	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: *8.0'*
SITE LOCATION: *SUFFERN, NY*	METHOD: *Backhoe*	SURFACE ELEV.: *' (MSL)*
START DATE: *5-8-97* TIME:	LOGGED BY: *MARK HOFFERBERT*	WATER LEVEL: *NA'*
COMPLETION DATE: *TIME:*		
TEST PIT LOCATION: *FORMER OIL HOUSE*		

DEPTH (feet)	SAMPLE DEPTH	PID HEADSPACE (ppm)	LITHOLOGY	DESCRIPTION
		0.0		Fill material consisting of crushed gravel.
		0.0		Test pit excavation within and outside of, brick foundation wall of oil house.
		0.0		From 0.5-7.0', Fill material consisting of 60% Gravel, dark brown to black, loose. 40% Debris.
		0.0		
		0.0		At 4.5' below ground surface, becomes wet.
5		10		
		30		At 7.0' Fill material becomes saturated with tar-like material, black, strong odor, high viscosity.
				Bottom of test pit
10				

REMARKS: Tar-like material sample taken-analyzed for hazardous characteristics.

REMEDIATION TECHNOLOGIES, INC.	TEST PIT LOG Test Pit TP-2	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: *12'*
SITE LOCATION: *SUFFERN, NY*	METHOD: *Backhoe*	SURFACE ELEV.: *' (MSL)*
START DATE: *5-8-97* TIME:	LOGGED BY: *MARK HOFFERBERT*	WATER LEVEL: *NA'*
COMPLETION DATE: *5-8-97* TIME:		
TEST PIT LOCATION: *EAST OF GARAGE*		

DEPTH (feet)	SAMPLE DEPTH	PID HEADSPACE (ppm)	LITHOLOGY	DESCRIPTION
				0.0-0.5' Fill material consisting of crushed gravel.
		0.0		Gravel. Light Brown, poorly sorted, moist, no odor. 30% Sand, brown, medium. 20% Cobbles, rounded, granitic, no odor.
		0.0		
5		0.0		
		0.0		
		0.0		
10		0.0		At 11.5' becomes wet.
		0.0		Bottom of test pit

REMARKS: No visual of olfactory evidence of contamination noted during test pit excavation.

REMEDIATION TECHNOLOGIES, INC.	TEST PIT LOG Test Pit TP-3	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: *5.0'*
SITE LOCATION: *SUFFERN, NY*	METHOD: *BACKHOE*	SURFACE ELEV.: *' (MSL)*
START DATE: *5-8-97* TIME:	LOGGED BY: *MARK HOFFERBERT*	WATER LEVEL: *NA'*
COMPLETION DATE: *TIME:*		
TEST PIT LOCATION: *SUFFERN, NY*		

DEPTH (feet)	SAMPLE DEPTH	PID HEADSPACE (ppm)	LITHOLOGY	DESCRIPTION
		0.0		0.0-0.5' Fill material consisting of crushed gravel and debris.
		0.0		Fill material consisting of: 60% Gravel, brown, loose, poorly sorted. 30% Sand, brown, medium. 10% Cobbles, rounded, granitic
		0.0		From 1-2' below ground surface-less than 2 cubic feet of tar-like material adjacent to, and inside of, portion of buried steel drum. Tar-like material is black, high viscosity, strong odor.
		32		
		20		
5		40		Bottom of test pit

REMARKS:

REMEDIATION TECHNOLOGIES, INC.	TEST PIT LOG Test Pit TP-3	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: *5.0'*
SITE LOCATION: *SUFFERN, NY*	METHOD: *BACKHOE*	SURFACE ELEV.: *' (MSL)*
START DATE: *5-8-97* TIME:	LOGGED BY: *MARK HOFFERBERT*	WATER LEVEL: *NA'*
COMPLETION DATE: *TIME:*		
TEST PIT LOCATION: *SUFFERN, NY*		

DEPTH (feet)	SAMPLE DEPTH	PID HEADSPACE (ppm)	LITHOLOGY	DESCRIPTION
		0.0		0.0-0.5' Fill material consisting of crushed gravel and debris.
		0.0		Fill material consisting of: 60% Gravel, brown, loose, poorly sorted. 30% Sand, brown, medium. 10% Cobbles, rounded, grantic.
		0.0		From 1-2' below ground surface-less than 2 cubic feet of tar-like material adjacent to, and inside of, portion of buried steel drum. Tar-like material is black, high viscosity, strong odor.
		32		
		20		
5		40		Bottom of test pit

REMARKS: