RETEC

PREREMEDIAL DESIGN INVESTIGATION REPORT

for the

Shore Realty Superfund Site
Glenwood Landing, New York

VOLUME I

Prepared for:

The Performing Parties Group

Prepared by:

Remediation Technologies, Inc.
9 Pond Lane
Concord, Massachusetts 01742

Project No. 3-1033

July 1993

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EXECUTIVE SUMMARY

The Pre-remedial Design Investigation (PDI) was focused on filling data gaps associated with engineering parameters necessary to complete the remedial design of the remedy. The field program consisted of the installation of six well points, one on-site monitoring well, three borings, a time-lag stage-ratio study, the collection of nine soil samples and the collection of sixteen groundwater samples. Laboratory studies included chemical analyses of the environmental samples obtained and treatability studies, including an iron precipitation evaluation, a water pre-treatment study, and a biological treatment study.

The results of the PDI were generally similar to those from the Remedial Investigation (RI). Two conclusions can be drawn from the PDI work. First, a reduction in the number of Volatile Organic Compounds (VOCs) detected occurred between the RI and the PDI, with the levels of the toluene, ethylbenzene and xylene concentrations in the water table samples being greatly reduced. Second, polynuclear aromatic hydrocarbons (PAHs) should not be a concern at the site since they are not present in the groundwater at the site and therefore are not migrating.

The off-site monitoring well was installed and sampled in June of 1993. Due to property access issues this well was not installed during the February PDI as planned. The well has been located on property owned by Nassau County. Analytical results will be submitted with this July's monthly progress report.

Due to the iron concentrations in the soil and groundwater identified at the site during the RI, it was necessary to perform an iron precipitation evaluation to evaluate the potential of fouling the aquifer and thereby inhibiting the implementation and effectiveness of the selected remedy. The study was performed during the course of three months. The soil in the column study did appear darker and there were areas of iron staining; however, the permeability was reduced not because of iron precipitate, but rather from settlement of the soil column which is not indicative of what will occur in the soils at the site when the remedy is implemented. The iron precipitation study has shown that fouling of the aquifer and soil matrix should not cause a significant reduction in permeability of the aquifer which would adversely impact implementation of *in situ* aerobic biological treatment and aquifer aeration.

The time-lag stage-ratio study was performed in place of the traditional pump test in order to determine the permeability of the soils at the site over a large area. The premise of the study is that as the tide rises and falls, a sinusoidal propagation of the water table occurs. Thus the time that the tide takes to travel a known distance can be used to determine the *in situ*

permeability of the soil at the site. The study was performed for one week during a full moon period to ensure maximum tidal fluctuation. The study determined the permeability of the soils at the site to be 57 ft/day (10-2 cm/sec). This value is within reported limits for soil formations on Long Island and is consistent with the values determined during the RI.

The water pre-treatment study was performed in order to determine how effectively iron could be removed from the groundwater prior to treatment or removal of the contaminants. Six treatability runs were performed in order to evaluate various iron removal strategies. Three treatment scenarios effectively reduced the iron concentration in the water to acceptable levels. During the design process itself, an economic analysis will be performed in order to determine which of these three scenarios is the most cost-effective strategy to remove the iron.

The biological treatment study was performed in order to determine if the conditions at the site were conducive to bio-remediation and to determine nutrient additions and pH adjustments necessary to optimize the degradation of the contaminants present at the site. In general, the conditions at the site are appropriate for implementing *in situ* bio-remediation. The microbiology at the site appears to be conducive to *in situ* bio-remediation, since there was a high density of total and VOC degrading bacteria. Additionally, the bacteria showed good oxygen uptake, activity indicating bio-degradation was occurring. The nutrient addition data from the treatability study was conflicting, in that nutrient addition caused an increase in oxygen demand but no increase in population. The soil contaminant analytical data showed that in-situ biodegradation was feasible at the site and that the constituents at the site are biodegradable based on the reduction of contaminant concentrations in the active samples. Since degradation did occur and there was an increase in oxygen uptake during the nutrient addition tests, the reinjected water will be amended with nutrients to optimize degradation rates of the contaminants at the site.

TABLE OF CONTENTS

SECTION **PAGE NO.**

TABLE OF CONTENTS (continued)

LIST OF APPENDICES

LIST OF FIGURES

* Not provided with this report to Technical and Executive Committees. Copy in project file at RETEC's Concord office.

LIST OF TABLES

LIST OF ACRONYMS

AES	Applied Environmental Services
ARARs	Applicable or Relevant and Appropriate Requirements
BDL	below detection limits
CFUs	colony forming units
Cl_2	chlorine
COIs	constituents of interest
CVOCs	chlorinated volatile organic compounds
DNAPL	Dense Non-Aqueous Phase Liquid
DW	deep water
Fe^{2+}	ferrous iron
Fe^{3+}	ferric iron
gpd/ft^2	gallons per day per square foot
H_2O_2	hydrogen peroxide
$KMnO_4$	potassium permanganate
LILCO	Long Island Lighting Company
LNNL	light non-aqeous phase liquid
MSL	mean sea level
NaOCl	sodium hypochloride
NYSDEC	New York State Department of Environmental Conservation
O_3	ozone
PAHs	polynuclear aromatic hydrocarbons
PCE	perchoroethlyene (tetrachloroethylene)
PDI	Preremedial Design Investigation
PDIR	Preremedial Design Investigation Report
ppm	parts per million
RETEC	Remediation Technologies, Inc.
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
Roux	Roux Associates, Inc.
SARA	Superfund Amendments and Reauthorization Act of 1986
SOP	Standard Operating Procedure
SVOCs	semivolatile organic compounds
SW	shallow water
TCA	1,1,1-trichloroethane
TCE	trichlorethylene
TSS	total suspended solids
VOCs	volatile organic compounds
WT	water table

1.0 INTRODUCTION

Remediation Technologies, Inc. (RETEC), on behalf of the Performing Parties Group, is submitting this Preremedial Design Investigation Report (PDIR) which summarizes the results of the Preremedial Design Investigation (PDI) undertaken at the Shore Realty Site (the "Site") in Glenwood Landing, Nassau County, New York. The PDIR is intended to present methodologies, procedures, results, and conclusions from the PDI.

1.1 SITE DESCRIPTION

The Site, located at One Shore Road, Glenwood Landing, New York, is approximately 3.2 acres in size, and surrounded on three sides by water: Motts Cove to the east and south, and Hempstead Harbor to the west (Figures 1-1 and 1-2). Both water bodies and associated intertidal areas are designated tidal wetlands by the State of New York (the State). The Site is at an elevation of approximately 5 to 30 feet above mean sea level (MSL).

The Site is surrounded by industrial, commercial and residential areas. Directly north of the Site on Hempstead Harbor is the Harbor Fuels oil terminal, and 200 feet to the north is an inactive hazardous waste disposal site (the Penetrex Site) which is a former dry cleaner. Approximately 600 feet farther north on Hempstead Harbor, along Shore Road, is the Long Island Lighting Company (LILCO) power station. Directly east of the Site, on Motts Cove, is a private marina, Burtis Boatworks. Approximately 200 feet northeast, upgradient of the Site, is a residential area.

The Site contains three brick buildings which are a pump house/storage building, warehouse, and office/garage. There are seven fixed above ground storage tanks ranging in size from approximately 56,200 gallons to 740,500 gallons. One of these storage tanks is split internally into two compartments. A canopied truck loading rack is located on-site along with the associated piping infra-structure. There are several other surface structures, including a burned trailer, six unmounted storage tanks, a tank trailer, van, boat, and truck. Underground storage tanks used for storing fuel oils, diesel fuels, and other liquids for on-site activities, i.e., building furnaces, site vehicles, etc., are presently in their original locations waiting for sampling, removal and disposal.

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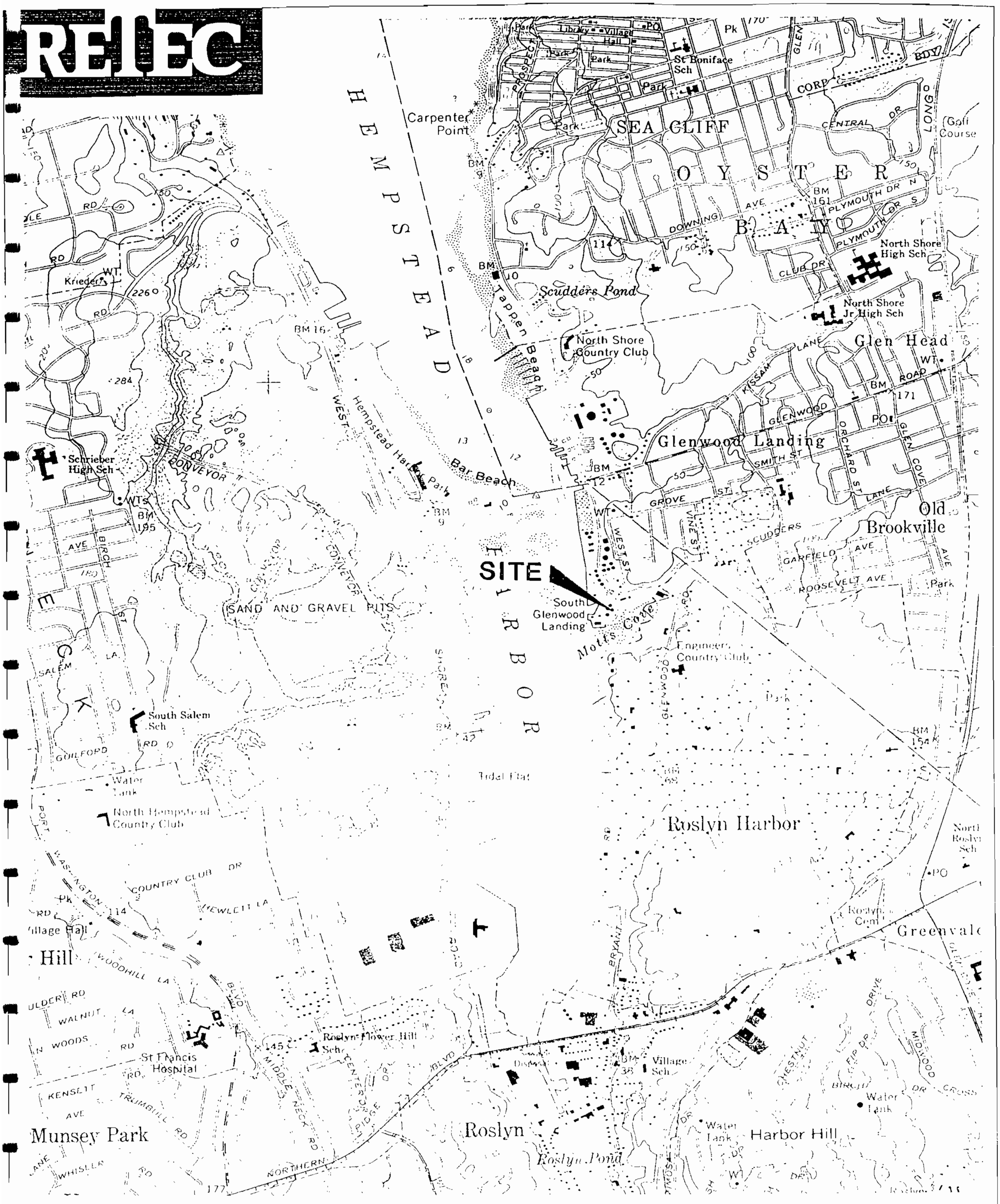

SITE LOCUS MAP

FIGURE

1-1

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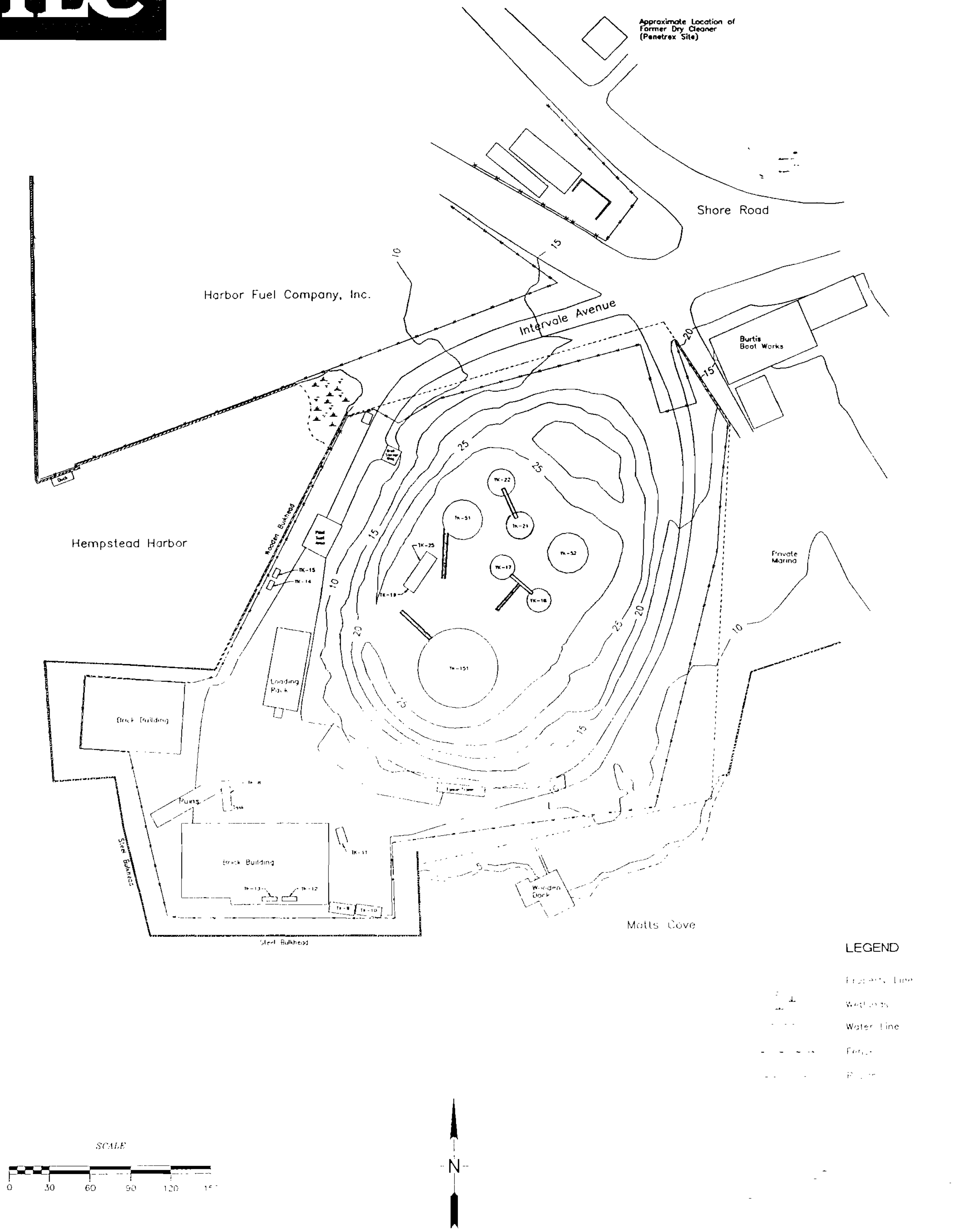

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SITE MAP

1-2

1.2 PREREMEDIAL DESIGN INVESTIGATION REPORT ORGANIZATION

This report is organized into seven narrative sections and eight appendices. Section 1.0 is the introduction. Section 2.0 contains site background information, site history, past investigation summaries, a discussion of the constituents of interest, and a description of the selected remedy. Section 3.0 presents recommended objectives for the remedial activities for the Site. Section 4.0 discusses the scope of the investigation. Section 5.0 presents the results of the investigation. Section 6.0 presents the treatability results and Section 7.0 lists references used. Appendix A presents the boring logs from the PDI. Appendix B presents the chain of custodies from the sample shipment. Appendix C presents the monitoring well logs. Appendix D is the soil gas survey field data sheets. Appendix E provides the bio-treatability study data sheets. Appendix F presents the water pretreatment data sheets. Appendix H is the soil analytical data sheets from the laboratory. Appendix G is the groundwater analytical sheets from the laboratory.

2.0 SITE HISTORY

2.1 SITE HISTORY

The Shore Realty property was first used for fuel storage purposes in 1939. In 1974, the site changed hands and was used for the storage and distribution of chemical solvents. Numerous spills of organic chemicals reportedly occurred during this period. In October 1980, the owner's did install monitoring wells and a recovery trench. In 1980, the property was leased to Applied Environmental Services (AES). AES operated the facility for the blending of various chemical waste materials that have a heat value to provide alternate fuel sources. AES also operated a hazardous waste storage facility.

AES continued the monitoring and recovery efforts undertaken, and installed product recovery equipment. The trench containing the product recovery equipment reportedly recovered approximately 500 gallons of liquid chemicals per month during 1981 and 1982. Groundwater samples collected in 1982 were found to contain dissolved concentrations of volatile halogenated and non-halogenated hydrocarbons.

Shore Realty Corporation purchased the Site in October 1983, and evicted AES in January 1984. The State filed suit against Shore Realty and its owner, Donald Leogrande, in February 1984. As a result of that suit, Shore Realty and Leogrande were ordered by the court to undertake remedial actions at the Site. Subsequent thereto, Shore Realty and Leogrande commenced a third party action against numerous defendants, including the prior landowners, prior on-site operators and a number of companies that had allegedly sent chemicals to the Site, while it was operated by AES.

In March 1984, the State inventoried and sampled chemicals contained on-site and collected surface water samples from Hempstead Harbor. From 1985 to 1986, a State contractor removed more than 700,000 gallons of chemicals stored in the above ground tanks and Shore Realty, under State supervision, removed all of the 55-gallon drums stored in the drum storage warehouse. However, drums currently exist on-site from the RI/FS activities. All of the aboveground tanks containing liquids were reportedly emptied and de-contaminated under State supervision.

In February 1987, a group of third-party defendants retained Roux Associates (Roux) to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site, which was completed in April 1991. The Record of Decision (ROD) was prepared by New York State Department of

Environmental Conservation (NYDEC) and the U. S. Environmental Protection Agency in June 1991. The Consent Judgement was lodged in June 1992, and entered on August 5, 1992.

2.2 PREVIOUS INVESTIGATIONS

2.2.1 Applied Environmental Services

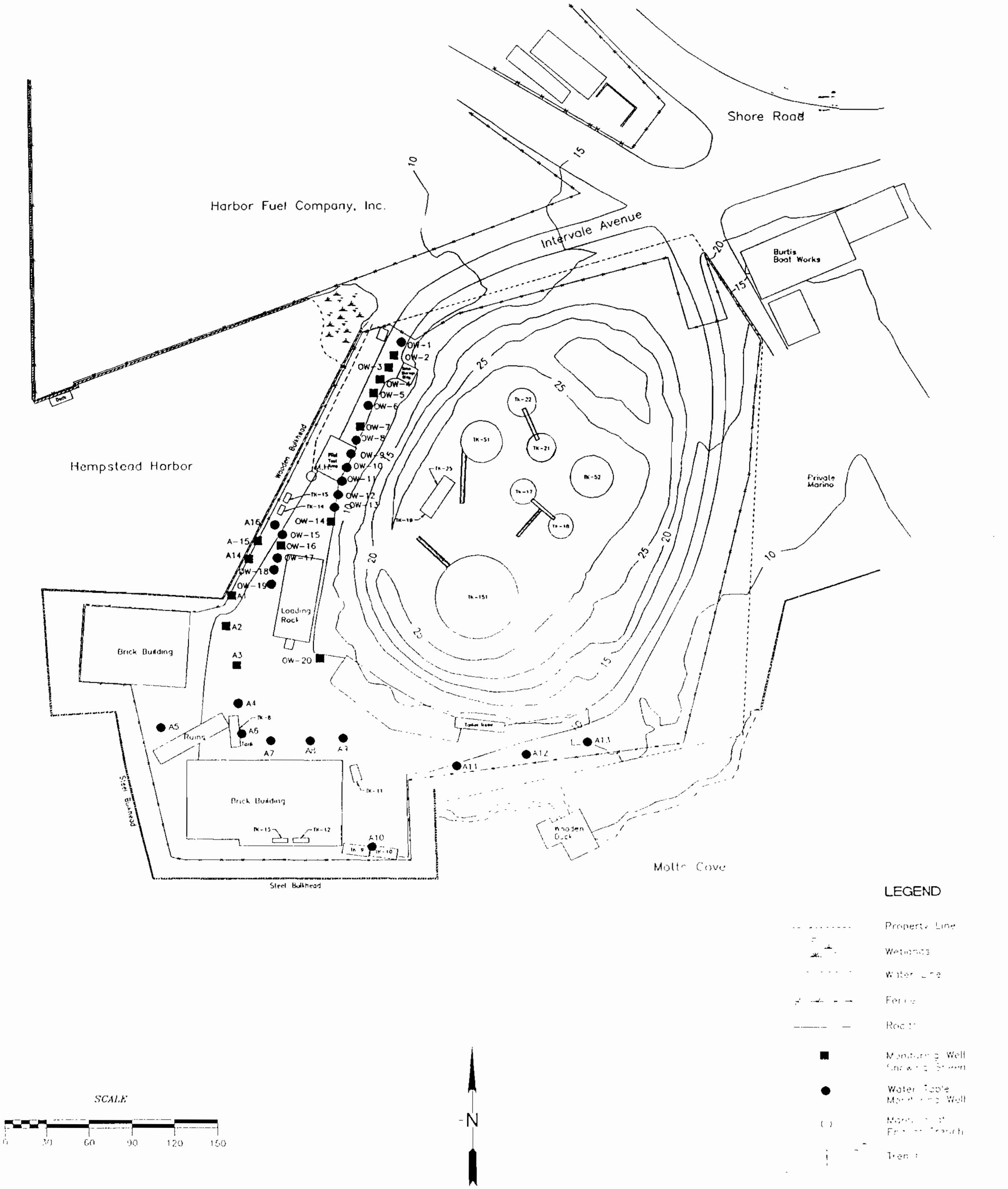
Groundwater monitoring and product recovery efforts were initiated by AES in 1981. Several monitoring wells and a product recovery trench were installed and sampled for analysis for volatile organic compounds. See Figure 2-1 for the locations of the wells and trench. The data indicated that dissolved volatile and semi-volatile constituents were present in the groundwater and the soils.

2.2.2 RI/FS by Roux Associates, Inc.

In February 1987, Roux was retained by a group of third-party defendants to conduct a RI/FS for the Site. In May 1987, Roux submitted a Work Plan for the RI/FS to the State of New York. The Work Plan was approved in September 1987. The initial RI began in October 1987, and the supplemental RI began in October 1989.

The RI investigation addressed the mediums of air, soil, sediments and groundwater. See Figure 2-2 for the locations of the RI sampling points. An air monitoring program was conducted to screen ambient air quality conditions to identify health and safety personal protection levels. Additional air monitoring was performed over the mud flats adjacent to the Site. Samples were collected from five monitoring points, six feet above the mud flats, and submitted for volatile organics analysis. Three of these samples were collected west and two were collected south of the Site. Benzene, toluene and ethylbenzene were detected in three of the samples. Only benzene was above New York State's ambient air guideline concentrations.

The soil investigation at the Site was initiated to determine the approximate levels and extents of chemicals in the soil (Roux, 1991a). The investigation included the analysis of soil gas and soil from the Site. A soil gas survey was conducted during the initial RI and during both the winter and spring months of the supplemental RI. The investigative technique used by Roux was limited and could analyze soil gas from a depth of only a few feet below the ground surface. A TIP II meter was used for analyzing the soil gas samples.



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Location of Wells By AES

2-1

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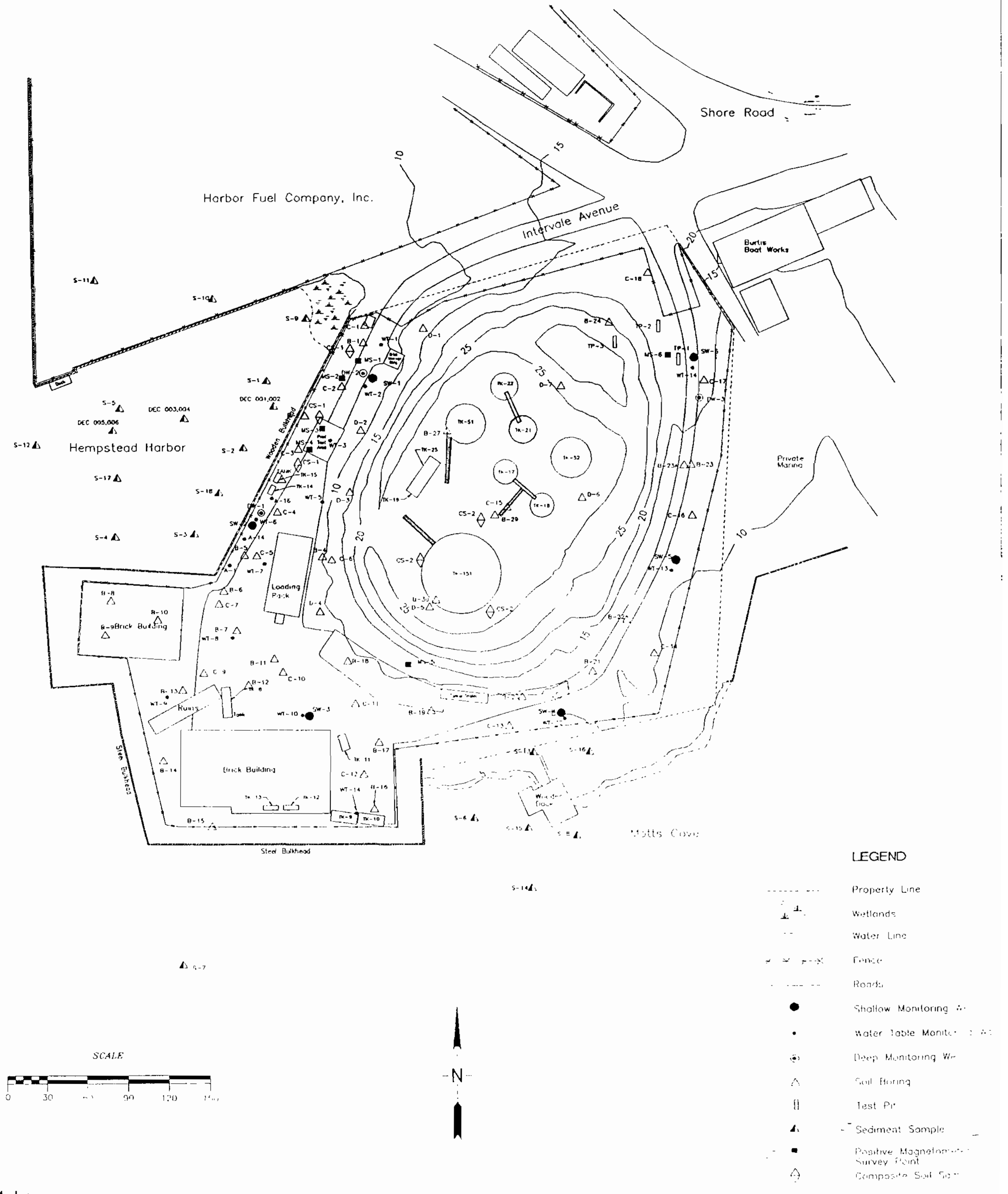

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Roux Investigation Locations

2-2

The soil boring program entailed the installation of thirty-eight soil borings and collection of thirty soil samples for chemical analysis during the initial RI. Twenty-five additional borings were installed and thirty-two soil samples were collected for chemical analysis to more fully characterize the lateral and vertical extent of soil contamination during the supplemental RI work.

The soil analytical program entailed the analysis of select soil samples for 129 priority pollutants plus 40 peaks, with the remainder of the samples analyzed for purgeable organics, priority pollution metals, PCBs, and semi-volatile organic compounds. The soil analytical results identified chlorinated volatile organic compounds (CVOCs), non-chlorinated volatile organic compounds, polynuclear aromatic hydrocarbons (PAHs), phthalates, phenols, and metals. The predominant chemicals found at the site were from the non-chlorinated suite of compounds including ethylbenzene, toluene, and xylenes. These three compounds comprises more than 98 percent by mass of the chemical constituents of concern identified at the Site.

The sediment investigation included the collection of samples during both the initial and supplemental RIs. Eight samples were collected during the initial RI. Four of these were analyzed for 129 priority pollutants plus 40 peaks. The last four samples were analyzed for purgeable organics, priority pollutant metals, and PCBs. Seventeen samples were collected from ten locations during the supplemental RI. All were analyzed for volatile organics, semi-volatile organics, and metals.

The groundwater medium was investigated through the Hydrogeologic and Groundwater Quality Investigation. The purposes of the hydrogeologic investigation were to:

- understand the occurrence, movement, and discharge of groundwater beneath the Site;
- determine the potential impact of the Site on groundwater quality; and
- determine whether drinking water resources are presently or potentially impacted by the Site.

Nine monitoring wells were installed for the initial RI. These wells, plus six existing monitoring wells, were sampled during the initial RI. The wells are arranged into three groups, i.e., at the water table (WT), shallow water (SW) and deep water (DW) wells. The WT wells are screened across the water table surface. The SW wells are screened below or near the water table surface. The DW wells are screened deeper into the aquifer. All of these water samples were analyzed for either 129 priority pollutants plus 40 peaks, or U.S. EPA Method 624 for purgeable organics, priority pollutant metals and PCBs. During the supplemental RI, two additional monitoring wells were installed and sampled, along with the 14 existing monitoring wells.

During December 1990, Roux conducted a well search for the area within a one-mile radius of the Site, referring to USGS publications for information on existing wells and their use within the researched area. Roux also contacted Sea Cliff Water Company, Jericho Water District, Roslyn Water District and Glenwood Landing Water District to update the published data. Only wells on the east side of Hempstead Harbor have been included in the results of the well search because Hempstead Harbor is a groundwater discharge area which acts as a constant head boundary to the water table aquifer.

In summary, the results of the well search reported in the RI indicated the following:

- there are no supply wells of any kind downgradient of the Site;
- there are no public supply wells within one mile of the Site;
- all potable water is supplied to the Glenwood Landing area by public supply wells located outside of the Glenwood Landing Water District;
- there are no domestic wells in close proximity to the Site which may be impacted by contamination at the Site; and
- the few commercial, irrigation and industrial wells being used in close proximity to the Site are all located upgradient or cross-gradient to the Site, and are therefore not at risk of being impacted by water from the Site.

2.3 SITE CHARACTERIZATION

2.3.1 Regional Geology

The Site is located in the Atlantic Coastal Plain Physiographic Province and is underlain by unconsolidated deposits of Pleistocene and late Cretaceous age. These deposits consist of gravel, sand, silt and clay and are underlain by a relatively impermeable bedrock of early Paleozoic and/or Precambrian age. The deposits form six hydrogeologic units. The units are, from bottom (oldest) to top (youngest), the Lloyd aquifer, Raritan clay, Magothy aquifer, Port Washington aquifer, Port Washington confining unit, and the Upper Glacial aquifer (Kilburn and

Krulikas, 1987). All of these units, with the exception of the Magothy aquifer, are present beneath the Site with a combined thickness of more than 500 feet (Roux, 1991a).

The water table at the Site is within the Upper Glacial aquifer. The Upper Glacial aquifer consists of two geologic units of Pleistocene and Holocene age that overlie the Port Washington confining unit (Kilburn and Krulikas, 1987). The upper Pleistocene deposits are moraine (till) composed of unsorted clay, sand, gravel, and boulders. These deposits may also consist of outwash deposits of stratified brown sand and gravel, and lacustrine and marine deposits consisting of clay, silt, and sand. The thickness of the upper Pleistocene deposits range from 10 to 380 feet. The Holocene deposits vary in thickness from 0 to 50 feet and are composed of sand, gravel, silt, and clay; organic mud, peat, loam, and shells (Kilburn and Krulikas, 1987). The upper surface of the upper glacial deposits comprise present day land surface except in areas such as the Site, where they are overlain by recent Holocene deposits and/or fill materials (Roux, 1991a).

2.3.2 Site Geology

The information presented in this section and section 2.3.4 (Site Hydrogeology) is largely taken from the Remedial Investigation (RI) report, dated April 1991 (Roux, 1991a). The moraine deposits of the Upper Glacial aquifer are estimated to be approximately 110 feet thick beneath the Site. The moraine (till) deposits at the Site consist of four lithotypes, designated Level A through Level D (Roux, 1991a).

Level A immediately underlies the Site and consists of a brown, moderately sorted fine to medium grained sand with intermittent coarse sand and gravel layers. In some areas, Level A may include non-native sediments and debris (fill). Level A ranges in thickness from 27.5 to 1.8 feet. The thickest deposits occur in the area of the storage tanks, whereas the thinnest deposits occur along the western edge near Hempstead Harbor.

Underlying Level A is Level B, which is composed of grey, moderate to well sorted, fine to medium grained sand with thin, intermittent gravel, silt, and clay layers. The bottom of Level B may consist locally of white, well sorted, medium to coarse sand. Level B is thickest in the western portion of the Site near Hempstead Harbor, where the Level is approximately 33 feet thick. Level B is either thin or totally absent in the northeast section of the Site.

Level C, underlying Level B, is a multi-colored (grey, orange, tan, and white), poorly sorted medium to coarse grained sand with many clay, silt, and gravel layers. Level C ranges in thickness from 55 feet in the northeast section of the Site where Level B is absent, to 22 feet in the west section of the Site where Level B is thickest.

Level D is a grey, silty clay. Level D is at least 5 feet in thickness, and may not be continuous under the entire Site.

2.3.3 Regional Hydrogeology

Precipitation is the source of virtually all the fresh water on Long Island. Precipitation on the island averages 44 inches/year, and evapotranspiration of precipitation averages 21 inches/year. Practically all the precipitation that is not consumed by evapotranspiration re-charges the groundwater system. Therefore, the natural groundwater re-charge rate is estimated to be about 23 inches/year (Cohen et al., 1968). The re-charge water is transmitted to the underlying aquifers by the Upper Glacial aquifer (Kilburn and Krulikas, 1987).

Groundwater in the Upper Glacial aquifer occurs under unconfined (water table) conditions. The 1980 water table map of the Upper Glacial aquifer in the northern part of the town of Oyster Bay (Kilburn and Krulikas, 1987) shows that the Site is located at a regional groundwater discharge area. The map also shows a groundwater divide to the east of the Site. In the area of Glenwood Landing, where the Site is located, groundwater moves westward from the divide to discharge in Hempstead Harbor. An upward vertical component of groundwater flow probably occurs from the deeper hydrogeologic units to Hempstead Harbor (Kilburn and Krulikas, 1987). The fact that groundwater discharges into the salt water bodies of Hempstead Harbor (and Motts Cove, as will be explained in Section 2.3.4), prevents the salt water from entering the aquifer.

Previous studies have estimated the hydraulic characteristics (hydraulic conductivity and storativity) of the Upper Glacial aquifer. The specific yield (unconfined aquifer storativity) of the Upper Glacial aquifer in the vicinity of Glenwood Landing is estimated to be 0.10 (Getzen, 1977). The average horizontal and vertical hydraulic conductivities of the Upper Glacial aquifer for Long Island are estimated to be 270 ft/day (2,000 gpd/ft^2) and 27 ft/day (200 gpd/ft^2) (Franke and Cohen, 1972). McClymonds and Franke (1972) determined the horizontal hydraulic conductivity values of selected lithologic classes in the Upper Glacial aquifer. When the Upper Glacial aquifer is composed of medium, fine, and very fine sand, and sand with silt or clay layers, the horizontal hydraulic conductivity ranges from 53.5 ft/day (400 gpd/ft^2) to 240 ft/day (1800 gpd/ft^2) (McClymonds and Franke, 1972).

2.3.4 Site Hydrogeology

The RI report shows that the water table configuration is the same under low and high tide conditions. The water table map depicting conditions during low tide on March 19, 1990 shows a shallow groundwater mound near the center of the Site. Groundwater flows radially away from the mound and discharges into Hempstead Harbor and Motts Cove. The mound is caused by the shape and permeability of the high, bermed area where the tanks are located. Precipitation cannot escape the area as surface runoff and there is little vegetation for transpiration. The permeable surface of this area will allow rapid infiltration, which in turn will cause a local mounding of the water table (Roux, 1991a).

Groundwater elevation data from the shallow wells (wells screened from approximately 10 to 20 feet below the water table) and the deep wells (wells screened from approximately 45 to 70 feet below ground surface) shows that at both low and high tide, groundwater enters the Site from the east and northeast and flows to the west and southwest, discharging into Hempstead Harbor. The horizontal hydraulic gradient (slope of the water table) varies from 0.005 under the tank area to 0.05 along the eastern perimeter. The average horizontal gradient south and west of the embankments is 0.02 (Roux, 1991a).

The principal effect of the tidal cycle on groundwater flow is that it reverses the vertical flow direction of the upper few feet of the shallow aquifer. Flow is upward at high tide and downward at low tide. Below the upper 10 to 20 feet of the aquifer, vertical flow is upward at all times (Roux, 1991a). The upward vertical component is a critical factor at the Site because it prevents surface contaminants from migrating into deeper portions of the aquifer.

No Dense Non-Aqueous Phase Liquid (DNAPL) were found in three deep wells at the Site indicates that downward migration of DNAPL has not occurred (Roux, 1991a). Light NAPL (LNAPL), such as those primarily found at the Site, will float on the water table and slowly dissolve. The dissolved components will behave in the same manner as the groundwater in which they are dissolved. At the Site, they will flow horizontally to Hempstead Harbor and Motts Cove. Mounding at the center of the Site will cause a downward flow component beneath the mound to a depth where it is overcome by the upward flow component in the aquifer.

In August 1990, Roux conducted three short-term specific capacity tests to determine the hydraulic conductivity of the shallow aquifer. The obtained hydraulic conductivity values range from 10 gallons per day per square foot (gpd/ft^2) (1.3 ft/day) to 225 gpd/ft^2 (30 ft/day). According to Roux (1991b), these values are less than the actual values because the tested wells were affected by well losses and partial penetration. In February 1992, RETEC utilized the tidal fluctuation technique of Ferris (1963) to determine the hydraulic conductivities of the shallow and deep aquifers. The obtained values are 57 ft/day (426 gpd/ft^2) for the shallow aquifer (Level B), and 53.5 ft/day (400 gpd/ft^2) for the deep aquifer (Level C). Results of the hydraulic conductivity based on the tidal fluctuation technique are discussed in section 4.3.2 of this report.

2.3.5 Meteorology

Long Island is located between 40° and 42° north latitude in a temperate-climate belt. Table 2-1 summarizes the average monthly precipitation observed at LaGuardia Airport, New York between the years 1962 and 1991. LaGuardia Airport is the closest location to the Site for which meteorological data is available. During this period, the average monthly precipitation is fairly evenly distributed throughout the year. The mean annual precipitation between 1962 and 1991 is 43.08 inches. Most of the rainfall from May through October comes from thunderstorms. It is usually of brief duration and sometimes intense. For the other months of the year, precipitation is more likely to be associated with widespread storm areas, so that day-long rain, snow or a mixture of both is more common. The maximum 24 hours precipitation event ranges from 2.9 to 7.11 inches, with an average of 3.9 inches.

The mean monthly temperature during the period 1962-1991 is 54.6° F. July is the warmest month with an average monthly temperature of 76.7° F and a maximum recorded temperature of 107°F (1966). January is the coldest month with an average temperature of 32.1° F, and a minimum recorded temperature of -3° (1985).

The prevailing wind direction is northwest during most of the year, except during the summer months when south and southwest winds prevail. Mean monthly wind speed does not vary widely, and averages 12.2 mph for the period 1949-1991 (NOAA, 1991).

2.4 CONSTITUENTS OF INTEREST

The types and concentrations of COIs detected in the soil, groundwater, sediments, and air at the Site are described in detail in the RI report and summarized below and in Section 5.0. A more complete description of these constituents of interest (COIs) and their relative distributions is also provided in the Risk Assessment portion of the Feasibility Study (Roux, 1991b).

TABLE 2-1

Average Monthly Precipitation[a]

Month	Average Precipitation (inches)
January	3.13
February	2.95
March	3.89
April	3.71
May	3.79
June	3.28
July	4.08
August	4.34
September	3.35
October	3.17
November	3.82
December	3.57

[a] observed at LaGuardia, New York between 1962 and 1991.

2.4.1 Soil and Sediments

The predominant chemicals found in the soils and sediments during the RI at the Site are ethylbenzene, toluene and xylenes. These three compounds comprise more than 98 percent (by mass) of the constituents identified in all samples detected. The sum of these three compounds concentrations ranged from below detection limits (BDL) up to 1 percent in one of the soil samples. Concentrations of xylenes ranged from BDL to approximately 8,400 parts per million (ppm); ethylbenzene from BDL to 1,300 ppm; and toluene from BDL to 2,600 ppm. Approximately 50 percent of the soil samples analyzed contained one or more of these constituents. In general, the highest concentrations of these three compounds were detected in shallow soil (above the water table) along the western portion of the Site (adjacent to the shoreline).

Eight halogenated compounds were detected in 10 out of 45 soil samples submitted for analysis during RI activities. TCA and methylene chloride were the most predominantly detected halogen compounds at the site.

Fifteen PAHs, four phthalates, and one phenolic compound were identified during the RI in Levels A, B, C, and D. These detections were predominantly behind the bulkhead along the western edge of the site and in the tank farm area.

Sixteen PAHs, four phthalates, and no phenolic compounds were detected during the RI in sediments of Motts Cove and Hempstead Harbor adjacent to the site. The detections of these compounds were more frequent, but similar to slightly greater concentrations than the soils on the site. This is particularly true of phthalates which were detected in all eighteen sediment samples collected during the RI. The levels and distributions of organic chemicals and metals in soil and sediments are described in detail in the RI and summarized in Section 5.0. Based on the RI results, the area of soil to be remediated was defined and shown in Figure 2.3.

2.4.2 Groundwater

Six shallow and three deep groundwater monitoring wells (SW- and DW-Series) were installed and sampled as part of the RI. These wells are screened below the water table to ascertain the quality of the groundwater exclusive of any non-aqueous phase liquids or organic sheen floating on the water table. Dissolved constituents within the groundwater consist primarily of ethylbenzene, toluene and xylenes. Other volatile organic compounds that were detected in some samples include benzene, methylene chloride, 1,1-dichloroethane, trans-1,2-dichloroethylene, 1,1,1-TCA, TCE and PCE. These constituents were more prevalent in the

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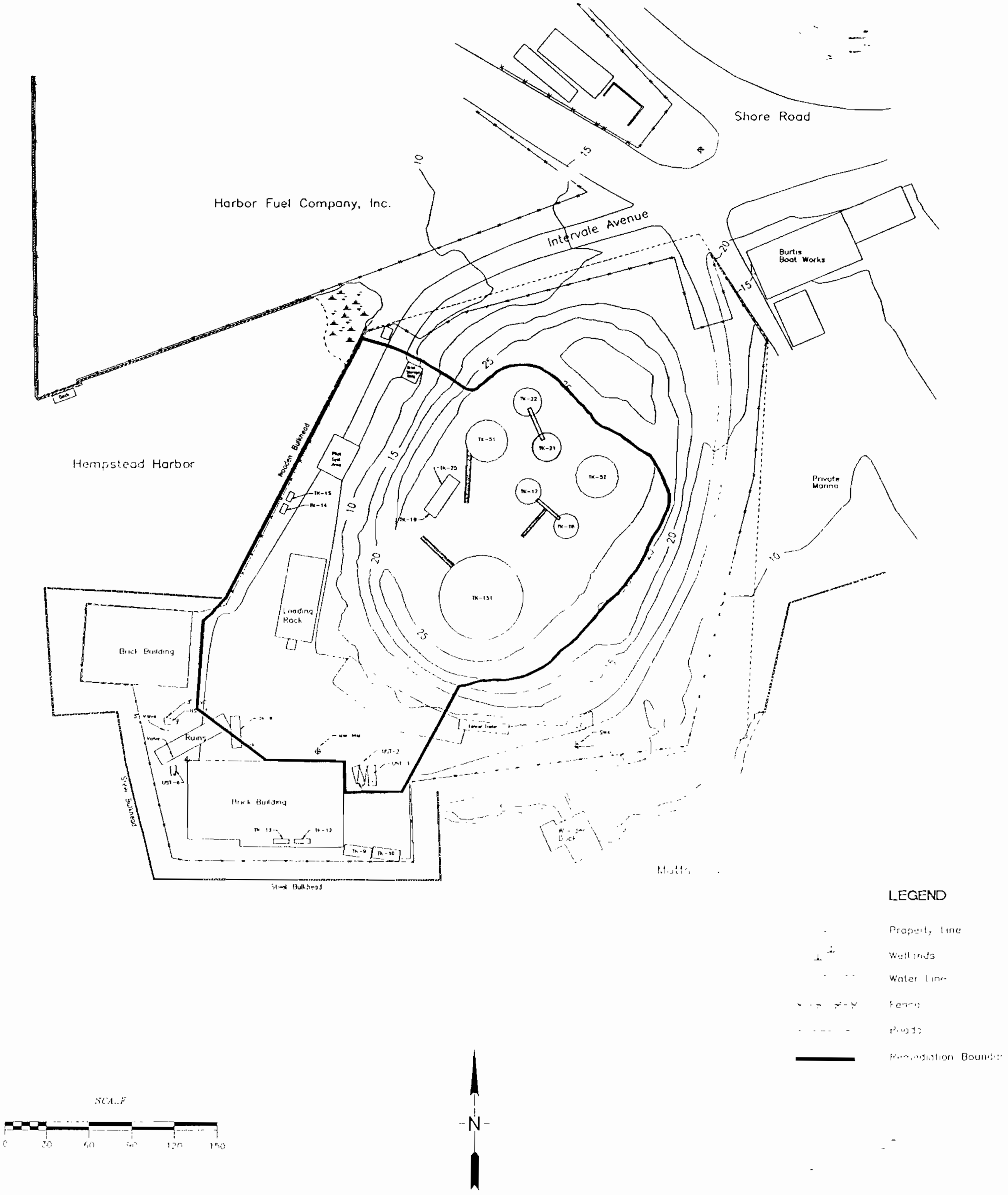

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Area Of Soil To Be Remediated As Identified In The RI

FIGURE 2-3

groundwater than in the soils and sediments which is more indicative of an off-site source for these chemicals.

Of all the semi-volatile compounds analyzed during the RI, only phthalates were detected in any of the samples. Two phthalates were detected in five wells. However, all three of the DW series wells detected these compounds. Complete analytical results from these wells are given in the RI report and summarized in Section 5.0.

2.5 SELECTED REMEDY

Based upon the results of the RI/FS and the criteria for selecting a remedy under the applicable laws and regulations, the New York State Department of Environmental Conservation (NYSDEC) and U.S. EPA selected an integrated remedy comprised of *in situ* soil venting, extraction of groundwater and treatment by air stripping and *in situ* biodegradation and monitoring to remediate the Site. The elements of the proposed remedial program are as follows:

1. **A biotreatability pilot study** to determine the type and amount of nutrient and oxygen additives needed to stimulate the growth of indigenous bacteria capable of biodegrading site contaminants.

2. **A remedial design program** to verify the components of the conceptual design and provide the details necessary for the construction, implementation, and monitoring of the remedial program.

3. Installation and operation of a **soil venting (vapor extraction) system**.

4. Installation and operation of a **groundwater collection and treatment system**.

5. **A biotreatment program** designed to reduce contaminants in the saturated soils and groundwater to the extent practicable, in conjunction with the other process options employed.

6. **A monitoring program** designed to evaluate both the performance of the remedial program while in operation, and its continued effectiveness after discontinuation.

3.0 OBJECTIVES

3.1 SITE REMEDIAL OBJECTIVES

The objectives to be obtained by implementing the proposed remedy as specified in the ROD are:

1. **Soil**

   a) Reduce the concentrations of benzene and methylene chloride so that the presence of these chemicals at the Site do not present an added risk of cancer of more than one in one million under the most conservative exposure scenario.

   b) Reduce the concentrations of organic contaminants in soils so that, to the extent feasible, contaminants do not leach from soils and contaminate groundwater to levels above standards.

2. **Groundwater** - Reduce the concentrations of contaminants in groundwater to below New York State groundwater standards as shown in Table 3-1, to the extent technically feasible.

3. **Sediments** - Indirectly remediate sediments by treating the source of contaminants to the sediments, site soils and groundwater.

4. **Air** - Eliminate the exceedances of applicable ambient air standards over the mudflats adjacent to the Site.

5. **Surface Water** - Eliminate the sheen on surface waters to comply with applicable surface water standards.

If monitoring indicates that continued operation of the remedy is not producing significant reductions in the concentrations of contaminants in soils and groundwater, in accordance with the NCP, the NYSDEC and the U.S.EPA will evaluate whether discontinuance of the remedy is warranted. The criteria for discontinuation will include an evaluation of the operating conditions and parameters as well as a statistical determination that the remedy has attained the feasible limit of contaminant reduction and that further reductions would therefore be impracticable.

TABLE 3-1

Potential Applicable or Relevant and Appropriate Requirements

Constituents of Interest	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) 40 CFR 141	Safe Drinking Water Act Maximum Contaminant Level Goals (MCLGs) 40 CFR 141 & 50 FR 46936	Clean Water Act Water Quality Criteria for Freshwater Aquatic Life Acute/Chronic	Clean Water Act Water Quality Criteria for Human Health - Fish Consumption	New York State Ambient Water Quality Standards and Guidance Values Part 703 Title 6	Clean Water Act Water Quality Criteria for Saltwater Aquatic Life Acute/Chronic
1.1 dichloroethylene	7	7	11,600/-(b)	1.85	5	224,000/-(b)
1.1.1-trichloroethane	200	200	---	1,030,000	5	31,200/-(b)
Trans-1.2-dichloroethylene	100	100	---	---	5	—
Tetrachloroethylene	5	0	5,280/840(b)	8.85	5	10,200/450
Trichloroethylene	5	0	45,000/21,900(b)	80.7	5	2,000/-(c)
Chloroform	100(a)	---	28,900/1,240(b)	15.7	7	12,000/6,400
Vinyl Chloride	2	0	---	525	2	—
Methylene Chloride	---	---	---	---	5	—
1,1 dichloroethane	---	---	11,800/20,000(b)	---	5	113,000/-(b)
1,2 dichloroethylene	---	---	11,600/-(b)	---	5	224,000/-(b)
Benzene	5	0	5,300/-(b)	40	0.7	5,100/700(b)
Toluene	1.000	1.000	17,500/-(b)	424,000	5	6,300/5,000(b)
Acetone	---	---	---	---	-(d)	—
Ethylbenzene	700	700	32,000/-(b)	3,250	5	430/-(b)
Xylene (total)	10.000	10.000	---	---	5	---
Styrene	100	100	---	---	5	---
Phenol	---	---	10.200/2,560(b)	---	1(e)	5,800/-(b)

--- indicates no specific criteria has been established.
All values in µg/l unless otherwise noted.

TABLE 3-1 (continued)

Potentially Applicable or Relevant and Appropriate Requirements

Constituents of Interest	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) 40 CFR 141	Safe Drinking Water Act Maximum Contaminant Level Goals (MCLGs) 40 CFR 141 & 50 FR 46936	Clean Water Act Water Quality Criteria for Freshwater Aquatic Life Acute/Chronic	Clean Water Act Water Quality Criteria for Human Health - Fish Consumption	New York State Ambient Water Quality Standards and Guidance Values Part 703 Title 6	Clean Water Act Water Quality Criteria for Saltwater Aquatic Life Acute/Chronic
Naphthalene	---	---	2,300/620	---	10	2,350/-$^{(b)}$
2-methylnaphthalene	---	---	---	---	-(d)	---
Dibutyl phthalate	---	---	---	154,000	50	---
Benzoic Acid	---	---	---	---	-(d)	---
Benzyl Alcohol	---	---	---	---	-(d)	---
Di-n-octylphthalate	---	---	---	---	50	---
Isophorone	---	---	117,000/-$^{(b)}$	520,000	50	12,900/-$^{(b)}$
DiBenzo Furan	---	---	---	---	-(d)	---
bis (2-ethylbexyl)phthalate	---	---	---	50,000$^{(c)}$	---	---
Acenapthylene	---	---	---	---	-(d)	---
Acenaphthene	---	---	1,700/520$^{(b)}$	---	20	970/500
Phenanthrene	---	---	---	---	50	---
Fluoranthene	---	---	3,980/-$^{(b)}$	54	50	40/16$^{(b)}$
Chrysene	---	---	---	---	.002	---
2-methylphenol (o-cresol)	---	---	---	---	---	---
4-methylphenol (p-cresol)	---	---	---	---	---	---
2,4 dimethylphenol (xylend)	---	---	2.120/$^{(b)}$	400	50	---

--- indicates no specific criteria has been established.
All values in $\mu g/l$ unless otherwise noted.

TABLE 3-1 (continued)

Potentially Applicable or Relevant and Appropriate Requirements

Constituents of Interest	Safe Drinking Water Act Maximum Contaminant Levels (MCLs) 40 CFR 141	Safe Drinking Water Act Maximum Contaminant Level Goals (MCLGs) 40 CFR 141 & 50 FR 46936	Clean Water Act Water Quality Criteria for Freshwater Aquatic Life Acute/Chronic	Clean Water Act Water Quality Criteria for Human Health - Fish Consumption	New York State Ambient Water Quality Standards and Guidance Values Part 703 Title 6	Clean Water Act Water Quality Criteria for Saltwater Aquatic Life Acute/Chronic
Anthracene	---	---	---	---	50	---
Benzo (a) Anthracene	---	---	---	---	.002	---
Fluorene	---	---	---	---	50	---
Pyrene	---	---	---	---	50	---
2.4 Dinitrophenol	---	---	---	14.3	---	4,850/-$^{(b)}$
4.6 Dinitro-2-methylphenol	---	---	---	765	---	4,850/-$^{(b)}$
N-Nitrosodipropylamine	---	---	---	---	---	---

(a) MCL for total trihalomethane concentration
(b) Lowest observed effect level
(c) Value shown is for di-2-ethylhexylphthalate
(d) Not regulated by State of New York under POC Groundwater standards
(e) Total phenols

--- indicates no specific criteria has been established.
All values in µg/l unless otherwise noted.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Under the Superfund Amendments and Reauthorization Act (SARA) of 1986, remedial actions must comply with Applicable or Relevant and Appropriate Regs (ARARs) unless one or more of six waiver conditions are met (CERCLA Section 121[d][2][A], [d][4]). Applicable requirements are:

> Those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations, promulgated under federal or state environmental facility listing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site.

(40 CFR Section 300.5 at 55 Fed. Reg. 8814, USEPA 1990b)

Relevant and appropriate requirements are:

> Those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal, or state environmental or facility listing laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

(40 CFR Section 300.5 at 55 Fed. Reg. 8817, USEPA 1990b)

The remedy will continue until such time that compliance with the substantive technical requirements of the ARARs listed in Tables 3-2 and 3-3 or conditions indicate that a waiver of these ARARs is justified based upon conditions given in the ROD.

TABLE 3-2

Listing of Potential Federal ARARs and TBCs

WATER

Safe Drinking Water Act [42 U.S.C. 300(f)]

40 CFR 141.11-16	Maximum Contaminant Levels
40 CFR 141.50-52	Maximum Contaminant Level Goals
40 CFR 144-147	Underground Injection Control Regulations
40 CFR 122-125	National Pollutant Discharge Elimination System
40 CFR 403	Pretreatment Standards

Clean Water Act (33 U.S.C. 1251)

40 CFR 230	Guidelines for Specification of Disposal Sites for Dredged or Fill Materials
40 CFR 231	Restriction of Disposal Sites for Dredged Materials
40 CFR 131	Water Quality Criteria

Rivers and Harbors Act

Section 10	Dredge and Fill Requirements

"Quality Control for Water, 1986" - EPA 44/5-86-001, May 1, 1986, 51 FR 43665

Health Advisories, EPA Office of Water

"Developing Requirements for Direct and Indirect Discharge of CERCLA Wastewaters, 1987" - USEPA Office of Water Guidance Documents

AIR

Clean Air Act (42 U.S.C. 7401)

40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 61	National Emissions Standards for Hazardous Air Pollutants
40 CFR 60	New Source Performance Standards

HAZARDOUS WASTE

Resource Conservation and Recovery Act

40 CFR 264	Identification and Listing of Hazardous Wastes
40 CFR 264.18	Location Standards and Prohibitions for TSD Facilities
40 CFR 264.90-109	Groundwater Protection and Monitoring
40 CFR 264.110-120	Closure and Post-closure
40 CFR 264.170-176	Containers
40 CFR 264.190-199	Tanks
40 CFR 264.270-299	Land Treatment
40 CFR 264.300-339	Landfills
40 CFR 264.340-999	Incinerators
40 CFR 268.1-50	Land Disposal Restrictions
40 CFR 264 Subpart S	Corrective Action at Hazardous Waste Management Facilities (Proposed)

USEPA RCRA Guidance Documents - Design Guidelines

Land Treatment Units

Landfill Design

USEPA Technical Resource Documents

Hazardous Waste Land Treatment

Review of In-Place Treatment Technologies for Contaminated Surface Soils, Vol.2, USEPA-540/2-84-0036, November 1984.

Department of Transportation

49 CFR 107, 171, 172	Hazardous Materials Transport

Toxic Substances Control Act (15 U.S.C. 2601)

40 CFR 761.60-79	Storage and Disposal of PCBs
40 CFR 761.120	PCB Spill Clean-up Policy Rule

TABLE 3-2 (continued)

Listing of Potential Federal ARARs and TBCs

MISCELLANEOUS	
Coastal Zone Management Act of 1972 (16 U.S.C. 1451)	
15 CFR 930, 923.45	Air and Water Pollution Control Requirements
Endangered Species Act of 1973 (16 U.S.C. 1531)	
50 CFR 81, 225, 402	
Fish and Wildlife Coordination Act (16 U.S.C. 661)	
Marine Protection, Research and Sanctuaries Act (33 U.S.C. 1401)	
Occupational Safety and Health Act (29 U.S.C. 651)	
29 CFR 1910	Requirements for Workers Engaged in Response Activities
Integrated Risk Information System (IRIS), USEPA 1990	
Carcinogenic Potency Factors (CPF)	
Reference Doses for Chronic Exposure (RfD)	
Health Effects Assessments (HEAs), USEPA 1985	
Executive Orders 11988 (Floodplains) and 11990 (Wetlands)	
U.S. EPA's Policy on Floodplains and Wetlands Assessment: for CERCLA Actions, August 6, 1985, (40 CFR 6, Appendix A)	

TABLE 3-3

Listing of Potential New York State ARARs/SCGs and TBCs

WATER	
6 NYCRR 701	Classifications and Standards of Quality and Purity, and Appendix 31
6 NYCRR 701.15	Derivation of Effluent Limitations; empowers State to enforce guidance values for surface water where no standards exist
6 NYCRR 702	Special Classifications and Standards
6 NYCRR 703	Groundwater Classifications, Quality Standards and Effluent Standards and/or Limitations
6 NYCRR 750-757	Implementation of NPDES Program in NYS
6 NYCRR 885	Classifies Hempstead Harbor Class SB Waters
10 NYCRR 5	Public Water Supply MCLs
10 NYCRR 170	Water Supply Sources
TOGS 1.1.1 (9/24/90)	Ambient Water Quality Standards and Guidance Values
TOGS 2.1.2 (4/1/88)	Underground Injection/Recirculation (UIR) at Groundwater Remediation Sites
AIR	
6 NYCRR 257	Air Quality Standards
6 NYCRR 212	General Process Emission Sources
Air Clean-up Criterion, January 1990, Ambient Guideline Concentrations	
HAZARDOUS WASTE	
6 NYCRR 371	Identification and Listing of Hazardous Waste
6 NYCRR 372	Hazardous Waste Manifest System and Related Standards
6 NYCRR 373	Location and Design Standards for TSD Facilities
6 NYCRR 373-2	Final Status Standards for Owners and Operators of Hazardous Waste Treatment/Storage/Disposal Facilities
6 NYCRR 374	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
MISCELLANEOUS	
Department of State Coastal Management Program	
State Coastal Policies	
Division of Marine Resource	
6 NYCRR 661	Chapter 10 Tidal Wetlands, Land Use Regulations
Division of Fish and Wildlife	
6 NYCRR 182	Endangered Species of Fish and Wildlife
Sediment Criteria (NYS 1989)	

4.0 SCOPE OF PRE-DESIGN INVESTIGATION

This section is the summary of site activities performed for the PDI from February 22 through March 12, June 7 and June 22, 1993. During this period, on-site activities included soil borings, soil gas survey, well points, monitoring well installation, time-lag stage-ratio study, and groundwater sampling. These activities are described below.

4.1 SOIL EXPLORATION

The soil explorations were conducted using a CME 550 drilling rig with 4-¼" I.D. hollow stem augers. The drilling contractor was Warren George, Inc. of Jersey City, New Jersey.

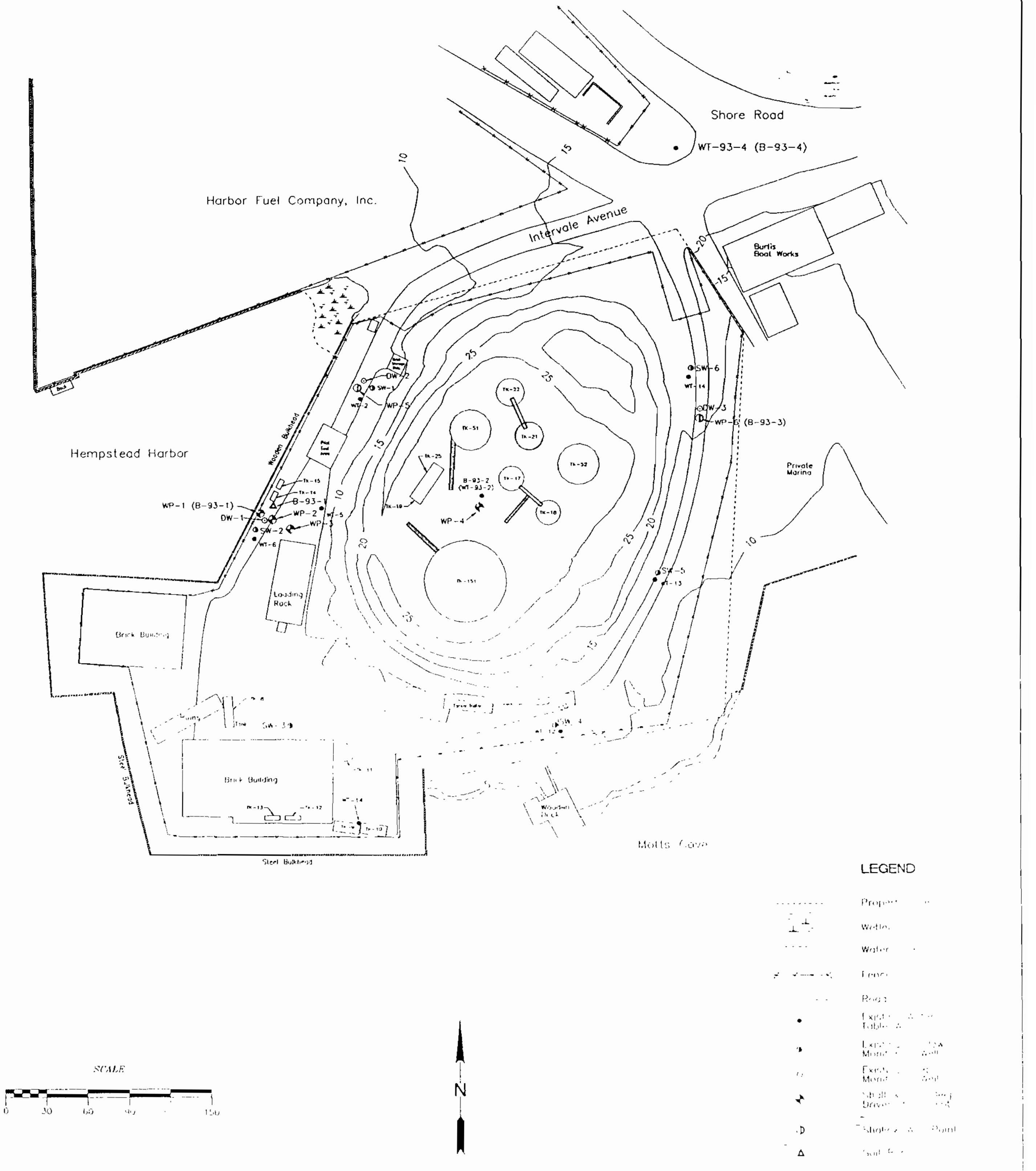
4.1.1 Soil Borings

Soil borings were conducted in 3 locations on-site and one location off-site, as shown in Figure 4-1. Logs are presented in Appendices A and C. The first boring (B-93-2), located in the center of the tank farm area, was drilled to 52 feet and 4" diameter split spoons were collected approximately every 5 feet. Soils collected were screened using an OVA, and 9 soil samples were collected for analysis. See Table 4-1. Samples for vertical hydraulic conductivity were attempted, but the sandy soil resulted in no suitable sample recovery. Soil samples for the iron precipitation study were collected from 31' to 35' using 4" diameter split spoons lined with plastic sleeves. The boring was then completed as monitoring well WT-93-2.

The second boring (B-93-3) was located in the northeast corner of the Site near the Burtis Boat Works. The boring was advanced to 44 feet and 4" diameter spilt spoons were collected approximately every 5 feet. Soil collected was screened using an OVA, and 9 soil samples were collected for analysis. Samples for vertical hydraulic conductivity were collected using 4-inch split spoons with plastic liners at depths 22'-24' and 47'-49'. The boring was then completed as well point WP-6.

The third boring was located along Hempstead Harbor adjacent to the truck loading rack. The boring was advanced to 14 feet and split spoons were driven continuously. Soil collected was screened using the OVA and 9 soil samples were collected for analyses. The boring was

RETEC



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PDI Investigation Locations

4-1

TABLE 4-1

Summary of Headspace Readings
Shore Realty Superfund Site
Glenwood Landing, New York

Boring I.D.	Sample I.D.	Depth	OVA Reading (ppm)
B-93-1	B-93-1A,B,C	0'-2'	0
		2'-4'	12
	B-93-1D,E,F	4'-6'	72
		6'-8'	>1,000
	B-93-1G,H,I	'8'-10'	350
		10'-12'	315
		13'-15'	275
B-93-2		0'-2'	0
		5'-7'	0
		10'-12'	2
	B-93-2A,B,C	12'-14'	200
	B-93-2C,D,E	15'-17'	>1,000
	B-93-2F,G,H	19'-21'	65
		33'-35'	10
		40'-42'	5
		45'-47'	0.5
B-93-3	B-93-3A,B,C	3'-5'	0
	B-93-3D,E,F	7'-9'	2.5
	B-93-3G,H,I	11'-13'	N/A
		15'-17'	4
		25'-27'	4
		30'-32'	2
		35'-37'	8
		40'-42'	6.5
WT-93-4		0'-2'	0
		2'-4'	0
		4'-6'	0
		6'-8'	0
		8'-10'	0
		10'-12'	0
		12'-14'	0
		14'-16'	0
		16'-18'	0

then completed as well point WP-1. The off-site boring was located on the northern side of Intervale Avenue adjacent to the Harbor Fuels Facility. The boring was advanced to 18.5 feet and split spoons were driven continuously. Soil collected was screened with an OVA. No samples were sent for chemical analysis. The boring was completed as WT-93-4.

4.1.2 Soil Samples

Soil samples, identified in Table 4-1, were collected from each of the three borings. Sampling tools were decontaminated after each use with soap, water and methanol. Each sample involved splitting the contents of the split spoon into three or four subsamples. The soil was divided into four sub-samples for the following analyses: individual constituents, total petroleum hydrocarbons, bio-treatability, and field screening. After the samples were collected, they were stored in coolers and depending on the number of samples collected, they were delivered or picked up by the analytical laboratory (NYTEST Environmental Inc.) daily. If the samples were not picked up, they were stored in coolers packed with ice. The chain of custody used to track sample shipments is presented in Appendix B. The results of the volatile organic chemical analyses are presented in Table 4-2. Total CVOCs in Table 4-2 include:

- methylene chloride;
- 1,1-dichloroethylene;
- 1,1-dichloroethane;
- 1,2-dichloroethylene (total);
- 1,2-dichloroethane;
- chloroform;
- 1,1,1-TCA;
- TCE;
- 1,1,2-TCA;
- PCE; and
- 1,1,2,2-PCE.

The results of the SVOCs analyses are presented in Table 4-3. The results of the inorganic chemical analyses are presented in Table 4-4.

Table 4–2
Soil Samples for TCL Volatile Organics (mg/kg)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	B–93–2A	B–93–2D	B–93–2G	B–93–3A	B–93–3D	B–93–3G	B–93–1A	B–93–1D	B–93–1G
Laboratory] ID	1589701	1589702	1589703	1592201	1592202	1592205	1597701	1597702	1597703
% Moisture	7	19	18	9	22	20	21	16	20
Diluiton Factor	1.00	1	1	1.00	1	1	1.00	10	1.00
Chloromethane	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 UJ
Bromomethane	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 U
Vinyl Chloride	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 U
Chloroethane	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 U
Methylene Chloride	< 0.008 U	< 11 U	< 0.016 U	< 0.011 U	< 0.014 U	< 0.013 U	< 3.7 U	< 16 UJ	< 2.3 U
Acetone	0.1	< 1.5 U	< 0.012 U	< 0.011 U	< 0.017 U	< 0.027 U	< 1.6 UJ	< 15 UJ	< 1.6 U
Carbon Disulfide	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,1–Dichloroethylene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,1–Dichloroethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,2–Dichloroethylene (total)	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Chloroform	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,2–Dichloroethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
2–Butanone	0.023	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 U
1,1,1–Trichloroethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Carbon Tetrachloride	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Vinyl Acetate	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 UJ	< 15 UJ	< 1.6 UJ
Bromodichloromethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,2–Dichloropropane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
cis–1,3–Dichloropropene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Trichloroethylene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Dibromochloromethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,1,2–Trichloroethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Benzene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	0.006 J	0.004 J	28 J	< 7.4 UJ	< 0.78 U
Trans–1,3–Dichloropropene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Bromoform	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
4–Methyl–2–Pentanone	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 U
2–Hexanone	< 0.011 U	< 1.5 U	< 0.012 U	< 0.011 U	< 0.013 U	< 0.012 U	< 1.6 U	< 15 UJ	< 1.6 U
Tetrachloroethylene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
1,1,2,2–Tetrachloroethane	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 UJ	< 7.4 UJ	< 0.78 UJ
Toluene	< 0.005 U	37 D	0.047	< 0.005 U	0.003 J	0.002 J	0.15 J	720 J	23
Chlorobenzene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Ethylbenzene	< 0.005 U	61 D	0.1	< 0.005 U	< 0.006 U	< 0.006 U	1.8 J	260 J	6.8
Styrene	< 0.005 U	< 0.77 U	< 0.006 U	< 0.005 U	< 0.006 U	< 0.006 U	< 0.79 U	< 7.4 UJ	< 0.78 U
Total Xylenes	0.007	530 D	0.6	< 0.005 U	< 0.006 U	< 0.006 U	27 J	1600 J	41
Total CVOCs	0	0	0	0	0	0	0	0	0
Total BTEX	0.007	628	0.747	0	9	6	56.95	2580	70.8

Notes:

U means the material was analyzed for, but not detected.

J means the associated numerical value is an estimated quantity.

UJ means the material was analyzed for, but not detected. The sample quantitation limit is an estimated value.

D means there was an analysis at a secondary dilution factor.

Table 4-3
Soil Samples for TCL Semivolatile Organics (mg/kg)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	B-93-2B	B-93-2E	B-93-2H	B-93-3B	B-93-3E	B-93-3H	B-93-1B	B-93-1E	B-93-1H
Laboratory ID	1589704	1589705	1589706	1592206	1592207	1592210	1597706	1597707	1597708
% Moisture	5	18	17	7	20	17	15	20	18
Dilution Factor	1.00	1.00	1.00	1.00	2.00	2.00	4.00	4.00	1.00
Polynuclear Aromatic Hydrocarbons									
bis(2-Chloroethyl)ether	< 0.035 U	< 0.4 U	< 400 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
1,3-Dichlorobenzene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
1,4-Dichlorobenzene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Benzyl Alcohol	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
1,2-Dichlorobenzene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
bis(2-Chloroisopropyl)ether	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
N-Nitroso-di-n-propylamine	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Hexachloroethane	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Nitrobenzene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Isophorone	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Benzoic Acid	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
bis(2-Chloroethoxy)methane	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
1,2,4-Trichlorobenzene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Naphthalene	< 0.035 U	1.1	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	2.2	0.17 J
4-Chloroaniline	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Hexachlorobutadiene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2-Methylnaphthalene	< 0.035 U	2	0.031 J	< 0.35 U	< 0.82 U	0.008 J	0.13 J	1.8	0.39 J
Hexachlorocyclopentadiene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2-Chloronaphthalene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2-Nitroaniline	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
Acenaphthylene	< 0.035 U	0.069 J	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	0.034 J	< 1.6 U	< 0.4 U
2,6-Dinitrotoluene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
3-Nitroaniline	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
Acenaphthene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	0.016 J
Dibenzofuran	< 0.035 U	0.12 J	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	0.04 J	0.019 J
2,4-Dinitrotoluene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
4-Chlorophenyl-phenylether	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Flourene	< 0.035 U	0.26 J	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	0.041 J	0.17 J	0.032 J
4-Nitroaniline	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
N-Nitrosodiphenylamine	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	0.059 J	0.59 J	< 0.4 U
4-Bromophenyl-phenylether	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Hexachlorobenzene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Pentachlorophenol	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
Phenanthrene	< 0.035 U	0.25 J	0.016 J	0.079 J	0.1 J	0.35 J	0.11 J	0.41 J	0.035 J
Anthracene	< 0.035 U	< 0.4 U	0.002 J	0.02 J	0.02 J	0.08 J	0.034 J	0.1 J	0.004 J
Flouranthene	< 0.035 U	< 0.4 U	< 0.4 U	0.21 J	0.17 J	0.5 J	< 1.6 U	0.3 J	< 0.4 U
Pyrene	< 0.035 U	< 0.4 U	< 0.4 U	0.15 J	0.92 J	0.29 J	0.12 J	0.29 J	< 0.4 U
3-3'-Dichlorobenzidine	< 0.069 U	< 0.81 U	< 0.8 U	< 0.71 U	< 1.6 U	< 1.6 U	< 3.1 U	< 3.3 U	< 0.81 U
Benzo (a) anthracene	< 0.035 U	< 0.4 U	< 0.4 U	0.12 J	< 0.82 U	0.24 J	< 1.6 U	< 1.6 U	< 0.4 U
Chrysene	< 0.035 U	< 0.4 U	< 0.4 U	0.11 J	< 0.82 U	0.22 J	< 1.6 U	< 1.6 U	< 0.4 U
Benzo(b)flouranthene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Benzo(k)flouranthene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Benzo(a)pyrene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Indeno(1,2,3-cd)pyrene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Dibenz(a,h)anthracene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Benzo(g,h,i)perylene	< 0.035 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U

Table 4−3 (continued)
Soil Samples for TCL Semivolatile Organics (mg/Kg)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	B−93−2B	B−93−2E	B−93−2H	B−93−3B	B−93−3E	B−93−3H	B−93−1B	B−93−1E	B−93−1H
Laboratory ID	1589704	1589705	1589706	1592206	1592207	1592210	1597706	1597707	1597708
% Moisture	5	18	17	7	20	17	15	20	18
Dilution Factor	1.00	1.00	1.00	1.00	2.00	2.00	4.00	4.00	1.00
Phthalates									
Dimethylphthalate	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Diethylphthalate	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Di−n−butylphthalate	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
Butylbenzylphthalate	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
bis(2−Ethylhexyl)phthalate	0.38	0.27 J	0.042 J	< 0.12 U	< 0.16 U	< 0.59 U	0.75 J	3.9	0.16 J
Di−n−octylphthalate	0.041 J	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	0.013 J	< 1.6 U	< 1.6 U	< 0.4 U
Phenols									
Phenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2−Chlorophenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2−Methylphenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	0.045 J
4−Methylphenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	0.063 J
2−Nitrophenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2,4−Dimethylphenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2,4−Dichlorophenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
4−Chloro−3−methylphenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2,4,6−Trichlorophenol	< 0.35 U	< 0.4 U	< 0.4 U	< 0.35 U	< 0.82 U	< 0.8 U	< 1.6 U	< 1.6 U	< 0.4 U
2,4,5−Trichlorophenol	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
2,4−Dinitrophenol	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
4−Nitrophenol	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
4,6−Dinitro−2−methylphenol	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U
Pentachlorophenol	< 1.7 U	< 2 U	< 1.9 U	< 1.7 U	< 4 U	< 3.9 U	< 7.5 U	< 8 U	< 2 U

Notes:
U means the constituent was not detected.
J means constituent detection below quantifiable detection limit.
E means constituent detection above quantifiable detection limit.
ND means constituent not detected.
NA means constituent was not analyzed for.

Table 4–4
Soil Samples for Inorganics (mg/kg)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	B–932B	B–932E	B–932H	B932KB	B932KT	B–933B	B–933E	B–933H	B93–1B	B93–1E	B93–1H
Laboratory ID	589704	589705	589706	589708	589707	592206	592207	592210	597706	597707	597708
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3.23	2.21	1.34	0.307	1.91	4.4	4.05	5.27	2.78	5.77	3.81
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia Nitrogen	4.56	< 1	< 1	NA	NA	8.47	5.54	6.05	< 1	< 1	< 1
Total Nitrogen	42.5	< 2	18.5	NA	NA	37	52	111	72.5	< 2	< 2
Orthophosphate	< 0.8	< 0.8	< 0.8	NA	NA	1.38	1.18	3.41	< 0.8	1.09	2.12
Total Phosphate	46.4	101	47.2	NA	NA	160	147	124	59.3	160	19.5
Nitrate	< 0.8	< 0.8	< 0.8	NA	NA	<0.8	<0.8	<0.8	< 0.8	< 0.8	< 0.8
Nitrite	< 0.2	< 0.2	< 0.2	NA	NA	<0.2	<0.2	<0.2	0.26	< 0.2	< 0.2

Notes:
Sample followed by KB is from Iron Precipitation Study.
Sample followed by KT is from Iron Precipitation Study.
U means the constituent was not detected.
J means constituent detection below quantifiable detection limit.
E means constituent detection above quantifiable detection limit.
ND means constituent not detected.
NA means constituent was not analyzed for.

TABLE 4-5

Well Point Screens

Well I.D.	Water Elevation	Upper Screen Interval	Lower Screen Interval
WP - 1	5.0’	2.0’-7.0’	8.0’-13.0’
WP - 2	approx 5’	2.0’-7.0’	8.0’-13.0’
WP - 3	approx 5’	2.0’-7.0’	8.0’-13.0’
WP - 4	18.4’	16.0’-21.0’	22.5’-27.5’
WP - 5	2.1’	1.0’-6.0’	7.0’-12.0’
WP - 6	7.80’	5.0’-10.0’	11.0’-16.0’

4.1.3 Well Points

Six groundwater elevation monitoring points were constructed on-site, see Table 4-5. Four well points were constructed by auguring down to depth, and the remaining two were constructed in boring locations. The well points were constructed by nesting two sections of 1.25" diameter PVC pipe. The screen zone was selected based on the location of the water table. The deeper screen was from 3'- 8' below the water table and the shallow screens were from 2' below the water table to 3' above. The annulus of the augured hole was allowed to naturally collapse as the augers were removed. After the screens were set based on the water table, the well point was finished off with either a cemented flush mount road box or a cemented protective casing. The logs of the well point construction are presented in Appendix C.

4.1.4 Groundwater Monitoring

4.1.4.1 Monitoring Well

One new well was installed on-site, WT-93-2 and one off-site, WT-93-4. The on-site well was completed in boring B-93-2. The off-site well was completed in B-93-4. The boring was augured to 52 feet, and the augers were pulled back to 25 feet and the hole was allowed to collapse below the augers. The off-site well was augered to a depth of 18.5 feet. The annulus of the wells was filled with #2 Morie sand. The sand interval was from 12 feet to 26 feet below the ground surface for WT-93-2 and 6 feet to 18 feet for WT-93-4. The wells were constructed with 2 inch diameter PVC and 10 feet of #20 slot screen. The screen was set from 24' to 14' for WT-93-2 and 8 to 18 feet in WT-93-4 and sand was placed 2 feet above the screen. The area above the sand pack was then filled with 2 feet of Baroid 3/8" bentonite pellets. The remainder of the well were filled with a bentonite-cement slurry to the surface and completed with cemented flush mounted road-boxes. The log of these wells are presented in Appendix C.

The on-site well was developed on March 3 and the off-site well on June 7 using the drill rig pump and a decontaminated intake hose. The hose was inserted into the well and the intake was placed at the bottom of the well. The pump was run at 4 gpm and the intake of the hose was moved up and down the well screen. After allowing the rig to pump water for 30 minutes the pump flow was varied as the intake line was moved up and down the screen. The rig pump removed 200 - 300 gallons of water from each well during development. The water quality at that time had stabilized and the clarity greatly increased.

4.1.4.2 Groundwater Sampling

The groundwater samples were collected during March from 16 wells around the Site, and on June 22 for the off-site well, see Table 4-6. The sampling was started by measuring the depth to water and the depth to bottom using a interface probe. Using the measured water levels, well volumes were calculated. The wells were purged using either a bailer or submersible pump. The well volume removed was monitored for: pH, conductivity, dissolved oxygen, temperature and turbidity. After each well volume was removed the parameters were measured and recorded. Table 4-6 summarizes these results. After a minimum of three well volumes were removed or after the parameters stabilized within 10%, the well was sampled. Sampling was performed using a decontaminated teflon bailer. The necessary sample bottles were filled and stored in a cooler. At the end of each day or every other day, the samples were picked-up or delivered to the analytical laboratory. Those samples not picked up each day, were stored on ice. Chain of custodies were completed and accompanied each sample delivery to track the samples. These are presented in Appendix B. Table 4-7 is a summary of the volatile organic chemical analyses of the groundwater samples. Table 4-8 is a summary of the semi-volatile organic chemical analyses. Table 4-9 is a summary of the inorganic chemical analyses of the groundwater. The off-site well, WT-93-4, sampling results will be submitted with the July monthly progress report.

4.2 SOIL GAS SURVEY

Soil gas measurements by Dräger gas detector tubes were performed at the site using the P*RE*SIT^{SM} methodology. The purpose of the investigation was to assess the lateral extent of contamination caused by VOCs in soils. Soil gas measurements were performed at various depths during the period of March 1, 1993 through March 5, 1993.

4.2.1 Measurement Procedures Applying Gas Detector Tubes

In vadose zone soils, the total concentration of volatile organic compounds analyzed from a soil sample describes a summation of constituents existing in three phases. Contaminants are present as vapors filling the soil pores, dissolved in the water making up the soil moisture, and adsorbed to soil solids. Partition co-efficients can be used to describe the distribution of contaminant concentrations between the different phases under equilibrium conditions.

TABLE 4-6

Groundwater Sampling Parameters
Shore Realty Superfund Site
Glrnwood Landing, New York

Well I.D.	Date(s) Sampled	Temperature °C	pH	Conductivity MHOS	Turbidity NTUs	Dissolved Oxygen mg/l
WT-2	3/11/93	8.9	6.33	N/A	>200	3.88
WT-5	3/10/93	7.8	5.80	N/A	>200	3.08
DW-2	3/11/93	11.5	6.75	N/A	>200	9.51
WT-6	3/9/93	6.0	7.24	N/A	>200	3.90
SW-1	3/10/93	9.5	6.89	N/A	>200	N/A
WT-14	3/5/93	10.9	6.28	435	>200	3.97
DW-1	3/9/93	10.0	7.21	N/A	34.2	10.00
DW-3	3/8/93	12.3	5.21	50	69.5	8.75
WT-93-2	3/10/93	11.4	6.42	N/A	>200	1.93
WT-13	3/8/93	7.8	8.09	482	>200	2.88
SW-5	3/8/93	11.4	7.78	102	>200	8.32
SW-6	3/8/93	12.8	4.28	160	>200	8.06
WT-12	3/9/93	6.7	6.42	N/A	>200	5.79
SW-2	3/9/93	9.6	6.55	N/A	>200	8.75
SW-3	3/9/93	9.8	6.68	125	>200	6.98
SW-4	3/9/93	10.0	6.86	48	>200	10.21
WT-93-4	6/22/93	8.3	5.50	477	N/A	N/A

NOTE: Conductivity Meter inoperable during field activities on March 9, 10, and 11, 1993.
Turbidity and dissolved oxygen meter inoperable during field activities on June 22, 1993.

Table 4–7
Groundwater Samples for TCL Volatile Organics (ug/l)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	DW–3	SW–2	SW–3	SW–4	SW–5	SW–6	WT–12	WT–13	DW–1	DW–2	SW–1	WT–2	WT–5	WT–6	WT–93–2	WT–14
Laboratory ID	1603802	1603807	1603806	1603805	1603803	1603801	1603808	1603804	1607403	1607405	1607404	1607407	1607408	1607401	1607402	1601001
% Moisture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	1	1	1	1	1.00	1	1.00
Chloromethane	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 100 UJ	< 10 UJ	< 500 UJ	< 100 UJ	< 10 U
Bromomethane	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
Vinyl Chloride	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
Chloroethane	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
Methylene Chloride	< 9 UJ	< 8 UJ	< 9 UJ	< 5 UJ	< 9 UJ	< 9 UJ	< 9 UJ	< 5 UJ	34 UJ	< 14 UJ	< 11 UJ	130 J	20 UJ	960 J	120 J	< 5 U
Acetone	< 10 UJ	< 10 UJ	< 5 UJ	< 10 UJ	< 10 UJ	< 100 UJ	< 10 UJ	< 10 UJ	66 J	< 13 UJ	< 23 UJ	250 J	15 UJ	810 J	< 86 UJ	< 10 U
Carbon Disulfide	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 J	< 5 UJ	< 5 UJ	< 50 UJ	< 5 UJ	< 250 UJ	< 50 UJ	< 5 U
1,1–Dichloroethylene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	1 J	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
1,1–Dichloroethane	< 5 U	< 5 U	< 5 U	< 5 U	1 J	2 J	< 5 U	< 5 U	< 5 U	< 5 U	1 J	19 J	< 5 U	< 250 U	< 50 U	1 J
1,2–Dichloroethylene (total)	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	69	17 J	< 5 U	44 J	< 50 U	23
Chloroform	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	1 J	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
1,2–Dichloroethane	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
2–Butanone	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
1,1,1–Trichloroethane	< 5 U	< 5 U	2 J	< 5 U	2 J	5	2 J	1 J	< 5 U	< 5 U	20	23 J	< 5 U	< 250 U	< 50 U	11
Carbon Tetrachloride	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
Vinyl Acetate	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
Bromodichloromethane	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
1,2–Dichloropropane	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
cis–1,3–Dichloropropene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
Trichloroethylene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	1 J	< 5 U	2 J	< 5 U	< 5 U	13	< 50 U	< 5 U	< 250 U	< 50 U	3 J
Dibromochloromethane	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
1,1,2–Trichloroethane	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
Benzene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	150 J	< 50 U	< 5 U
Trans–1,3–Dichloropropene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
Bromoform	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
4–Methyl–2–Pentanone	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
2–Hexanone	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 UJ	< 10 U	< 10 U	< 10 U	< 100 U	< 10 U	< 500 U	< 100 U	< 10 U
Tetrachloroethylene	< 5 U	< 5 U	4 J	< 5 U	< 5 U	< 5 U	< 5 U	4 J	< 5 U	< 5 U	79	10 J	< 5 U	< 250 U	< 50 U	18
1,1,2,2–Tetrachloroethane	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
Toluene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	490	< 5 U	15000 D	400	< 5 U
Chlorobenzene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	< 250 U	< 50 U	< 5 U
Ethylbenzene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	2800 D	< 5 U	4700 J	1500	< 5 U
Styrene	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 50 U	< 5 U	210 J	< 50 U	< 5 U
Total Xylenes	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	15000 D	< 5 U	25000 J	4500 J	< 5 U
Total CVOCs	0	0	6	0	3	8	2	7	34	0	184	199	20	1004	120	56
Total BTEX	0	0	0	0	0	0	0	0	0	0	0	15990	0	35670	6400	0

Notes:

U means the material was analyzed for, but not detected.

D means there was an analysis at a secondary dilution factor.

J means the associated numerical value is an estimated quantity.

UJ means the material was analyzed for, but not detected. The sample quantitation limit is an estimated value.

Table 4–8
Groundwater Samples for TCL Semivolatile Organics (ug/l)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	DW–3	SW–2	SW–3	SW–4	SW–5	SW–6	WT–12	WT–13	DW–1	DW–2	SW–1	WT–2	WT–5	WT–6	WT–93–2	WT–14
Laboratory ID	1603802	1603807	1603806	1603805	1603803	1603801	1603808	1603804	1607403	1607405	1607404	1607407	1607408	1607401	1607402	1601001
% Moisture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	1	1	1	1	1.00	1	1.00
Polynuclear Aromatic Hydrocarbons																
bis(2–Chloroethyl)ether	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
1,3–Dichlorobenzene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
1,4–Dichlorobenzene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Benzyl Alcohol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	46	2 J	< 10 U
1,2–Dichlorobenzene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
bis(2–Chloroisopropyl)ether	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
N–Nitroso–di–n–propylamine	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U
Hexachloroethane	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Nitrobenzene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Isophorone	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	2 J	< 10 U	< 10 U
Benzoic Acid	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U
bis(2–Chloroethoxy)methane	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
1,2,4–Trichlorobenzene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Naphthalene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	8 J	18	32	46	< 10 U
4–Chloroaniline	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Hexachlorobutadiene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2–Methylnaphthalene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	3 J	6 J	16	21	< 10 U
Hexachlorocyclopentadiene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2–Chloronaphthalene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2–Nitroaniline	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U
Acenaphthylene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2,6–Dinitrotoluene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
3–Nitroaniline	< 50 U	< 50	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U
Acenaphthene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U
Dibenzofuran	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U
2,4–Dinitrotoluene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
4–Chlorophenyl–phenylether	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Flourene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U
4–Nitroaniline	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U
N–Nitrosodiphenylamine	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U
4–Bromophenyl–phenylether	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Hexachlorobenzene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Phenanthrene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U	< 10 U
Anthracene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Flouranthene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Pyrene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
3–3'–Dichlorobenzidine	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U	< 20 U
Benzo (a) anthracene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Chrysene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Benzo(b)flouranthene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Benzo(k)flouranthene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Benzo(a)pyrene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Indeno(1,2,3–cd)pyrene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Dibenz(a,h)anthracene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Benzo(g,h,i)perylene	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U

Table 4–8 (continued)
Groundwater Samples for TCL Semivolatile Organics (ug/l)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	DW–3	SW–2	SW–3	SW–4	SW–5	SW–6	WT–12	WT–13	DW–1	DW–2	SW–1	WT–2	WT–5	WT–6	WT–93–2	WT–14
Laboratory ID	1603802	1603807	1603806	1603805	1603803	1603801	1603808	1603804	1607403	1607405	1607404	1607407	1607408	1607401	1607402	1601001
% Moisture	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dilution Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1	1	1	1	1	1.00	1	1.00
Phthalates																
Dimethylphthalate	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Diethylphthalate	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U
Di–n–butylphthalate	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Butylbenzylphthalate	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
bis(2–Ethylhexyl)phthalate	< 10 U	< 10 U	< 10 U	< 10 U	< 12 U	< 10 U	< 10 U	< 10 U	1 J	< 10 U	< 10 U	< 10 U	1 J	< 10 U	< 10 U	< 10 U
Di–n–octylphthalate	3 J	5 J	< 10 U	1 J	< 10 U	< 10 U	4 J	4 J	5 J	1 J	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
Phenols																
Phenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	2 J	4 J	< 10 U	< 10 U
2–Chlorophenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2–Methylphenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	30	10	920 E	9 J	< 10 U
4–Methylphenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	11	6 J	310 E	6 J	< 10 U
2–Nitrophenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2,4–Dimethylphenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	970 E	31	440 E	11	< 10 U
2,4–Dichlorophenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
4–Chloro–3–methylphenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2,4,6–Trichlorophenol	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2,4,5–Trichlorophenol	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U
2,4–Dinitrophenol	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	2 J	< 50 U
4–Nitrophenol	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U
4,6–Dinitro–2–methylphenol	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	1 J	< 50 U
Pentachlorophenol	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U	< 50 U

Notes:
U means the constituent was not detected.
J means constituent detection below quantifiable detection limit.
E means constituent detection above quantifiable detection limit.
ND means constituent not detected.
NA means constituent was not analyzed for.

Table 4–9
Groundwater Samples for Inorganics (ug/L)
Shore Realty Superfund Site
Glenwood Landing, New York

Sample ID	DW–3	SW–2	SW–3	SW–4	SW–5	SW–6	WT–12	WT–13	DW–1	DW–2	SW–1	WT–2	WT–5	WT–6	WT–932	WT–14T
Laboratory ID	603802	603807	603806	603805	603803	603801	603808	603804	607403	607405	607404	607407	607408	607401	607402	601001
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	105	8620	1380	30300	67000	< 59000 U	1810	51300	112	26600	974	19300	40600	4990	101000	14800
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cyanide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ammonia Nitrogen	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	280	2450	2840	1480	< 5 U
Total Nitrogen	2120	3730	3890	2580	4750	7270	2710	6980	2000	1480	13000	810	2590	2610	1100	15900
Orthophosphate	4	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	< 4 U	40
Total Phosphate	< 4 U	160	5	180	170	290	140	2970	< 4 U	< 4 U	5 U	110	4	400	120	100
Natrate	2510	3220	3950	2120	4410	7010	2350	5370	1880	1440	12100	< 4 U	< 4 U	< 4 U	< 4 U	14500
Nitrite	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	5	7	4	< 1 U
Dissolved Iron	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	181	15.6	< 10 U	< 10 U	< 10 U	1450	1890	1260	8850	13.1

Notes:
U means the constituent was not detected.
J means constituent detection below quantifiable detection limit.
E means constituent detection above quantifiable detection limit.
ND means constituent not detected.
NA means constituent was not analyzed for.

Soil gas concentrations indicative of relevant source areas should be expected to be within the ppm range. Substance-specific gas detector tubes are designed to operate in this range, thus allowing an instantaneous evaluation and delineation of source areas in a cost-effective manner. The P*RE*SIT^{SM} methodology uses gas detector tubes for *in situ* soil gas analyses at ambient pressures, and requires relatively small volumes of gas for analysis. This method, as applied at this facility, requires a borehole of 1 inch in diameter established with a grooved boring rod driven into the ground by means of a jackhammer. A probe containing a gas detector tube in the tip is inserted into the boring. Using a small, hand-operated bellows pump, a defined volume of gas from the bottom of the boring is drawn through the detector tube. The gas volume required is dependent on the type of tube used, and the indicating range desired; for thetubes used, the volume varied from 500 to 1,000 ml. The tube contains a reagent that changes color in the presence of a specific chemical. The length of the color band in the tube indicates the concentration of the chemical vapor. The instantaneous reading enables the field crew to adapt the investigation program in terms of locations and depths to the actual contamination pattern.

Accuracy of the measurement is a function of both incidental and systematic error. Where incidental error is a measurement of fluctuation when several measurements are taken of a precisely defined concentration, this incidental error is quantified and reported as standard deviation by the manufacturer. This standard deviation, which is actually a co-efficient of variation (i.e., relative standard deviation), is given as a percentage and relates to the mean value. In contrast, systematic error such as miscalibration, storage effects, equipment malfunctions, and "cross-sensitivity" cannot be calculated using statistical methods, but can be avoided. For some tubes, measurement beyond detection range can be taken by using more or fewer pump strokes, although, more precise readings can be expected at concentrations within the detection range. The Dräger detector tubes used for this survey, together with their respective range are presented in Table 4-10.

Different gas detector tubes show different degrees of cross-sensitivity. They not only indicate the substance they are designed and calibrated for, but also some other compounds of similar chemistry. For example, the benzene tube is sensitive to alkyl benzenes (toluene) and petroleum hydrocarbons; the methylene chloride tube to TCE, PCE, TCA, octane, and toluene; the PCE tube and the TCE tube to free halogens, hydrogen halides, and easily cleaved halogenated hydrocarbons; and the petroleum hydrocarbon tube to volatile petroleum hydrocarbons including n-octane, n-hexane, n-heptane, iso-octane, n-nonane, benzene, toluene, and xylene. Hence, the strength of the method is in the ability to determine the relative change in the readings as a site is traversed.

TABLE 4-10

Summary of Dräger Tubes Used During Survey

Title (Tube Type)	Detection Range
Benzene (5/b)	5-50 ppm
Methylene Chloride (100/a)	100-200 ppm
Perchloroethylene (2/a)	2-40/20-300 ppm
Trichloroethylene (2/a)	2-50/20-250 ppm
Trichloroethane (50/d)	50-600 ppm
Petroleum Hydrocarbon (100/a)	100-1,200 ppm

The highest readings indicate the potential source area as distinguished from other areas where readings are relatively low or non-detectable. Because the method is not intended to quantify the exact chemical composition of the soil gas, however, results are considered to be only semi-quantitative. The manufacturer gives a relative standard deviation of 10-15% for benzene tubes, 10-15% for methylene chloride tubes, 15-20% for PCE tubes, 10-15% for TCE tubes, and 10-15% for petroleum hydrocarbon tubes, if only a single substance is involved.

4.2.2 PRESIT™ Soil Gas Survey Results

A drawing showing the site, the location of each soil gas survey point, and the results of the soil gas measurements is presented as Figure 4-2. Table 4-11 lists the results of the measurements, soil characterization, total depth, water level, and any additional comments. Copies of the field data sheets prepared on-site during the investigation are presented in Appendix D.

4.3 HYDROGEOLOGIC INVESTIGATION

4.3.1 Permeability Samples

The permeability samples were collected from two of the borings, B-93-2 and B-93-3. The samples were intended to be collected using thin walled shelby tubes, but due to the sandy soil, success was minimal.

At B-93-2, shelby tubes were attempted at 25'-27', 27'-29' and 50'-52'. The three attempts had no soil recovery due to the lack of cohesiveness in the soils. At WP-4, next to B-93-2, a shelby tube sample was successfully collected from 13'-15'. The recovery was about 2/3 full, but the sampling tube stuck into the sampling head. The tube was cut off at the sampling head and sealed with end caps and wax. A shelby tube failed at 18'-20'. The sample was then collected from 20'-22' using a split spoon and plastic sleeve. A shelby tube sample was collected from 22'-24'. All tubes were capped, sealed with wax and stored upright.

The sampling efforts at B-93-3 were unsuccessful using the shelby tubes. Samples were collected using split spoons with liners from 22'-24' and 47'-49'. The samples were capped and sealed with wax, and stored in an upright position. Table 4-12 summarizes the vertical hydraulic conductivity analysis results. Due to poor recovery and the samples being collected with a

BH-6

D	30	
B	>50	
M	<100	
P	ND	
TCE	ND	
W	30	

BH-21

D	72	96 [1]
B	>50	>50
M	NA	NA
P		260
W	96 (120)	

BH-5

D	36
B	>50
M	NA
PCE	ND
W	36

BH-20

D	72	114	120 [1]
B	ND	8	15
M	NA	NA	TR
W	120 (144)		

BH-4

D	30
B	50
M	NA
W	34

BH-19

D	42	38 [1]
B	NA	TR
M	NA	NA
W	38 (50)	

BH-3

D	30
B	>50
M	NA
W	34

BH-2

D	24
B	>50
M	NA
W	24

BH-14

D	42
B	>50
M	>2,000
PCE	ND
W	NE

BH-15

D	42
B	>50 [2]
M	ND
W	NE

BH-11

D	25 [1]
B	15
M	ND
W	29

BH-16

D	42
B	>50 [2]
M	NA
W	NE

BH-17

D	42	44 [1]
B	TR	TR
M	NA	ND
W	48	(52)

BH-1

D	45	36
B	10	<5
M	NA	NA
W	36	

BH-13

D	41	44 [1]
B	ND	TR
M	NA	ND
PCE	ND	
W	44	(67)

BH-7

D	30
B	>50
M	TR
W	30

BH-22

D	24 [1]
B	30
M	NA
W	24

BH-23

D	72	144	213 [1]
B	ND	>50	NA
M	NA	NA	NA
P	1,200		
W	213		

BH-32

D	144	180 [1]
B	ND	>50
M	NA	NA
P	100	
W	180 (204)	

BH-34

D	216	288
B	ND	ND
M	NA	NA
W	NE	

BH-33

D	144	180 [1]
B	>50	>50
M	NA	NA
P	<100	
W	NE	

BH-24

D	72	144
B	>50	>50
M	NA	NA
P	TR	

BH-25

D	72	118
B	ND	ND
M	NA	NA
W	NE	

BH-26

D	72	144
B	ND	>50
M	NA	NA
P		200.
W	NE	

BH-31

D	144
B	>50
M	NA
W	NE

BH-30

D	144	216	264 [1]
B	ND	ND	10
M	NA	NA	NA
W	264		

BH-27

D	144	216
B	ND	>50
M	NA	NA
P		100

BH-28

D	72	96 [1]
B	ND	ND
M	NA	NA
W	96 (132)	

BH-29

D	144	216
B	ND	>50
M	NA	NA
W	NE	

BH-18

D	[illegible]
B	TR
M	NA
W	33 [illegible]

[illegible]

D	41	[illegible]
B	TR	TR
M	NA	ND
W	30 [illegible]	

[illegible]

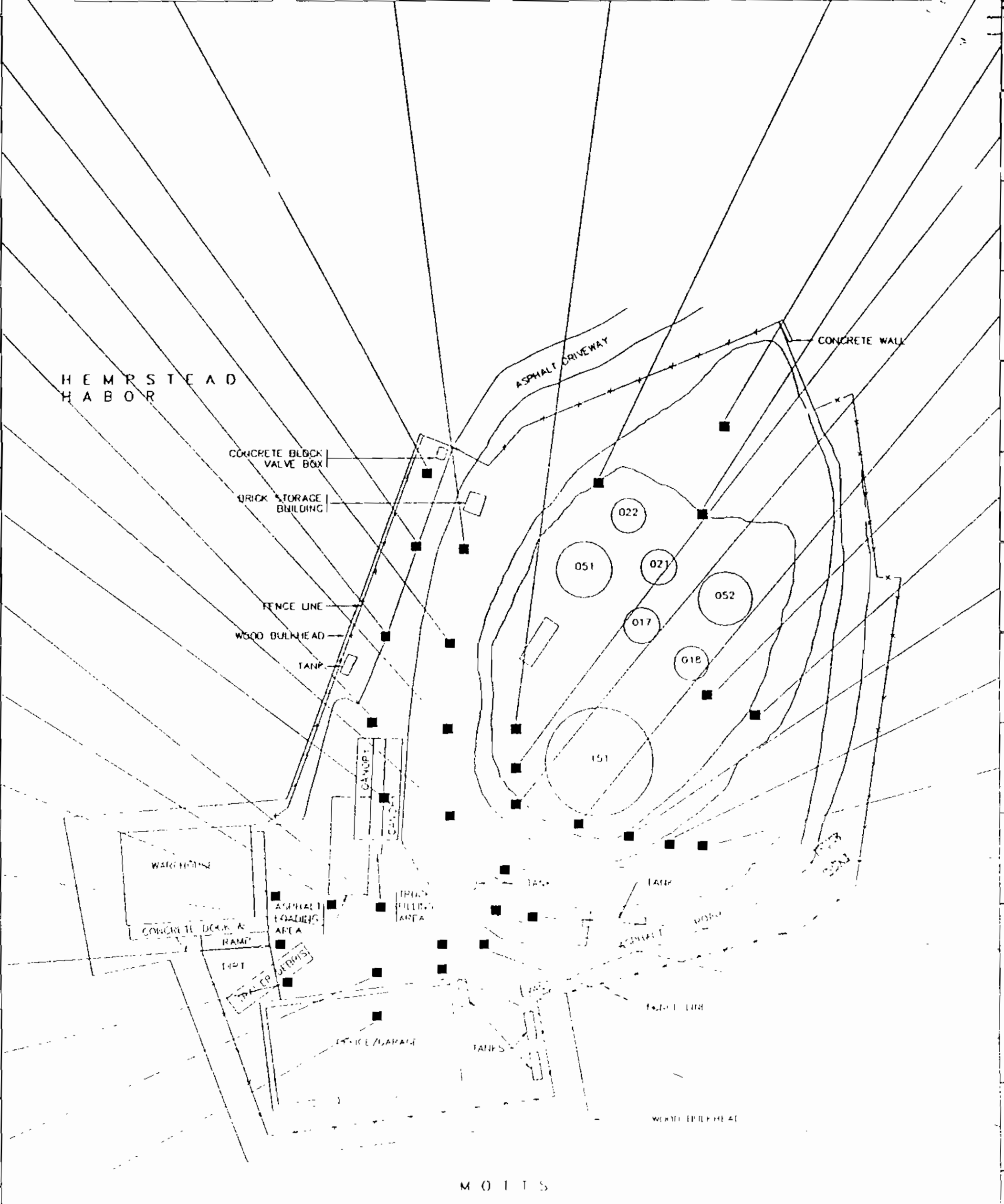
D	[illegible]
B	[illegible]
M	[illegible]
W	[illegible]

BH-10

D	[illegible]
B	5
M	ND
W	[illegible]

BH-12

D	[illegible]
B	[illegible]
M	[illegible]
W	[illegible]



D - SAMPLE DEPTH IN INCHES
B = BTEX (TUBE 5/b) IN ppm
M = METHYLENE CHLORIDE (TUBE 10/a) IN PPM
P = PETROLEUM HYDROCARBONS (TUBE [illegible]) IN PPM
W - WATER TABLE DEPTH IN INCHES [3]
NA - NOT ANALYZED
ND - NOT DETECTED
NE - NOT ENCOUNTERED
TR - TRACE AMOUNTS DETECTED

LEGEND

- · -	FENCE
	ROADS
■	SOIL GAS SAMPLE LOCATION

NOTES:

[1] Water table punctured prior to Drager analysis

[2] Half the required number of pumps for the Drager tube were used

[3] Water Table Value indicates the depth to which the water level rose within the [illegible] The number in parenthesis indicate the depth where water was first encountered. When only one number is presented [illegible] difference was [illegible]

Soil Gas Concentrations Data

TABLE 4-11

Summary *PRE*SIT^{SM} Soil Gas Survey Results

I.D.	Depth	Benzene 5/b Range 5 to 50 ppm	Methylene Chloride 100/a Range 100 to 200 ppm	Soil Characterization	Total Depth	Water Level	Comments
MARCH 1, 1993							
BH-1	45" 36"*	10 ppm <5 ppm		0-6" concrete 6"-74" dark sand and gravel 44"-72" tan sand, some dark spots	72"	36"*	Moved hole twice
BH-2	24"*	>50 ppm		0-8" asphalt 8"-24" brown sand 24"-44" brown sand to tan sand to grey sand 44'-72" grey sand	72"	24"*	44"-77" heavy odor
BH-3	30"*	>50 ppm		0-2" organics (weeds) 2"-30" reddish brown sand per gravel 30"-42" dark grey sand	42"	34"*	30"-42" heavy odor
BH-4	30"*	50 ppm		0-2" organics (weeds) 2"-29" dark brown sand 20"-39" dark brown sand and light tan sand 39"-44" light tan sand	44"	34"*	
BH-5	36"*	>50 ppm		0-2" organics 2"-38" dark brown sand and gravel 38"-44" charcoal color sand	44"	36"*	tried perchloroethylene - ND
BH-6	30"*	>50 ppm	<100 ppm	0-2" organics 2"-15" brown sand and gravel 15'-44" black sand and some gravel	44"	30"*	tried perchloroethylene - ND, trichloroethane - ND, 15"-44" heavy odor
BH-7	30"*	>50 ppm	TR	0-2" organics 2"-27" brown sand and gravel 15"-44" dark discolored sand and gravel	42"	30"*	27" - 42" oil sheen, heavy odor
BH-8	22"*	>50 ppm	<100 ppm	0-4" asphalt 4"-18" dark brown to black sand and gravel 18"-42" dark grey brown sand	42"	22"*	18"-42" faint odor

TABLE 4-11 (continued)

Summary *PRE*SIT^{SM} Soil Gas Survey Results

I.D.	Depth	Benzene 5/b Range 5 to 50 ppm	Methylene Chloride 100/a Range 100 to 200 ppm	Soil Characterization	Total Depth	Water Level	Comments
BH-9	45" 30"*	TR TR	ND	0-6" asphalt 6"-20" light brown to black sand and gravel 20"-33" dark brown sand 33"-44" grey sand 44"-45" grey brown sand	67"	30"*	move hole due to concrete; water table 60"
BH-10	20"*	9 ppm	ND	0-4" asphalt 4"-24" dark brown to black sand and gravel 24"-42" dark charcoal sand	42"	20"*	water table 32"
BH-11	25"*	15 ppm	ND	0-4" asphalt 4"-21" black sand and gravel 21"-36" dark sand and gravel 36"-43" dark sand	43"	29"*	
BH-12	35"*	<5 ppm	TR	0-4" asphalt 4"-24" tan sand 24"-38" dark brown sand 38"-43" grey sand	43"	35"*	
MARCH 2, 1993							
BH-13	41" 44"*	ND TR	ND	0-6" concrete 6"-19" dark sand and gravel 19"-30" brown sand 30"-39" black sand 39"-58" brown sand 38"-67" grey sand	67"	44"*	perchloroethylene - ND water table 67"
BH-14	42"	>50 ppm	>2.000 ppm	0-10" asphalt 10"-18" dark sand and gravel 18"-29" dark sand 29"-42" tan sand	42"		perchloroethylene - ND heavy odor 18-29"
BH-15	42"	>50 ppm	>2,000 ppm	0-4' asphalt 4"-17" brown sand 17"-36" grey brown sand mix 36"-42" light tan sand	42"		Dräger tubes ½ number of pumps 17"-36" heavy odor

TABLE 4-11 (continued)

Summary *PreSIT*℠ Soil Gas Survey Results

I.D.	Depth	Benzene 5/b Range 5 to 50 ppm	Methylene Chloride 100/a Range 100 to 200 ppm	Soil Characterization	Total Depth	Water Level	Comments
BH-16	42"	>50 ppm		0-6" asphalt 6"-42" dark brown and grey sand	42"		**Dräger tubes** ½ number of pumps 6"-42" heavy odor
BH-17	42" 44"*	TR TR	ND	0-10" asphalt 10"-19" sand and gravel fill 19"-36" brown sand and gravel 36"-53" brown sand 53"-67"grey sand	67"	48"*	water table 52"
BH-18	33"*	TR		0-2" organic weeds 2"-42" brown sand	42"	33"*	water table 35"
BH-19	42" 38"*	ND TR		0-2" organic weeds 2"-67" brown sand	67"	38"*	water table 50"
BH-20	72" 114" 120"*	ND 8 ppm 15 ppm	TR TR	0-144" tan sand 144"-168" grey sand	168"	120"*	water table 144"
BH-21	72" 96"*	>50 ppm >50 ppm		0-120" brown sand 120"-144" grey sand	144"	96"*	water table 120" petroleum hydrocarbon 260 ppm
BH-22	24"*	30 ppm		0-2" organic weeds 2"-41" dark sand	41"	24"*	
MARCH 3, 1993							
BH-23	72" 144"	ND >50 ppm		0-6" dark organic sand 6"-36" sand and gravel 36"-72" sand 72"-140" sand 140"-240" grey sand	216"	*213"	petroleum hydrocarbon 213" 1,200 ppm heavy odor 140"-213" water table 213"

TABLE 4-11 (continued)

Summary *Pre*SIT℠ Soil Gas Survey Results

I.D.	Depth	Benzene 5/b Range 5 to 50 ppm	Methylene Chloride 100/a Range 100 to 200 ppm	Soil Characterization	Total Depth	Water Level	Comments
BH-24	72" 144"	>50 ppm >50 ppm		0-6" dark organic sand 6"-60" orange and grey sand mix 60"-109" grey sand 109"-139" light to organic sand 139"-144" tanish brown sand	144"		petroleum hydrocarbon TR
BH-25	72" 118"	ND ND		0-68" sand and gravel 68"-72" white sand 72"-118" sand gravel 118"-120" concrete refusal	120"		118" - 120" refusal moved hole twice
BH-26	72" 144"	ND >50 ppm		0-6" black sand 6"-72" brown sand 72"-144" brown sand	144"		benzene at 144", black petroleum hydrocarbon 200 ppm heavy odor 6"-144"
BH-27	144" 216"	ND >50 ppm		0-6" organic and dark sand 6"-180" brown sand 180"-216" dark brown to black sand	216"		heavy odor 180"-216" petroleum hydrocarbon 100 ppm
BH-28	72" 96"*	ND ND		0-3" organic sand 3"-67" brown sand 67"-72" dark brown sand 72"-138" dark brown sand 138"-144" dark brown sand	144"	96"*	water table 132"
BH-29	144" 216"	ND >50 ppm		0-3" organic 3"-180" brown sand 180"-216" black sand	216"		189"-216" heavy odor
BH-30	144" 216" 264"*	ND ND 10 ppm		0-3" organic sand 3"-82" brown sand 72"-180" dark brown sand 180"-216" black sand 216"-288" grey sand	288"	264"*	water table 264"

TABLE 4-11 (continued)

Summary *Pre*SIT^{SM} Soil Gas Survey Results

I.D.	Depth	Benzene 5/b Range 5 to 50 ppm	Methylene Chloride 100/a Range 100 to 200 ppm	Soil Characterization	Total Depth	Water Level	Comments
MARCH 4, 1993							
BH-31	144"	>50 ppm		0-3" organic 3"-120" brown sand 120"-144" tan sand	144"		120"-144" heavy odor
BH-32	144" 180"	ND >5 ppm		0-6" organic sand 6"-120" brown sand 120"-144" grey sand 144"-216" whte sand	216"	180"*	water table 204" petroleum hydrocarbon - 144"-100 ppm
BH-33	144"	>50 ppm		0-6" organics and sand 6"-77" brown sand 72"-109" tan sand 109"-120" red sand 120"-144" tan sand	144"		petroleum hydrocarbon <100 ppm
BH-34	216" 288"	ND ND		0-6" organics and sand 6'-288" brown sand	288"		

TR = Trace
ND = Not Detected
* = After punching through water table.

Table 4–12

Summary of Vertical Hydraulic Conductivity Analysis

Shore Realty Superfund Site

Glenwood Landing, NY

Sample Number	Depth	Wet unit Weight (pcf)	Dry Unit Weight (pcf)	Water Content (%)	Confining Stress (psi)	Effective Confining Stress (psi)	Permeability (cm/sec)	Notes
WP–4	13–15	98.4	94.3	4.3	1.1	NA	2.3×10^{-2}	Not Remolded
WP–4	20–22	112.3	97.3	15.4	1.3	NA	9.2×10^{-4}	Remolded
B–93–3J	22–24	134.8	113.2	19.1	1.2	NA	6.2×10^{-4}	Remolded
B–93–3K	47–49	131.3	112.6	16.6	1.2	NA	3.8×10^{-5}	Remolded
B–93–2J	24–26	128.1	109.2	17.3	75	4.7	2.0×10^{-6}	Not Remolded

Notes:

Samples that were remolded could not be retrieved with shelby tubes due to sandy soil and had to be retrieved by driving a split spoon with a plastic sleeve inside it.

NA – Data not analyzed for or not applicable

pcf – pounds per cubic foot

psf – pounds per square foot

driven split spoon instead of a shelby tube, the samples had to be remolded in order to have a sufficient for the analysis.

4.3.2 Determination of Hydraulic Conductivity Based on Cyclic Water Level Fluctuations

The tidal fluctuation technique of Ferris (1963) was used to determine the transmissivity and the horizontal hydraulic conductivity at the site. A hydraulic profile was developed for Level B and Level C perpendicular to the edge of Hempstead Harbor. The profile consisted of three driven wellpoint clusters: WP-1, WP-2, and WP-3, installed at distances of 17, 35, and 50 feet from the harbor (see Figure 4-1). Each cluster consisted of two wellpoints, a shallow one screened in Level B and a deep one screened in Level C. Two data loggers and nine pressure transducers were used to record water level fluctuations over a seven-day period. However, one of the data loggers experienced mechanical problems during the first day of the study, so two of the well points have an additional day of data. In addition to monitoring water level fluctuations in the aquifer, tidal fluctuations of the Hempstead Harbor were also measured using the same data logger and pressure transducer system. The tidal fluctuations at the harbor, and the water level response to these fluctuations at the wellpoints, were monitored simultaneously and continuously for a period of seven days. In order to maximize the tidal fluctuations, the monitoring period was chosen to include three days before and three days after a full moon. The system was also set up before a storm which caused local flooding, and was operated from March 4 to March 11, with water levels monitored every 10 minutes.

According to Ferris (1963), in an aquifer bounded by a body of tidal water, the water level in the aquifer will respond to the tidal fluctuations. This is known to be the case at the Site, based on the tidal fluctuation data shown in Figures 4-3, 4-4, and 4-5. When the tides fluctuate as a simple harmonic motion, a train of sinusoidal waves is propagated through the aquifer. Because the amplitude of each transmitted wave decreases as the distance from the boundary (tide source) increases and the time lag of a given maximum or minimum increases as the distance from the boundary increases, the transmissivity of the aquifer can be found by either the stage-ratio method or the time-lag method (Ferris, 1963). Both methods were employed to determine the transmissivity at the Site.

4.3.2.1 Stage-Ratio Method

The stage-ratio method can be summarized as follows. The ratio of the groundwater fluctuation to the tidal fluctuation is computed for the rising and falling limb of each cycle, and the averages of the ratios for rising and falling limbs are calculated for each wellpoint. The average length of the period of the tidal fluctuation is computed and the averages of the ratios for rising and falling limbs are plotted on semi-logarithmic graph paper against the distances of the observation wells from the edge of the tide source (Hempstead Harbor). The transmissivity is calculated from the following equation:

$$T = \frac{4.4\,(\Delta x)^2\,S}{t_o} \qquad \textit{where;}$$

T = *Transmissivity,*

Δx = *Distance From Edge of Surface Water Body,*

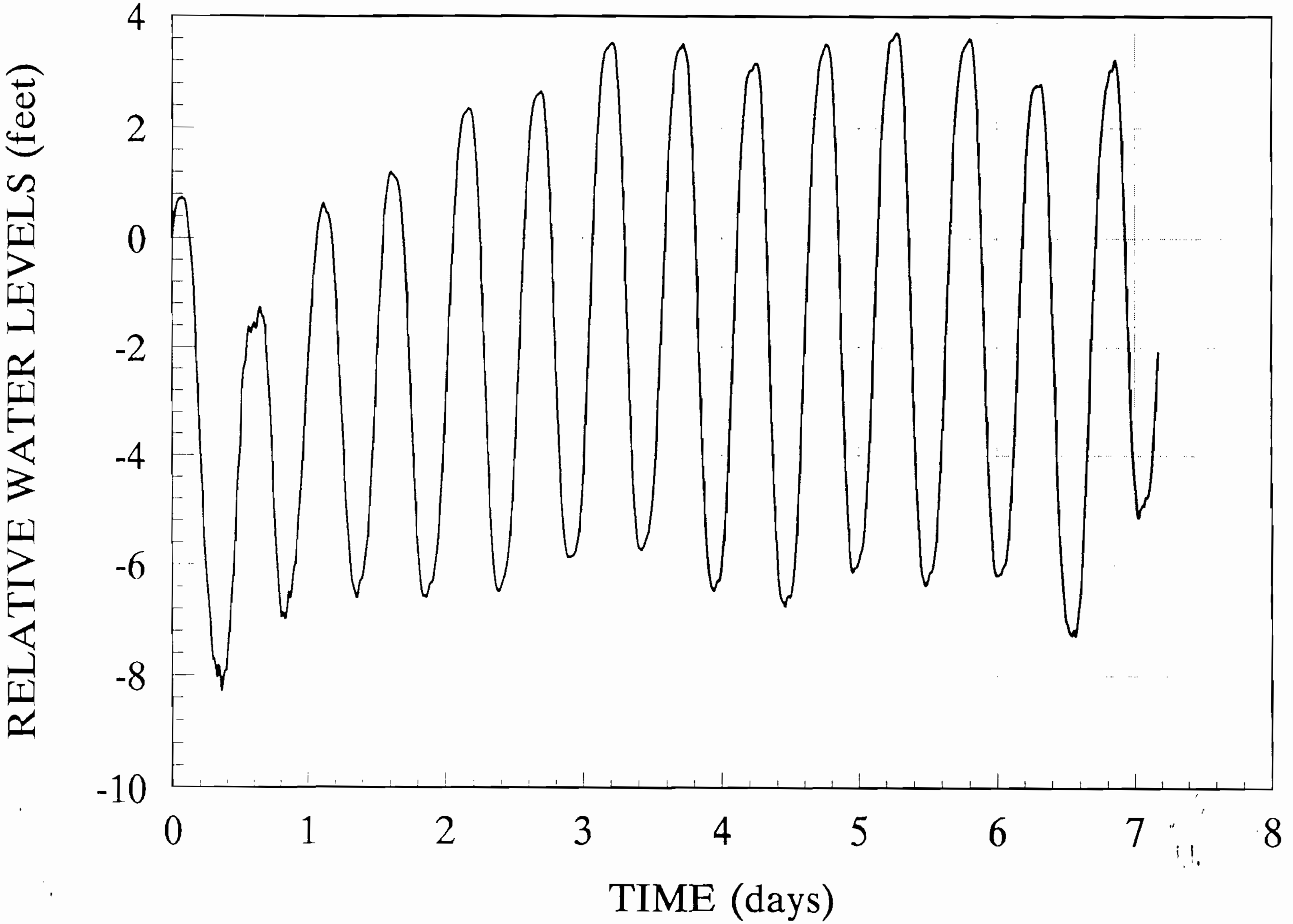
S = *Storativity, and*

t_o = *Periodicity of Tidal Fluctuation*

Figures 4-3, 4-4, and 4-5 depict normalized plots of water levels for Hempstead Harbor,the shallow wellpoints, and the deep wellpoints. The shallow wellpoints were screened in Level B, and the deep wellpoints were screened in Level C. Using the water level data of Figures 4-3, 4-4, and 4-5, the ratio of groundwater fluctuation to Hempstead Harbor stage fluctuation was computed for the rising and falling limb of each cycle. These ratios are listed in Table 4-13. The length of the period of the Hempstead Harbor fluctuation averaged 0.51 days. The averages of the ratios for rising and falling stages were calculated and are included in Table 4-14. Figures 4-6 and 4-7 plot these average ratios against the distances of the observation wells from Hempstead Harbor's edge.

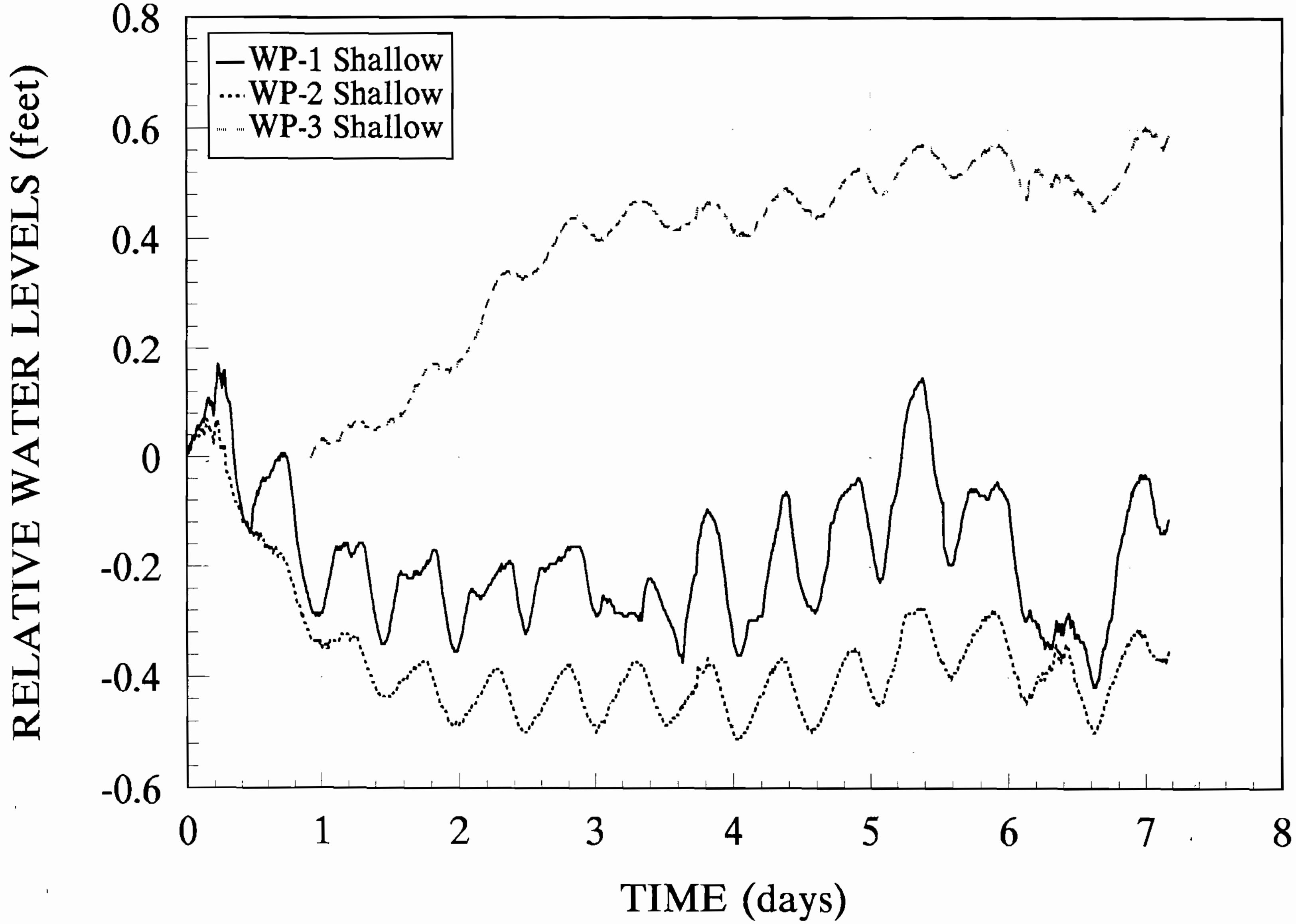
As shown on these figures, for one log cycle, $\Delta x = 59$ feet in case of the shallow wellpoints, and $\Delta x = 101$ feet in case of the deep wellpoints. The U.S. Geological Survey determined the storativity of the Upper Glacial Aquifer in the vicinity of Glenwood Landing to be 0.10 (Getzen, 1977). Thus, the transmissivity is 400 ft^2/day (3,000 gpd/ft) for Level B, and 1,175 ft^2/day (8,800 gpd/ft) for Level C. If the saturated thickness of Level C is 22 feet (Roux, 1991a), and the saturated thickness of Level B is 7 feet in the vicinity of WP-1, WP-2, and WP-3, then the horizontal hydraulic conductivities of Level B and Level C are 57 ft/day (426 gpd/ft^2) and 53.5 ft/day (400 gpd/ft^2), respectively. Well logs (soil boring B-93-1) show that Level B

RETEC



Cyclic Water Level Fluctuations - Ocean

FIGURE 4-3



Cyclic Water Level Fluctuations - Shallow Observation Wells

FIGURE 4-4

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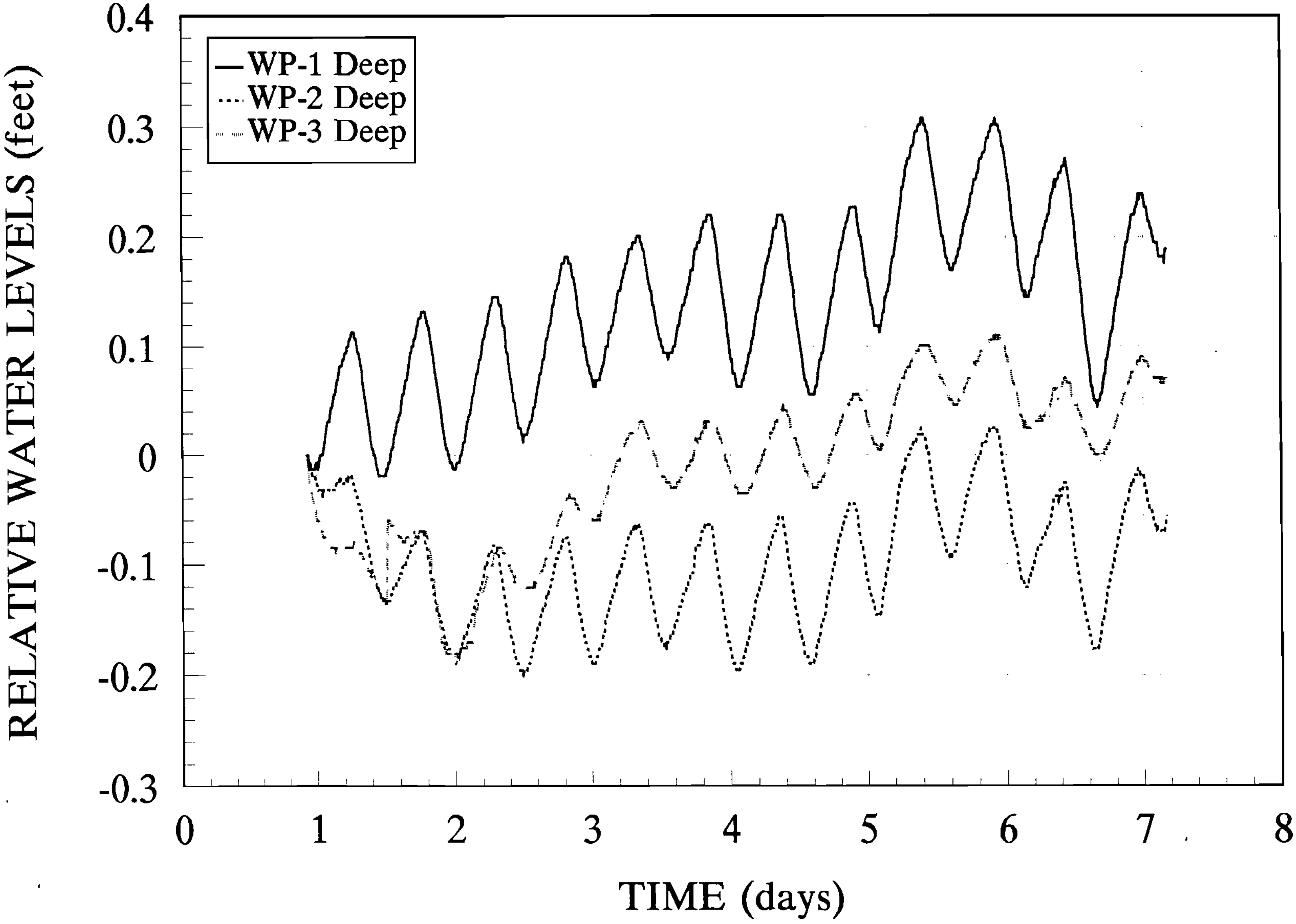

Cyclic Water Level Fluctuations - Deep Observation Wells

FIGURE 4-5

Table 4−13
Ratio of the range in water level fluctuation in observation wells WP−1, WP−2, and WP−3 to the corresponding range in stage of the Hempstead Harbor

Segment of curves of cyclic fluctuations	Shallow Observation Wells			Deep Observation Wells		
	WP−1	WP−2	WP−3	WP−1	WP−2	WP−3
Rising Stage 1−2	−−−	−−−	−−−	0.0164	−−−	−−−
Falling Stage 2−3	−−−	−−−	0.0018	0.0181	−−−	0.0080
Rising Stage 3−4	−−−	−−−	0.0149	0.0190	0.0087	0.0099
Falling Stage 4−5	−−−	0.0149	0.0017	0.0182	0.0153	0.0153
Rising Stage 5−6	−−−	0.0114	0.0207	0.0171	0.0121	0.0114
Falling Stage 6−7	−−−	0.0130	0.0014	0.0145	0.0138	0.0043
Rising Stage 7−8	−−−	0.0134	0.0120	0.0183	0.0141	0.0095
Falling Stage 8−9	−−−	0.0136	0.0045	0.0140	0.0136	0.0030
Rising Stage 9−10	−−−	0.0144	0.0075	0.0147	0.0137	0.0096
Falling Stage 10−11	−−−	0.0125	0.0063	0.0122	0.0125	0.0066
Rising Stage 11−12	0.0299	0.0132	0.0056	0.0142	0.0125	0.0069
Falling Stage 12−13	0.0269	0.0154	0.0064	0.0154	0.0135	0.0067
Rising Stage 13−14	0.0313	0.0153	0.0093	0.0163	0.0147	0.0083
Falling Stage 14−15	0.0232	0.0135	0.0058	0.0165	0.0135	0.0074
Rising Stage 15−16	0.0238	0.0150	0.0088	0.0169	0.0144	0.0081
Falling Stage 16−17	0.0200	0.0113	0.0060	0.0120	0.0109	0.0050
Rising Stage 17−18	0.0377	0.0182	0.0097	0.0201	0.0175	0.0097
Falling Stage 18−19	0.0344	0.0134	0.0057	0.0143	0.0121	0.0057
Rising Stage 19−20	−−−	0.0129	0.0058	0.0142	0.0123	0.0065
Falling Stage 20−21	−−−	−−−	0.0105	0.0167	0.0147	0.0088
Rising Stage 21−22	−−−	−−−	0.0079	0.0143	0.0104	0.0050
Falling Stage 22−23	−−−	−−−	0.0064	0.0231	0.0154	0.0077
Rising Stage 23−24	−−−	−−−	0.0147	0.0190	0.0160	0.0092
Falling Stage 24−25	−−−	−−−	0.0046	−−−	−−−	−−−
Average Ratio	0.0284	0.0138	0.0077	0.0163	0.0134	0.0079

Table 4-14

Time lag, in hours, between the minimum and maximum stages of the Hampstead Harbor and the corresponding minimum and maximum water levels in observation wells WP-1, WP-2, and WP-3

Shore Realty Superfund Site
Glenwood Landing, New York

Segment of curves of cyclic fluctuations		Shallow Observation Wells			Deep Observation Wells		
		WP-1	WP-2	WP-3	WP-1	WP-2	WP-3
Minimum	1	---	---	---	---	---	---
Maximum	2	---	---	---	3.17	3.17	---
Minimum	3	1.38	2.06	---	2.17	4.00	3.33
Maximum	4	---	3.43	---	3.67	3.83	---
Minimum	5	2.06	2.06	---	2.83	3.17	2.83
Maximum	6	---	2.06	---	2.67	3.17	4.17
Minimum	7	2.06	2.06	---	2.67	2.50	4.33
Maximum	8	---	2.74	4.11	2.83	3.17	3.50
Minimum	9	---	2.74	4.11	2.67	2.83	3.17
Maximum	10	---	2.06	3.43	2.83	3.00	3.83
Minimum	11	---	2.05	4.11	3.17	2.67	4.50
Maximum	12	2.06	2.06	3.43	2.83	3.33	4.17
Minimum	13	2.06	2.06	4.11	2.67	3.00	4.67
Maximum	14	2.06	2.06	3.43	2.17	2.83	3.00
Minimum	15	2.06	2.06	4.12	2.67	3.33	4.17
Maximum	16	3.43	3.43	4.11	2.67	3.33	4.17
Minimum	17	2.74	2.74	3.43	3.33	3.33	3.33
Maximum	18	2.06	2.06	4.12	2.67	2.50	4.00
Minimum	19	2.05	2.05	4.11	2.67	2.83	4.00
Maximum	20	---	2.06	---	3.00	3.17	3.67
Minimum	21	---	3.43	---	3.00	3.50	4.67
Maximum	22	---	2.05	---	2.67	2.83	2.83
Minimum	23	---	2.06	---	2.17	2.17	2.67
Maximum	24	---	2.74	---	2.67	2.83	3.50
Average Time Lag		2.18	2.37	3.89	2.78	3.07	3.74

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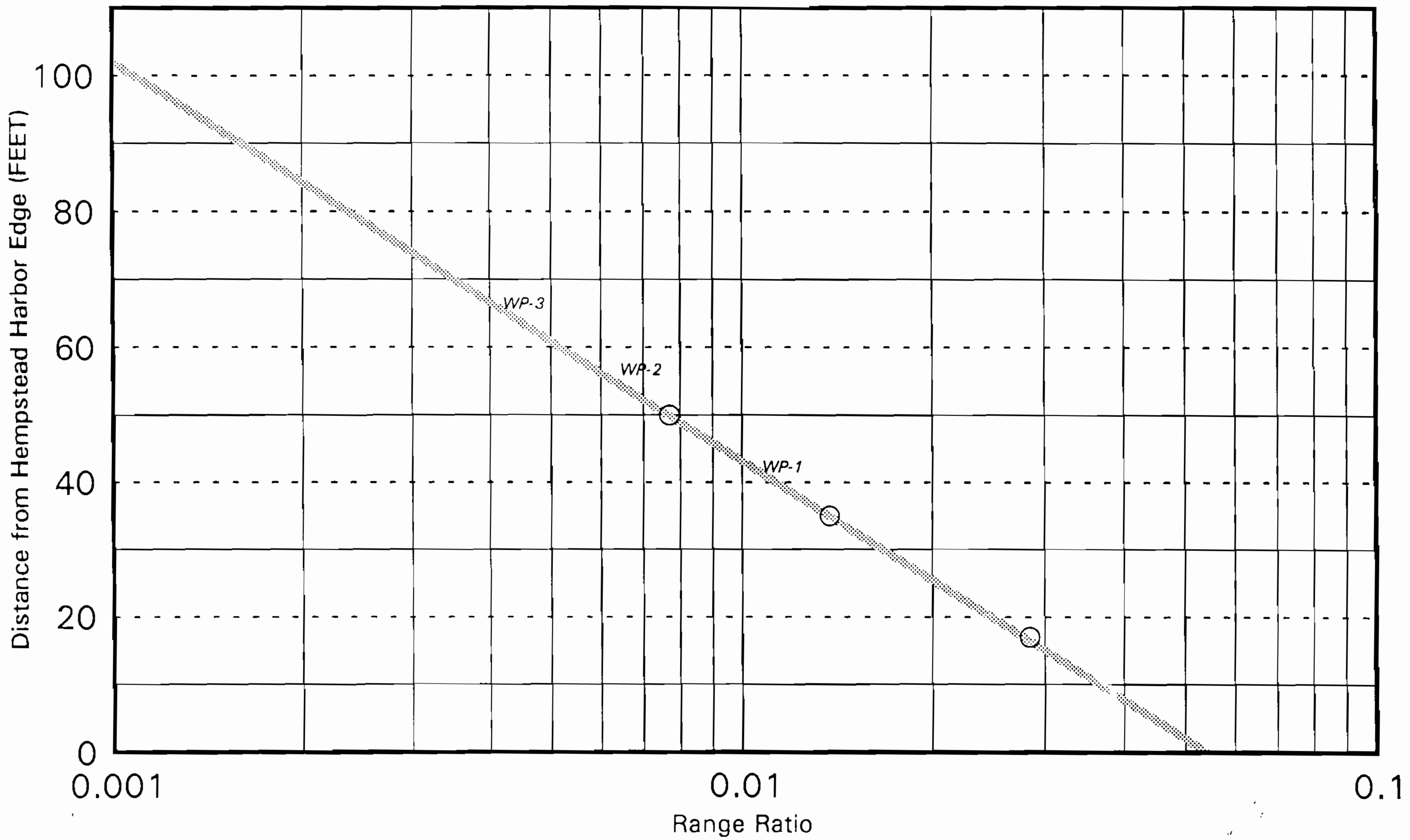


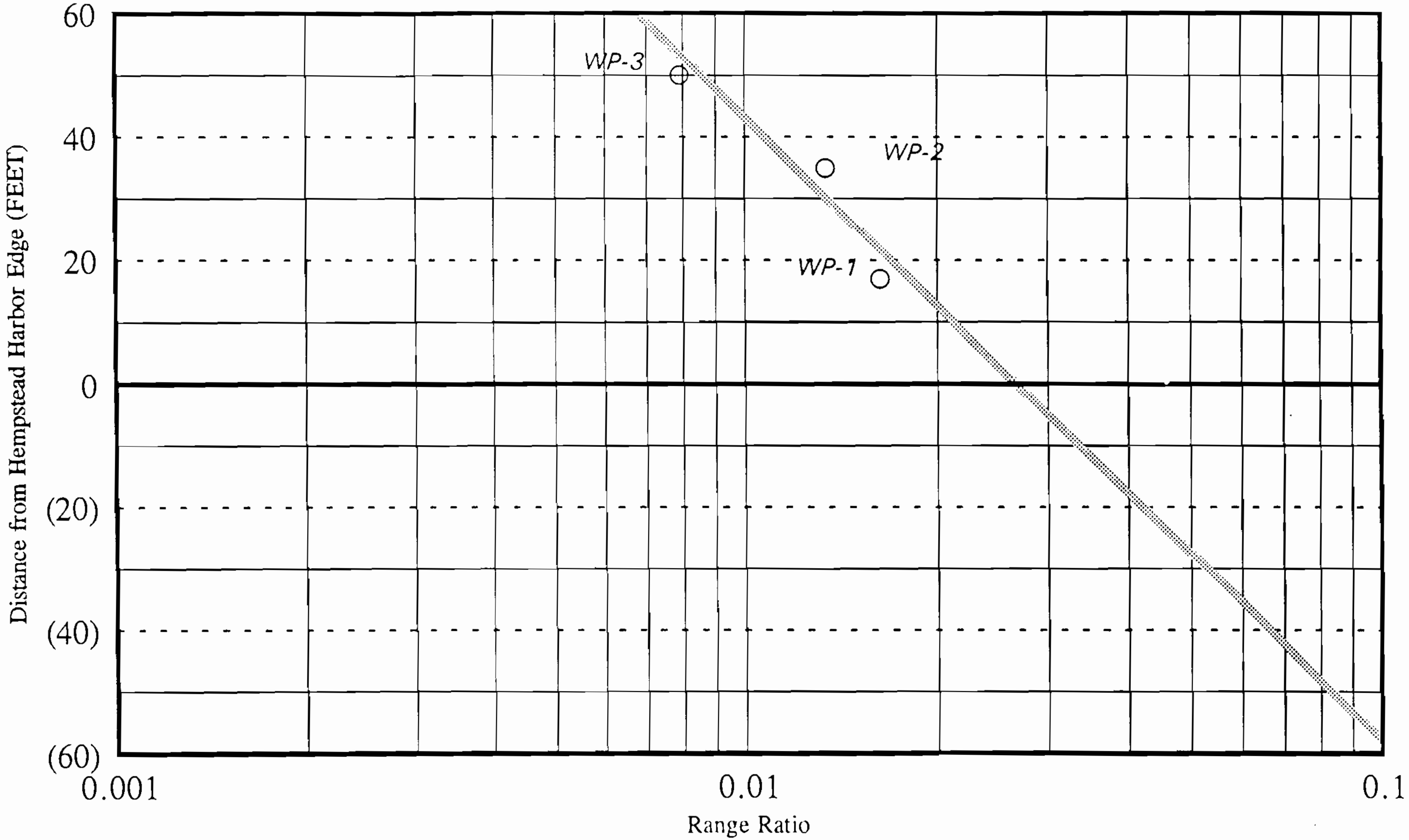
NOTE: AVERAGE RATIO OF RISING AND FALLING STAGES OF HEMPSTEAD HARBOR PLOTTED AGAINST THE DISTANCE OF THE SHALLOW OBSERVATION WELLS FROM THE HARBOR EDGE

PD-R/FIG4-6.DRW

Stage Ratio - Shallow Observation Wells

FIGURE
4-6

RETEC



NOTE: AVERAGE RATIO OF RISING AND FALLING STAGES OF HEMPSTEAD HARBOR PLOTTED AGAINST THE DISTANCE OF THE DEEP OBSERVATION WELLS FROM THE HARBOR EDGE

Stage Ratio - Deep Observation Wells

FIGURE
4-7

and Level C are composed of medium and fine sand, silt and clay in the vicinity of WP-1, WP-2, and WP-3. McClymonds and Franke (1972) reported that the horizontal hydraulic conductivity of the Upper Glacial Aquifer when composed of medium, fine, and very fine sand, and sand with silt or clay layers, ranges from 400 gpd/ft^2 (53.5 ft/day) to 1,800 gpd/ft^2 (240 ft/day). Therefore, the determined horizontal hydraulic conductivities compare very well with the lower end of the range obtained by McClymonds and Franke (1972).

4.3.2.2 Time-Lag Method

The same data collected for the stage-ratio analysis can also be analyzed using the time-lag method, however, Ferris (1963) implies, that this methodology is less reliable than the stage-ratio method and gives a number of explanations including differences in the effective screen resistance of the observation wells could tend to distort observations of the timing of maximum and minimum water levels. This rationale could explain the large range in the measured lag of maxima and minima listed in Table 4-14.

In the time-lag method, the time lag is determined between the minimum and maximum of the tidal fluctuations and the corresponding minimum and maximum fluctuations in the wellpoints. The averages were calculated for the time lag of the minima and maxima for each wellpoint, and then plotted against the distances of the observation wells from the edge of Hempstead Harbor. The slope of the line through these plotted values (x/t) is determined. The transmissivity was calculated as follows:

$$T = \frac{0.60\, x^2\, S\, t_o}{t^2} \qquad \textit{where;}$$

T = *Transmissivity,*

$\frac{x}{t}$ = *Slope of the Distance – Time Lag Plot,*

S = *Storativity,*

t_o = *Periodicity of Tidal Fluctuation*

The average values of the time lag, t, are plotted against the distance of the wellpoints from the harbor's edge, x, in Figures 4-8 and 4-9. The slope of the line passing through the plotted values is x/t , where: x = 13 feet, t = 1 hour for the shallow wellpoints, and x = 17 feet, t = 0.6 hours for the deep wells. Substituting these values into the above equation with

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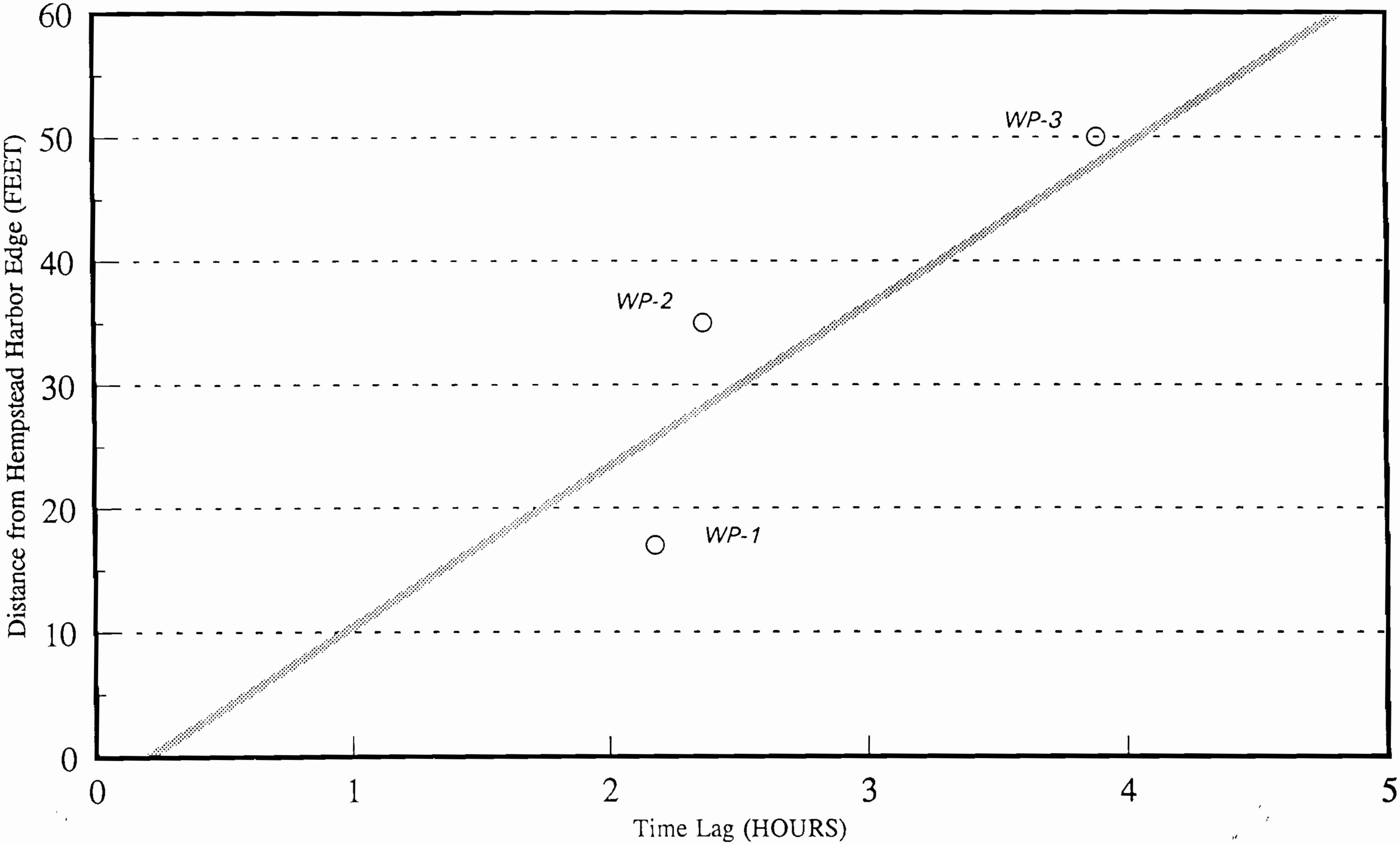


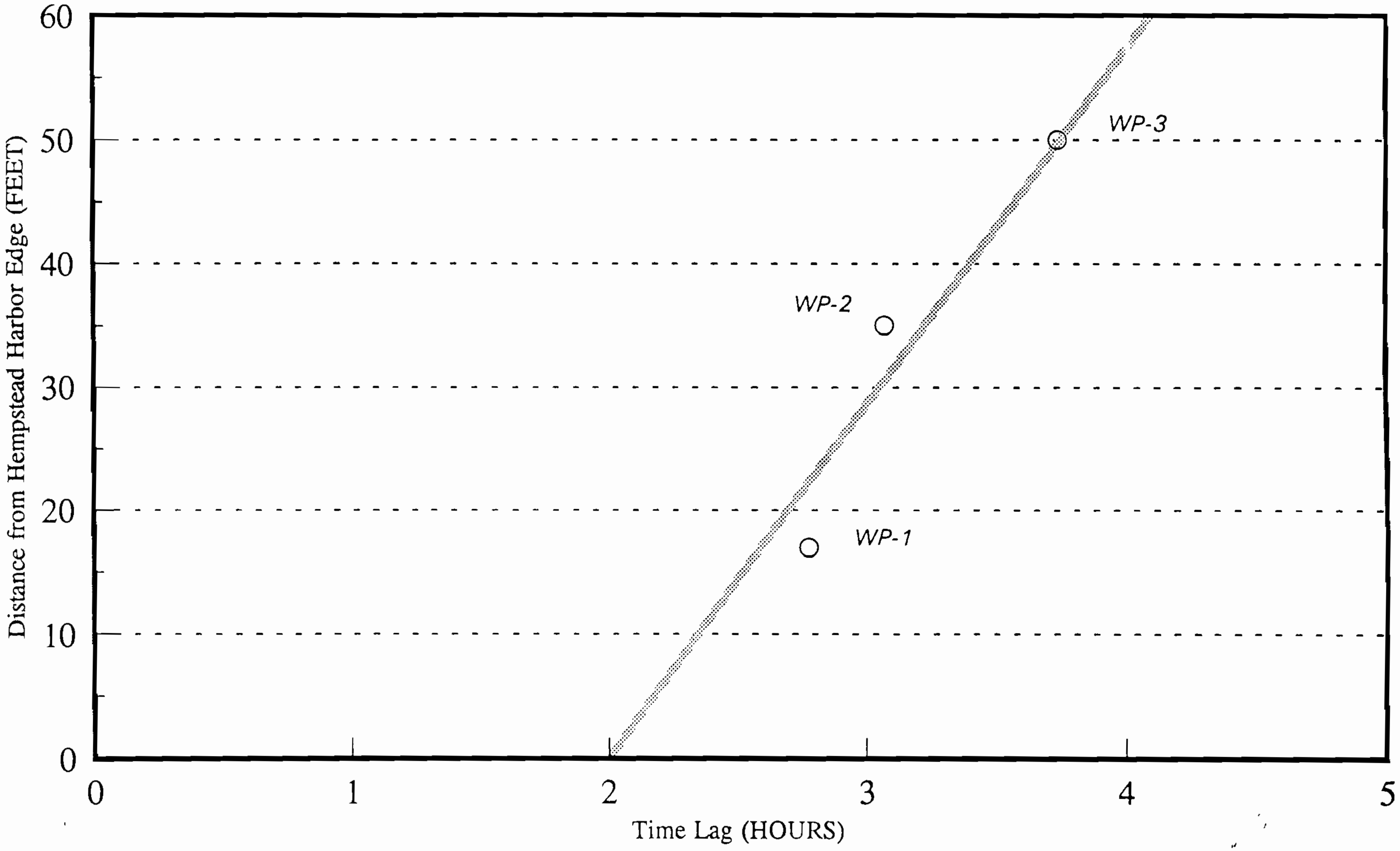
NOTE: TIME LAG BETWEEN MAXIMUM AND MINIMUM STAGES OF THE HEMPSTEAD HARBOR AND CORRESPONDING WATER LEVELS IN THE SHALLOW OBSERVATION WELLS PLOTTED AGAINST THE DISTANCE OF THE WELL FROM THE HARBOR EDGE

PDIR/PIO4-8.DRW

Time Lag - Shallow Observations Wells

FIGURE
4-8

RETEC



NOTE: TIME LAG BETWEEN MAXIMUM AND MINIMUM STAGES OF THE HEMPSTEAD HARBOR AND CORRESPONDING WATER LEVELS IN THE DEEP OBSERVATION WELLS PLOTTED AGAINST THE DISTANCE OF THE WELL FROM THE HARBOR EDGE

PDIR/FIO4-9.DRW

Time Lag - Deep Observation Wells

FIGURE
4-9

t_o = 0.51 days, and S = 0.10 (Getzen, 1977), gave a transmissivity of 400 ft^2/day (3,000 gpd/ft) for Level B, and 1,900 ft^2/day (14,150 gpd/ft) for Level C. Although the transmissivity value determined for Level B is the same as that obtained by the stage ratio method, the time-lag method is not considered as reliable as the stage-ratio method, as indicated above. Therefore, the transmissivity and horizontal hydraulic conductivity of Level B and Level C are considered to be those determined by the stage-ratio method.

4.3.3 Summary

The horizontal hydraulic conductivity as determined by the stage-ratio method is approximately 2 X 10^{-2} cm/sec. The values for vertical hydraulic conductivity for the samples collected from the shelby tube were 2.3 X 10^{-2} and 2.0 X 10^{-6} cm/sec. Remolded samples of sand and silty sand typically decrease in hydraulic conductivity due to the compaction that takes place as the soil is put into a plastic sleeve. It is also typical for the driving action of the split spoon to compress a soil sample. For this reason, the 2.0 X 10^{-6} cm/sec result seems unrepresentative of the site based upon the known background data for these formations on Long Island and the results of the time-lag stage-ratio test. Neglecting this sample, the laboratory hydraulic conductivity analyses support the results of the stage-ratio method.

5.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination at the Site was identified and described during the RI/FS and refined during the PDI. The stratigraphy of the Site is divided into four levels related to the water table. Level A is greater than five feet above the water table. Level B is five feet above the water table to three feet below the water table. Level C is three to fifteen feet below the water table, and Level D is greater than fifteen feet below the water table.

5.1 RESULTS OF SOILS INVESTIGATIONS

The analytical results from the RI were divided into six groups: CVOCs, non-chlorinated volatile organics (primarily ethylbenzene, toluene and xylenes), PAHs, phthalates, phenols, and total metals. Three of these six groups - PAHs, phthalates, and phenols - are subsets of the semivolatile organic compounds (SVOCs). Table 5-1 presents a summary of the various compounds identified in Zone A soils during the RI & PDI. Table 5-2 presents a summary of the various compounds identified in Zone B soils during the RI & PDI. Figure 5-1 is a summary of the results from the RI and PDI. The concentrations shown are for CVOCs, BTEX, and SVOCs.

5.1.1 Vadose Zone (Level A) Soils

Only a portion of the site has vadose zone soils: the tank farm, berms, and the northeastern portion of the access road adjacent to the Marina. The soils in this zone are moderately impacted. Two of the three samples collected from this zone during the RI were impacted by non-chlorinated volatile organics constituents ranging from 0.077 to 274.9 ppm. CVOCs detected during the RI and PDI include:

- methylene chloride;
- 1,1-dichloroethylene;
- 1,1-dichloroethane;
- 1,2-dichloroethylene;
- chloroform;
- vinyl chloride;
- 1,1,1-trichloroethane;
- 1,1,2-trichloroethane;

Table 5-1
Summary Of Compounds Identified in Zone A Soil Samples During the RI and PDI (mg/kg)
Shore Realty Superfund Site
Glenwood Landing, New York

CHEMICAL NAME	Zone A Soil				
	No. of Detects	No. of Samples	Range of Levels	Geometric UCL	UCL
Volatile Organic Compounds					
Vinyl Chloride	0	29	ND	ND	ND
Methylene Chloride	2	29	0.006 - 0.37	10	5
Acetone	1	29	1	10	9
1,1-Dichloroethane	1	29	0.064	9	5
trans-1,2-Dichloroethylene	1	26	0.1	10	5
1,1,1-Trichloroethane	3	29	0.074 - 7.6	10	5
1,2-Dichloropropane	0	29	ND	ND	ND
Trichloroethylene	1	29	0.009	9	5
1,1,2-Trichloroethane	1	29	0.011	9	5
Benzene	2	29	0.005 - 28	10	6
Tetrachloroethylene	0	29	ND	ND	ND
Toluene	26	29	0.002 - 2,600	44	492
Ethylbenzene	22	29	0.001 - 1,300	28	188
Xylenes	24	29	0.01 - 8,400	48	1,183

	No. of Detects	No. of Samples	Range of Levels	Average Level	Geometric Avg. Level
Polynuclear Aromatic Hydrocarbons(1)					
Benzoic acid	0	4	ND	ND	ND
Napthalene	5	5	0.089 - 12	4.34	1.99
2-Methylnapthalene	5	5	0.13 - 13	5.13	2.46
Acenaphthene	2	4	0.1 - 13	0.53	0.24
Acenaphthylene	0	5	ND	ND	ND
Dibenzofuran	2	4	0.12 - 0.22	0.17	0.16
Fluorene	2	4	0.23 - 0.3	0.61	0.39
Phenanthrene	2	4	0.33 - 0.45	0.69	0.49
Anthracene	1	5	0.048	0.63	0.32
Fluoranthene	2	5	0.08 - 0.23	0.63	0.36
Pyrene	2	4	0.024 - 0.17	0.55	0.26
Benzo(a)anthracene	1	5	0.076	0.63	0.35
Chrysene	1	5	0.12	0.64	0.39
Benzo(b)fluoranthene	2	5	0.036 - 0.14	0.61	0.28
Benzo(k)fluoranthene	0	5	ND	ND	ND
Benzo(a)pyrene	2	5	0.025 - 0.065	0.59	0.22
Indeno(1,2,3-cd)pyrene	1	5	0.033	0.62	0.30
Dibenzo(a,h)anthracene	0	5	ND	ND	ND
Benzo(g,h,i)perylene	1	5	0.033	0.62	0.30
Phthalates(1)					
Di-n-butylphthalate	3	5	0.037 - 1.5	1.00	0.59
Butylbenzylphthalate	2	3	0.033 - 0.047	0.10	0.07
bis(2-Ethylhexyl)phthalate	4	5	0.74 - 12	4.55	3.41
Di-n-octylphthalate	2	5	0.08 - 3.3	1.11	0.45
Phenols(1)					
2-Methylphenol	1	4	1.5	0.53	0.33
4-Methylphenol	0	4	ND	ND	ND
2,4-Dimethylphenol	0	4	ND	ND	ND
2,4-Dinitrophenol	0	5	ND	ND	ND

Notes:

Range and average values reported in this table include all constituents detected in samples including estimated values and constituents detected in method blanks.

(1) - Polynuclear Aromatic Hydrocarbons, Phthalates, and Phenols statistics are based on RI data only.

ND - Not Detected

NA - Not Applicable

UCL - Upper 95% Confidence Limit

Table 5-2
Summary Of Compounds Identified in Zone B Soil Samples During the RI and PDI (mg/kg)
Shore Realty Superfund Site
Glenwood Landing, New York

Volatile Organic Compounds

CHEMICAL NAME	Zone B Soil No. of Detects	No. of Samples	Range of Levels	Geometric UCL	UCL
Vinyl Chloride	0	16	ND	ND	ND
Methylene Chloride	3	16	0.005 - 20	18	5
Acetone	1	16	0.10	ND	ND
1,1-Dichloroethane	0	16	ND	ND	ND
trans-1,2-Dichloroethylene	0	12	ND	ND	ND
1,1,1-Trichloroethane	0	16	ND	ND	ND
1,2-Dichloropropane	0	16	ND	ND	ND
Trichloroethylene	0	16	ND	ND	ND
1,1,2-Trichloroethane	0	16	ND	ND	ND
Benzene	0	16	ND	ND	ND
Tetrachloroethylene	1	16	0.004	11	1
Toluene	8	16	0.009 - 140	24	31
Ethylbenzene	8	16	0.003 - 87	37	31
Xylenes	12	16	0.007 - 530	79	217

Polynuclear Aromatic Hydrocarbons(1)

CHEMICAL NAME	No. of Detects	No. of Samples	Range of Levels	Average Level	Geometric Avg. Level
Benzoic acid	0	1	ND	ND	ND
Napthalene	1	2	6.2	3.19	1.04
2-Methylnapthalene	1	2	9.6	4.89	1.30
Acenaphthene	0	2	ND	ND	ND
Acenaphthylene	0	2	ND	ND	ND
Dibenzofuran	1	2	0.22	0.22	0.22
Fluorene	1	2	0.3	0.24	0.23
Phenanthrene	1	2	0.41	0.29	0.27
Anthracene	0	2	ND	ND	ND
Fluoranthene	0	2	ND	ND	ND
Pyrene	1	2	0.024	0.10	0.06
Benzo(a)anthracene	0	2	ND	ND	ND
Chrysene	0	2	ND	ND	ND
Benzo(b)fluoranthene	0	2	ND	ND	ND
Benzo(k)fluoranthene	0	2	ND	ND	ND
Benzo(a)pyrene	0	2	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0	2	ND	ND	ND
Dibenzo(a,h)anthracene	0	2	ND	ND	ND
Benzo(g,h,i)perylene	0	2	ND	ND	ND

Phthalates(1)

CHEMICAL NAME	No. of Detects	No. of Samples	Range of Levels	Average Level	Geometric Avg. Level
Di-n-butylphthalate	1	2	0.16	0.17	0.17
Butylbenzylphthalate	0	2	ND	ND	ND
bis(2-Ethylhexyl)phthalate	1	2	0.74	0.46	0.36
Di-n-octylphthalate	0	2	ND	ND	ND

Phenols(1)

CHEMICAL NAME	No. of Detects	No. of Samples	Range of Levels	Average Level	Geometric Avg. Level
2-Methylphenol	0	2	ND	ND	ND
4-Methylphenol	0	2	ND	ND	ND
2,4-Dimethylphenol	0	2	ND	ND	ND
2,4-Dinitrophenol	0	2	ND	ND	ND

Notes:
Range and average values reported in this table include all constituents detected in samples including estimated values and constituents detected in method blanks.
(1) - Polynuclear Aromatic Hydrocarbons, Phthalates, and Phenols statistics are based on RI data only.
ND - Not Detected
NA - Not Applicable
UCL - Upper 95% Confidence Limit

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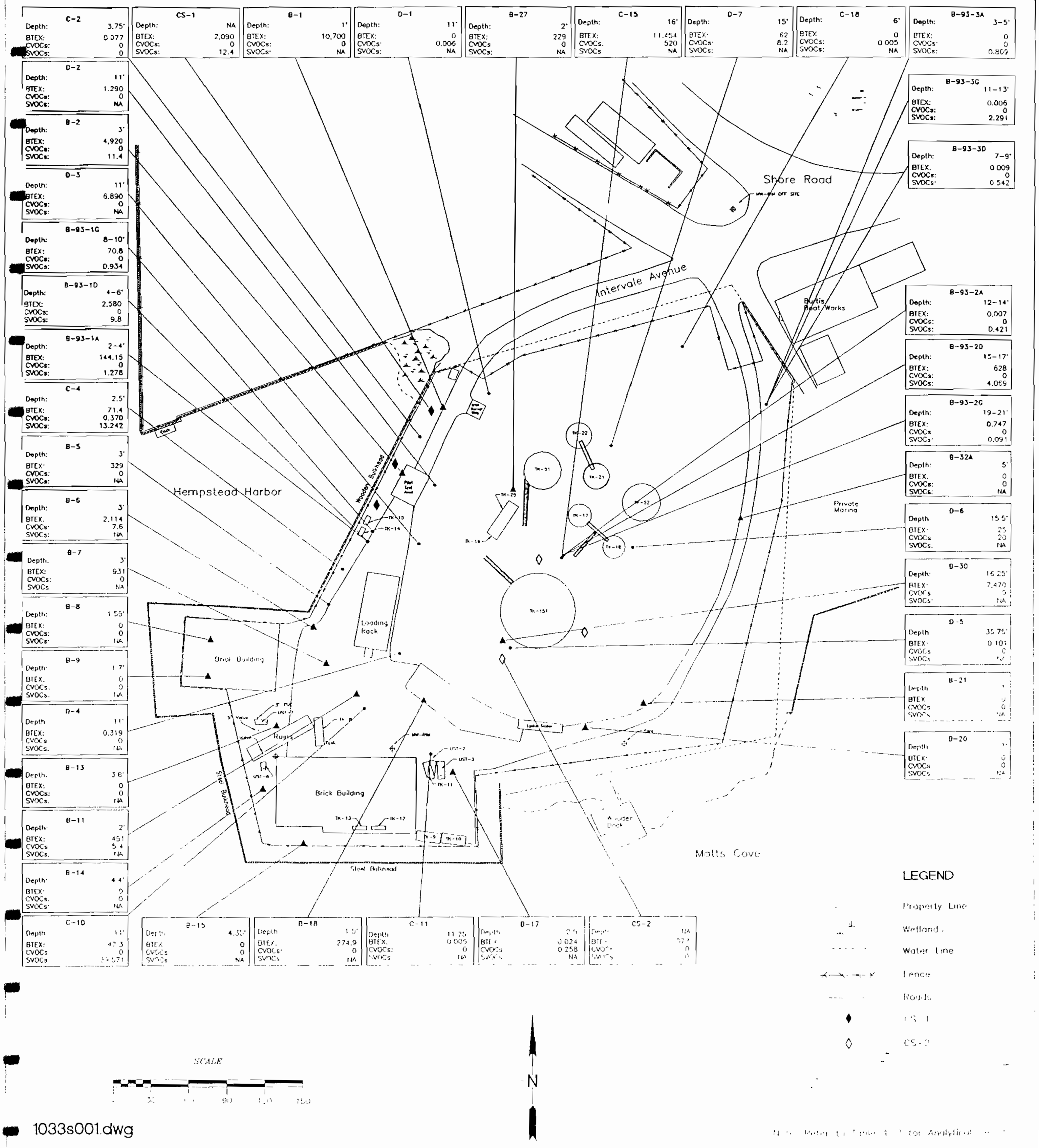

	Depth	BTEX	CVOCs	SVOCs
C-2	3.75'	0.077	0	0
CS-1	NA	2,090	0	12.4
B-1	1'	10,700	0	NA
D-1	11'	0	0.006	NA
B-27	2'	229	0	NA
C-15	16'	11,454	520	NA
D-7	15'	62	8.2	NA
C-18	6'	0	0.005	NA
B-93-3A	3-5'	0	0	0.809
B-93-3G	11-13'	0.006	0	2.291
B-93-3D	7-9'	0.009	0	0.542
D-2	11'	1.290	0	NA
B-2	3'	4,920	0	11.4
D-3	11'	6.890	0	NA
B-93-1G	8-10'	70.8	0	0.934
B-93-1D	4-6'	2,580	0	9.8
B-93-1A	2-4'	144.15	0	1.278
C-4	2.5'	71.4	0.370	13.242
B-5	3'	329	0	NA
B-6	3'	2,114	7.6	NA
B-7	3'	931	0	NA
B-8	1.55'	0	0	NA
B-9	1.7'	0	0	NA
D-4	11'	0.319	0	NA
B-13	3.6'	0	0	NA
B-11	2'	451	5.4	NA
B-14	4.4'	0	0	NA
C-10	11'	47.3	0	33.571
B-15	4.35'	0	0	NA
B-18	1.5'	274.9	0	NA
C-11	11.75'	0.005	0	NA
B-17	2.5'	0.024	0.258	NA
CS-2	NA	37.7	0	0
B-93-2A	12-14'	0.007	0	0.421
B-93-2D	15-17'	628	0	4.069
B-93-2G	19-21'	0.747	0	0.091
B-32A	5'	0	0	NA
D-6	15.5'	25	20	NA
B-30	16.25'	7,470	0	NA
D-5	35.75'	0.101	0	NA
B-21	[illegible]	0	0	NA
B-20	[illegible]	0	0	NA

Note: Refer to Table 4-? for Analytical [illegible]

1033s001.dwg

Soil Data (mg/kg)

FIGURE 5-1

- trichloroethylene; and
- tetrachloroethylene.

No CVOCs or SVOCs were detected in Level A soils during the RI. Total metals analysis was performed on samples from this level, and four total metals were detected ranging from 0.0072 ppm of copper to 0.224 ppm of zinc.

Two samples were collected from this level during the PDI. One sample detected non-chlorinated volatile organics at 0.009 ppm. No CVOCs, phthalates, or phenols were detected. Both samples detected PAHs at concentrations ranging from 0.382 ppm to 0.689 ppm. The samples were analyzed only for total iron from the metals group.

5.1.2 Saturated Soils

The saturated soils at the Site were divided into three levels during the RI.

5.1.2.1 Level B

Level B had the most detections during the RI, and the most samples, since it contains the water table surface where most of the contamination is expected to be present. Seven CVOCs were detected in six samples ranging from 0.009 ppm of TCE to 20 ppm of methylene chloride. Eighteen soil samples detected non-chlorinated volatiles in the form of ethlybenzene, toluene and xylenes ranging from 0.024 ppm to 10,700 ppm. Fifteen PAHs were detected in five samples ranging from 0.025 ppm of benzo(a)pyrene to 13 ppm of 2-methyl naphthalene. Phthalates were detected in four samples ranging from 0.033 ppm of butylbenzylphthalate to 12 ppm of bis(2-ethylhexyl)phthalate. One sample identified 2-methyl phenol at a concentration of 1.5 ppm. Total metals were detected in all of the samples, but in no pattern that would indicate that site operations have increased total metals concentrations.

Five samples were collected from Level B during the PDI. Non-chlorinated volatile compounds, CVOCs, PAHs, phthalates, and phenols were detected at similar levels in similar areas of the Site as identified in the RI. There were no SVOC results from the tank farm during the RI. However, samples were analyzed for SVOCs from the center of the tank farm during the PDI. PAHs in the two samples from this area ranged from non-detect to 3.799 ppm. Phthalates in the two samples ranged from 0.270 ppm to 0.421 ppm. No phenols were detected in the two samples.

5.1.2.2 Level C

Ten samples were collected from Level C during the RI. CVOCs were detected in the form of methylene chloride in two samples at concentrations from 0.006 ppm to 0.37 ppm. Nine samples detected non-chlorinated volatiles in the form of ethlybenzene, toluene and xylenes ranging from 0.005 to 71.4 ppm. Acetone was also detected in one sample at a concentration of 1 ppm. Two PAHs were detected in one sample ranging from 0.089 ppm of naphthalene to 0.13 ppm of 2-methyl naphthalene. Two phenolic compounds were detected in one sample ranging from 0.037 ppm of di-n-butylphthalate to 1.6 ppm of bis(2-ethylhexyl)phthalate. No total metals were detected.

Two samples were collected from Level C during the PDI. The concentrations of the various constituents was similar to those found during the RI along the bulkhead. However, a sample was collected from this level in the center of the tank farm. Chlorinated compounds were detected in the form of methylene chloride at 0.016 ppm. Non-chlorinated compounds were detected in the form of ethlybenzene, toluene and xylenes at 0.747 ppm. PAHs and phthalates were detected at 0.049 ppm and 0.042 ppm, respectively. No phenols were detected.

5.1.2.3 Level D

Five soil samples were collected from the Level D during the RI. The only CVOC detected was PCE at 0.004 ppm. Ethlybenzene, toulene, and xylenes was detected in all of the soil samples ranging from 0.002 ppm to 2.87 ppm. None of the samples were analyzed for PAHs, phthalates, phenols or total metals. No samples were collected from this level during the PDI.

5.1.3 Limits of Soil to be Remediated

The soils investigation conducted during the PDI refined the limits of soil to be remediated presented in Figure 5-2. This area is expanded from the RI due to the results of the PDI soil gas survey which was able to collect samples from just above the water table in the areas of higher elevation at the site. The area identified in the RI was expanded northward and directly southward of the tank farm.

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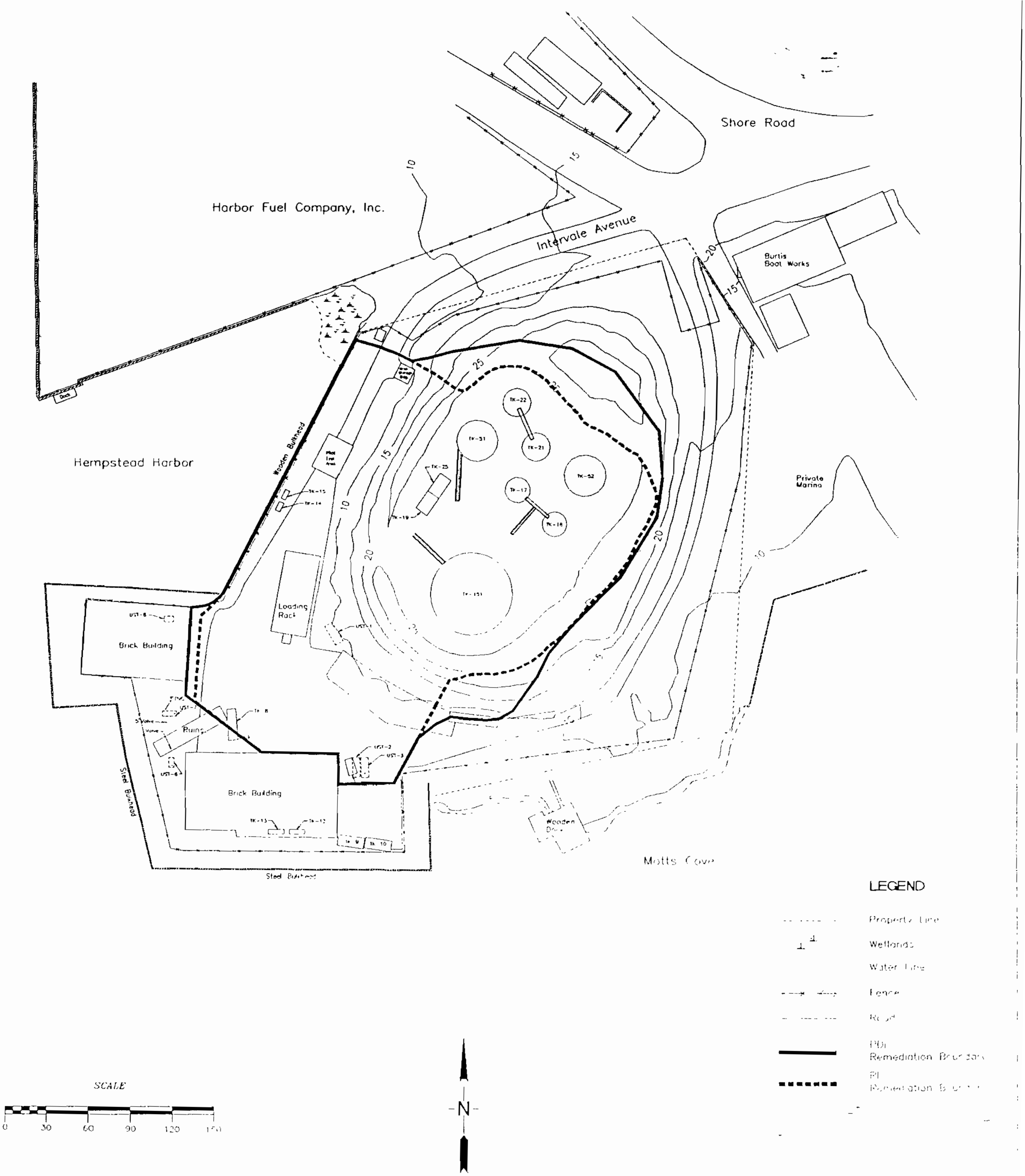

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Area Of Soil To Be Remediated

5-2

5.2 RESULTS OF SEDIMENTS INVESTIGATION

The analytical results from the RI were divided into the same six groups as those for the soil: CVOCs, non-chlorinated volatile organics, PAHs, phthalates, phenols, and total metals. Table 5-1 presents a summary of the various compounds identified in sediments during the RI.

The chlorinated suite had only two detectable constituents, methylene chloride and PCE. Methylene chloride was considered a laboratory-introduced contaminant and PCE was an estimated value. The non-chlorinated suite included ethlybenzene, toluene, xylenes and acetone. Ethylbenzene, toluene and xylenes were detected in four samples ranging from 0.013 ppm toluene to 1.4 ppm xylenes. Five samples detected acetone ranging from 0.017 ppm to 0.051 ppm. PAHs were the most frequently detected organics in the sediment samples. Thirteen of the samples detected PAHs ranging from an estimated value of 0.03 ppm fluorene to 1.2 ppm fluoranthene. Sixteen PAH compounds were detected in the sediment samples. Phthalates were detected in all of the sediment samples ranging from 0.038 ppm of butylbenzylphthalate to 8.1 ppm of bis(2-ethylhexyl)phthalate. Phenols were not detected in any sediment samples. Total metals were detected in all of the sediment samples.

5.3 WATER TABLE OBSERVATIONS

During the RI and PDI, the water table fluctuations were observed and the organic sheen on the water table was noted. Figure 5-3 presents the location of the organic sheen observed on the water table in November of 1990 during the RI. The water table at the Site propagates in a sinusoidal fashion at the Site due to the fluctuation in the tides. As the tide rises and falls, it sends this propagation through the Site from the south and west. This propagation, in combination with a majority of the contaminants (by mass) floating on the water table, explain the reason for the highest result of contamination being present in Level B. Section 4.0 discusses the water fluctuation data more thoroughly.

5.4 GROUNDWATER SAMPLES

The monitoring wells at the Site were divided into three groups during the RI; WT, SW, and DW. The summary of the compounds identified in Zone A groundwater and water table samples during the RI & PDI is presented in Table 5-3. Table 5-4 summarizes the compounds

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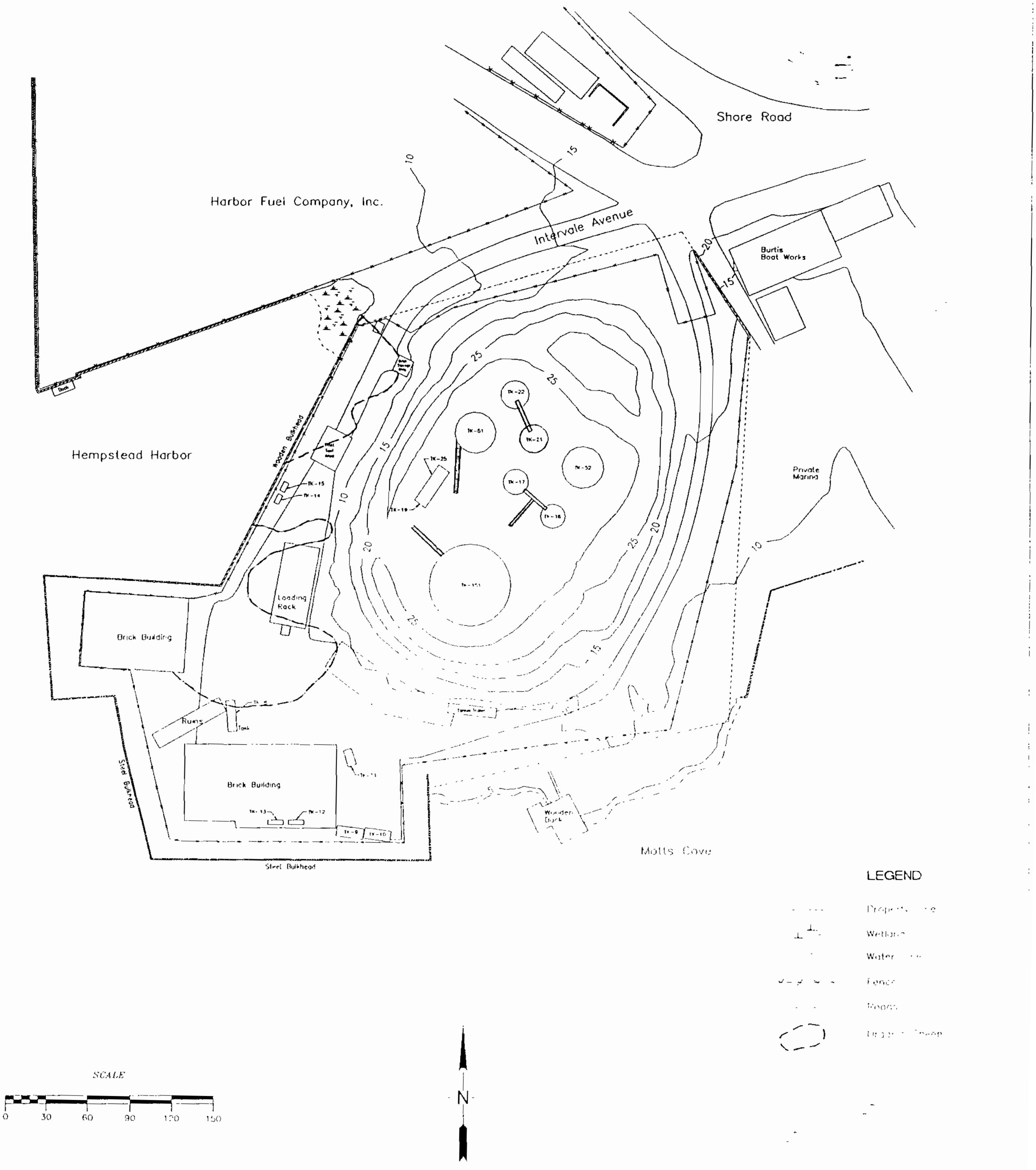

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Location Of Organic Sheen

5-3

TABLE 5-3
Summary of Compounds Identified in Zone A Groundwater Samples during the RI and PDI (ug/l)
Shore Realty Superfund Site
Glenwood Landing, New York

CHEMICAL NAME	Zone A Groundwater				
	No. Of Detects	No. Of Samples	Range Of Levels	Geometric UCL	UCL
Volatile Organic Compounds					
Vinyl Chloride	0	19	ND	ND	ND
Methylene Chloride	6	19	1 - 34	10	832
Acetone	1	19	66	ND	ND
1,1-Dichloroethane	4	19	1 - 4	8	830
trans-1,2-Dichloroethylene	2	14	7 - 10	13	1,147
1,1-Dichloroethylene	1	19	1	8	830
1,1,1-Trichloroethane	5	19	2 - 20	9	832
1,2-Dichloropropane	0	19	ND	ND	ND
Trichloroethylene	3	19	4 - 13	9	831
1,1,2-Trichloroethane	0	19	ND	ND	ND
Benzene	1	19	370	9	837
Tetrachloroethylene	9	19	1 - 280	15	850
Toluene	8	19	2 - 350,000	29	84,994
Ethylbenzene	1	19	4,800	11	1,263
Xylenes	2	19	16,000 - 30,000	15	6,095
	Detects	No. Of Samples	Range Of Levels	Average Level	Geometric Avg. Level
Polynuclear Aromatic Hydrocarbons(1)					
Benzoic acid	0	6	ND	ND	ND
Napthalene	0	7	ND	ND	ND
2-Methylnapthalene	0	7	ND	ND	ND
Acenaphthene	0	6	ND	ND	ND
Acenaphthylene	0	7	ND	ND	ND
Dibenzofuran	0	6	ND	ND	ND
Fluorene	0	6	ND	ND	ND
Phenanthrene	0	6	ND	ND	ND
Anthracene	0	6	ND	ND	ND
Fluoranthene	0	7	ND	ND	ND
Pyrene	0	6	ND	ND	ND
Benzo(a)anthracene	0	7	ND	ND	ND
Chrysene	0	7	ND	ND	ND
Benzo(b)fluoranthene	0	7	ND	ND	ND
Benzo(k)fluoranthene	0	7	ND	ND	ND
Benzo(a)pyrene	0	7	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0	7	ND	ND	ND
Dibenzo(a,h)anthracene	0	7	ND	ND	ND
Benzo(g,h,i)perylene	0	7	ND	ND	ND
Phthalates(1)					
Di-n-butylphthalate	4	7	7 - 73	24	15
Butylbenzylphthalate	0	6	ND	ND	ND
bis(2-Ethylhexyl)phthalate	4	7	8 - 20	14	13
Di-n-octylphthalate	0	7	ND	ND	ND
Phenols(1)					
2-Methylphenol	0	6	ND	ND	ND
4-Methylphenol	0	6	ND	ND	ND
2,4-Dimethylphenol	0	6	ND	ND	ND
2,4-Dinitrophenol	0	6	ND	ND	ND

Notes:

Range and average values reported in this table include all constituents detected in samples including estimated values and constituents detected in method blanks.

(1) - Polynuclear Aromatic Hydrocarbons, Phthalates, and Phenols statistics are based on RI data only.

ND - Not Detected

NA - Not Applicable

UCL - Upper 95% Confidence Limit

TABLE 5-4
Summary of Compounds Identified in Zone B Groundwater Samples during the RI and PDI (ug/l)
Shore Realty Superfund Site
Glenwood Landing, New York

CHEMICAL NAME	Groundwater				
	No. Of Detects	No. Of Samples	Range Of Levels	Geometric UCL	UCL
Volatile Organic Compounds					
Vinyl Chloride	0	43	ND	ND	ND
Methylene Chloride	14	43	1 - 120	5	363
Acetone	1	43	66	9	722
1,1-Dichloroethane	12	43	1 - 8	5	360
trans-1,2-Dichloroethylene	6	30	1 - 77	6	520
1,1-Dichloroethylene	3	43	1 - 2	5	360
1,1,1-Trichloroethane	16	43	1 - 20	6	361
1,2-Dichloropropane	0	43	ND	ND	ND
Trichloroethylene	16	43	1 - 13	5	361
1,1,2-Trichloroethane	0	43	ND	ND	ND
Benzene	1	43	370	5	363
Tetrachloroethylene	18	43	1 - 280	8	371
Toluene	9	43	2 - 350,000	9	37,073
Ethylbenzene	2	43	1,500 - 4,800	6	592
Xylenes	3	43	4,500 - 30,000	7	2,766

	No. Of Detects	No. Of Samples	Range Of Levels	Average Level	Geometric Avg. Level
Polynuclear Aromatic Hydrocarbons(1)					
Benzoic acid	0	6	ND	ND	ND
Napthalene	0	7	ND	ND	ND
2-Methylnapthalene	0	7	ND	ND	ND
Acenaphthene	0	6	ND	ND	ND
Acenaphthylene	0	7	ND	ND	ND
Dibenzofuran	0	6	ND	ND	ND
Fluorene	0	6	ND	ND	ND
Phenanthrene	0	6	ND	ND	ND
Anthracene	0	6	ND	ND	ND
Fluoranthene	0	7	ND	ND	ND
Pyrene	0	6	ND	ND	ND
Benzo(a)anthracene	0	7	ND	ND	ND
Chrysene	0	7	ND	ND	ND
Benzo(b)fluoranthene	0	7	ND	ND	ND
Benzo(k)fluoranthene	0	7	ND	ND	ND
Benzo(a)pyrene	0	7	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0	7	ND	ND	ND
Dibenzo(a,h)anthracene	0	7	ND	ND	ND
Benzo(g,h,i)perylene	0	7	ND	ND	ND
Phthalates(1)					
Di-n-butylphthalate	4	7	7 - 73	24	15
Butylbenzylphthalate	0	6	ND	ND	ND
bis(2-Ethylhexyl)phthalate	4	7	8 - 20	14	13
Di-n-octylphthalate	0	7	ND	ND	ND
Phenols(1)					
2-Methylphenol	0	6	ND	ND	ND
4-Methylphenol	0	6	ND	ND	ND
2,4-Dimethylphenol	0	6	ND	ND	ND
2,4-Dinitrophenol	0	6	ND	ND	ND

Notes:

Range and average values reported in this table include all constituents detected in samples including estimated values and constituents detected in method blanks.

(1) - Polynuclear Aromatic Hydrocarbons, Phthalates, and Phenols statistics are based on RI data only.

ND - Not Detected

NA - Not Applicable

UCL - Upper 95% Confidence Limit

identified in Zone B groundwater and water table samples during the RI & PDI. Table 5-5 presents the Zone A water table results within the organic sheen from the RI & PDI. Figure 5-4 presents a summary of CVOCs, BTEX, and SVOCs data from both the RI and PDI.

5.4.1 Water Table Wells

CVOCs were detected in seven of the nine WT wells during the RI. Eight different CVOCs were detected in all. Detections ranged from 2 ppb of methylene chloride, PCE, and trans-1,2-dichloroethylene to 970 ppb of methylene chloride. Five non-chlorinated volatile compounds were detected in six wells. Ethylbenzene, toluene, and xylenes were the most predominant, but there were also detections of benzene and acetone. Ethlybenzene, toluene and xylenes ranged from 806 ppb to 384,800 ppb. Two wells had PAHs detected ranging from 9 ppb of 2-methylnaphthalene to 120 ppb of benzoic acid. Four of the wells had two phthalates ranging from 6 ppb of butylbenzylphthalate to 130 ppb of di-n-butylphthalate. Two of the wells contained three phenolic compounds ranging from 47 ppb of 4-methylphenol to 490 ppb of 2-methylphenol. Twelve unfiltered total metals were detected in all of the wells ranging from less than 1 ppb of mercury to 76,200 ppb of iron.

The PDI detected lower levels of CVOCs, non-chlorinated volatile compounds and SVOCs in all but one of the wells. WT-14 had 60 ppb of non-chlorinated volatile compounds, no non-chlorinated volatile compounds were detected during the RI in this well. Samples from wells WT-6, WT-13 and WT-14 were analyzed for SVOCs during the PDI although they were not analyzed for SVOCs during the RI. PAHs were detected in WT-6 at 97 ppb. Phthalates were detected in WT-13 at 10 ppb. Phenols were detected in WT-6 at 444 ppb. A well was installed and screened across the water table, in the center of the tank farm. This well detected 180 ppb of CVOCs, 11,500 ppb of non-chlorinated volatile compounds, 75 ppb of PAHs, 1 ppb of phthalates and 27 ppb of phenols. No wells were present in this area prior to this well installation. The off-site well, WT-93-4, results will be reported in this July's monthly progress report.

5.4.2 Shallow Groundwater Wells

There are six SW wells at the Site. Seven SVOCs were detected in the six wells ranging from 1 ppb of methylene chloride, PCE, TCE, and 1,1-DCA to 280 ppb of PCE. Of the non-chlorinated volatile compounds, only toluene was detected at 2 ppb in the wells. No PAHs or phenolic compounds were detected. Two phthalates were detected in one well, 8 ppb of bis(2-ethylhexyl)phthalate and 73 ppb of di-n-butylphthalate. Twelve unfiltered total metals were

TABLE 5-5
Summary of Compounds Identified in Zone A Water Table Samples during the RI and PDI (ug/l)
(Basis for Pump & Treat)
Shore Realty Superfund Site
Glenwood Landing, New York

CHEMICAL NAME	Zone A Water Table				
	No. Of Detecs	No. Of Samples	Range Of Levels	Geometric UCL	UCL
Volatile Organic Compounds					
Vinyl Chloride	1	12	12	113	3,575
Methylene Chloride	6	12	2 - 970	81	536
Acetone	6	12	15.0 - 2,000	121	744
1,1-Dichloroethane	3	12	6 - 19	80	1,867
trans-1,2-Dichloroethylene	3	9	25 - 31	176	2,539
1,1-Dichloroethylene	0	12	ND	ND	ND
1,1,1-Trichloroethane	3	12	6 - 23	79	1,867
1,2-Dichloropropane	1	12	5	73	1,866
Trichloroethylene	2	12	4 - 29	85	1,868
1,1,2-Trichloroethane	0	12	ND	ND	ND
Benzene	7	12	6 - 270	48	250
Tetrachloroethylene	2	12	10 - 430	95	1,894
Toluene	10	12	330 - 270,000	2,354	95,458
Ethylbenzene	9	12	160 - 5,600	444	4,153
Xylenes	11	12	450 - 45,000	5,532	28,077

	No. Of Detecs	No. Of Samples	Range Of Levels	Average Level	Geometric Avg. Level
Polynuclear Aromatic Hydrocarbons(1)					
Benzoic acid	1	4	120	NA	NA
Napthalene	2	4	29 - 40	35	34
2-Methylnapthalene	2	4	9 - 11	10	10
Acenaphthene	0	4	ND	ND	ND
Acenaphthylene	0	4	ND	ND	ND
Dibenzofuran	0	4	ND	ND	ND
Fluorene	0	4	ND	ND	ND
Phenanthrene	0	4	ND	ND	ND
Anthracene	0	4	ND	ND	ND
Fluoranthene	0	4	ND	ND	ND
Pyrene	0	4	ND	ND	ND
Benzo(a)anthracene	0	4	ND	ND	ND
Chrysene	0	4	ND	ND	ND
Benzo(b)fluoranthene	0	4	ND	ND	ND
Benzo(k)fluoranthene	0	4	ND	ND	ND
Benzo(a)pyrene	0	4	ND	ND	ND
Indeno(1,2,3-cd)pyrene	0	4	ND	ND	ND
Dibenzo(a,h)anthracene	0	4	ND	ND	ND
Benzo(g,h,i)perylene	0	4	ND	ND	ND
Phthalates(1)					
Di-n-butylphthalate	4	4	7 - 130	45	80
Butylbenzylphthalate	1	4	6	NA	NA
bis(2-Ethylhexyl)phthalate	0	4	ND	ND	ND
Di-n-octylphthalate	0	4	ND	ND	ND
Phenols(1)					
2-Methylphenol	2	4	100 - 490	295	221
4-Methylphenol	2	4	47 - 130	89	78
2,4-Dimethylphenol	3	4	120 - 390	247	221
2,4-Dinitrophenol	0	4	ND	ND	ND

Notes:

Range and average values reported in this table include all constituents detected in samples including estimated values and constituents detected in method blanks.

(1) - Polynuclear Aromatic Hydrocarbons, Phthalates, and Phenols statistics are based on RI data only.

ND - Not Detected

NA - Not Applicable

UCL - Upper 95% Confidence Limit

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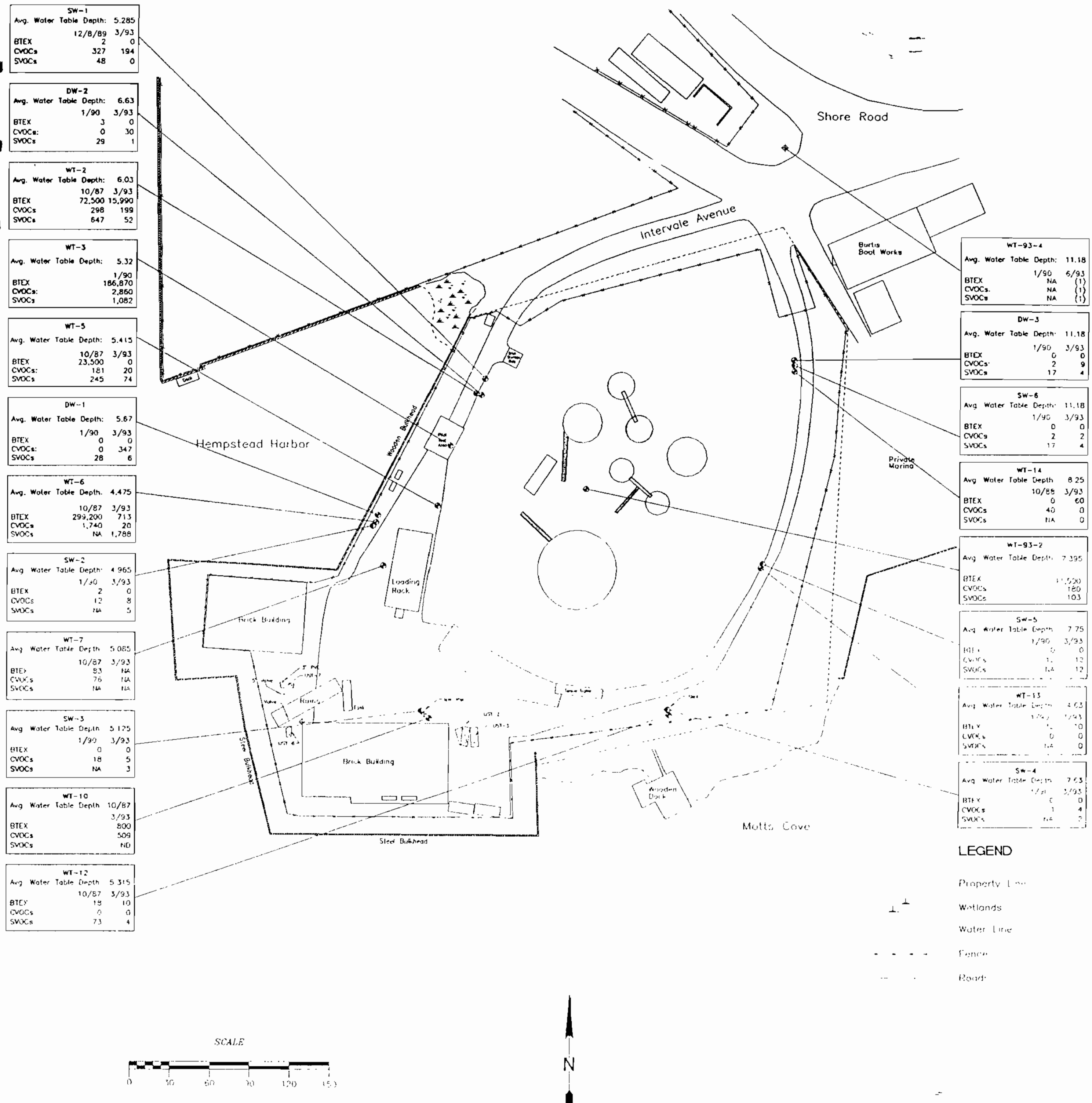

SW-1

Avg. Water Table Depth:	5.285	
	12/8/89	3/93
BTEX	2	0
CVOCs	327	194
SVOCs	48	0

DW-2

Avg. Water Table Depth:	6.63	
	1/90	3/93
BTEX	3	0
CVOCs:	0	30
SVOCs	29	1

WT-2

Avg. Water Table Depth:	6.03	
	10/87	3/93
BTEX	72,500	15,990
CVOCs	298	199
SVOCs	647	52

WT-3

Avg. Water Table Depth:	5.32
	1/90
BTEX	186,870
CVOCs:	2,860
SVOCs	1,082

WT-5

Avg. Water Table Depth:	5.415	
	10/87	3/93
BTEX	23,500	0
CVOCs:	181	20
SVOCs	245	74

DW-1

Avg. Water Table Depth:	5.67	
	1/90	3/93
BTEX	0	0
CVOCs:	0	347
SVOCs	28	6

WT-6

Avg. Water Table Depth.	4.475	
	10/87	3/93
BTEX	299,200	713
CVOCs	1,740	20
SVOCs	NA	1,788

SW-2

Avg Water Table Depth:	4.965	
	1/90	3/93
BTEX	2	0
CVOCs	12	8
SVOCs	NA	5

WT-7

Avg Water Table Depth	5.085	
	10/87	3/93
BTEX	53	NA
CVOCs	76	NA
SVOCs	NA	NA

SW-3

Avg Water Table Depth	5.175	
	1/90	3/93
BTEX	0	0
CVOCs	18	5
SVOCs	NA	3

WT-10

Avg Water Table Depth	10/87
	3/93
BTEX	800
CVOCs	509
SVOCs	ND

WT-12

Avg Water Table Depth	5.315	
	10/87	3/93
BTEX	15	10
CVOCs	0	0
SVOCs	73	4

WT-93-4

Avg. Water Table Depth:	11.18	
	1/90	6/93
BTEX	NA	(1)
CVOCs.	NA	(1)
SVOCs	NA	(1)

DW-3

Avg. Water Table Depth:	11.18	
	1/90	3/93
BTEX	0	0
CVOCs:	2	9
SVOCs	17	4

SW-6

Avg Water Table Depth:	11.18	
	1/90	3/93
BTEX	0	0
CVOCs	2	2
SVOCs	17	4

WT-14

Avg Water Table Depth	8.25	
	10/88	3/93
BTEX	0	60
CVOCs	40	0
SVOCs	NA	0

WT-93-2

Avg Water Table Depth	7.395
BTEX	[illegible]
CVOCs	180
SVOCs	103

SW-5

Avg Water Table Depth	7.75	
	1/90	3/93
BTEX	0	0
CVOCs	[illegible]	12
SVOCs	NA	12

WT-13

Avg Water Table Depth	4.63	
	[illegible]	3/93
BTEX	[illegible]	10
CVOCs	0	0
SVOCs	NA	0

SW-4

Avg Water Table Depth	7.63	
	[illegible]	3/93
BTEX	0	0
CVOCs	1	4
SVOCs	NA	[illegible]

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Based Upon Analytical Results from the RI and [illegible]
(1) Results are Expected [illegible]

Ground Water Data

detected in the six wells ranging from less than one ppb of mercury to 644 ppb of iron.

The shallow groundwater samples analyzed during the PDI detected similar or lower concentrations in all of the wells for each of the six compound categories. The samples from SW-2, SW-3, SW-4 and SW-5 were analyzed for SVOCs, whereas the samples from the same wells during the RI were not analyzed for SVOCs. Samples from SW-2, SW-3, and SW-4 detected only phthalates ranging from 1 ppb to 5 ppb.

5.4.3 Deep Groundwater Wells

There are three DW wells at the site. Only bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were above state MCLs, 5 ppb. They were detected in the range of 7 ppb to 20 ppb. Six total metals were detected in the three wells ranging from 6.1 ppb of cadmium to 414 ppb of iron.

The deep groundwater samples analyzed during the PDI detected similar or lower concentrations in all of the wells for all of the six compound categories except CVOCs. Only DW-3 detected CVOCs during the RI and the PDI detected a similar concentration at this location. Wells DW-1 and DW-2, along the western portion of the site, detected CVOCs at 347 ppb and 30 ppb, respectively.

5.5 REPRESENTATIVE CONTAMINANTS

The RI identified twelve VOCs, fifteen PAHS, four phthalates, and one phenol. In soils, the PDI identified five VOCs, twelve PAHs, two phthalates and two phenols. Most of the CVOCs detections during the RI were single instances, and the PDI was limited and focused on filling in data gaps associated with engineering design parameters; therefore, the differences are minimal between these two investigations in this regard. The highest PAH detection was during the RI, and was 13 ppm of 2-methylnaphthalene and acenaphthene. These concentrations are minimal, and are susceptible to further reduction through the implementation of the *in situ* biodegradation component of the Remedy. (Ryan and Loehr, 1991)

The RI identified fourteen VOCs, three PAHs, two phthalates and three phenolic compounds in the groundwater samples from the water table wells. The PDI identified twelve VOCs, ten PAHs, three phthalates and six phenolic compounds. Generally, the PDI found the concentrations of these compounds were lower. All of the PAHs and phthalates identified during the RI and PDI are below their respective clean-up standard. The phenols as well as the other constituents are degradable, and the remedy for the site should be effective at reducing their respective concentrations.

The RI identified eight VOCs and two phthalates in the groundwater at the site. The PDI identified seven of the same eight VOCs. The concentrations of these were generally the same as those identified during the RI. The PDI also identified one of the same phthalates as the RI at generally the same concentrations. Neither investigation identified PAHs or phenols in the groundwater. The discrepancies between the two investigations are negligible and do not effect the design of the remedy.

The ROD identified six VOCs as the primary contaminants of interest. Generally, VOC concentrations were found to be somewhat lower during the PDI than the RI. In addition, the ROD identifies PAHs and phthalates as potential contaminants of concern. The PDI suggests these compounds are not primary constituents of concern. The PAHs and phthalates have been removed from the Table 5-6 since their concentrations are below clean-up criteria in the groundwater and were found in such minute amounts in the soil during both the RI and PDI. These primary COIs are presented in Table 5-7 along with some of their chemical properties. These chemical properties are pertinent to the design of the remedy. These contaminants are presented in Table 5-6 with their maximum concentrations detected by media during the RI and PDI.

TABLE 5–6

Physical Properties of Primary COIs

Representative Contaminants	Class	MW	Boiling Point (°C)	Henry's Constant (atm)	Vapor Pressure (mmHG)	Water Solubility (mg/l)	Ease of Stripping
Benzene	Aromatics	78.11	78.00	315.00	95.04	1750	Easily Stripped
Ethylbenzene	Aromatics	106.16	136.20	357.00	9.90	152	Easily Stripped
Toluene	Aromatics	92.13	110.70	360.00	28.40	535	Easily Stripped
Xylenes	Aromatics	106.16	~ 140	338.00	8.50	198	Easily Stripped
Tetrachloroethylene	Halogenated Hydrocarbons	166.00	121.00	1,457.00	133.35	150	Easily Stripped
1,1,1–Trichloroethane	Halogenated Hydrocarbons	133.42	75.00	251.00	17.80	1500	Easily Stripped

Notes:

The Boiling Temperature of Xylenes is not available. However, Xylene isomers boiling points are:

– 139 °C for m–Xylene (meta)
– 144 °C for o–Xylene (ortho)
– 138 °C for p–Xylene (para)

TABLE 5-7

Primary COIs
Maximum Concentration Detected by Media

Contaminants	Soil (ppm)	Groundwater (ppb)	Sediments (ppb)	Air (ppb)
Benzene	28	270	-	1.00
Ethylbenzene	1,300	6,200	150	0.36
Toluene	2,600	350,000	13	0.84
Xylenes	8,400	45,000	1,400	-
Tetrachloroethylene	0.004	430	3	-
1,1,1-trichloroethane	7.6	11	-	-

(1) This table was presented in the ROD and modified after the PDI.

6.0 TREATABILITY STUDIES

6.1 IRON PRECIPITATION STUDY

The iron precipitation study was conducted using two samples collected with the 4" split spoon and plastic liners. The samples collected were two columns of soil inside clear 2½"-by-2' sleeves. The two samples were connected using a rubber coupler and silicone. After connecting the two tubes, soil samples were collected from each end of the column to determine initial iron concentrations. The original design of the column was to pump water from well DW-2 to the top of the soil column and allow it to pass by gravity through the soil column while diffusing air from the bottom of the column into the sample. Refer to Figure 6-1.

After initial setup of the column, flow was negligible due to sample disturbance resulting in compaction of the loose sands which will not occur in the field during implementation of the remedy. To try and increase the flow rate, the sample was remolded, and the apparatus reconnected. The flow in the column increased to approximately 0.2 gpd. The air flow was maintained by keeping a constant pressure of air below the soil column. Initially, the soil column needed daily water additions above the soil. As the study progressed, significant settlement of the soil column was noted, resulting in lower flow rates through the column. The system operated from March 8 until June 3, 1993. The material in the column has changed appearance modestly since it was initially remolded; the soil now has a slightly darker color in the lower half of the soil column, and a few very small spots of iron staining have developed. Samples were collected from the top, bottom, and middle of the column and sent for iron analysis.

It appears that some iron precipitation occurred during the three months of the study; however, it does not appear that the precipitation has significantly impacted air or water flow. Reduction in permeability has been caused by settlement rather than iron precipitation. Once the sample results are received from the laboratory, a final determination will be made.

6.2 BIODEGRADATION STUDIES

6.2.1 Microbial Characterization

Tests to characterize the microbial populations in the soils and groundwater at the site were performed on samples collected from soil borings B-93-1, B-93-2, and B-93-3, and from monitoring wells SW-2, WT-93-2, and SW-6 (wells in the vicinity of the soil sampling

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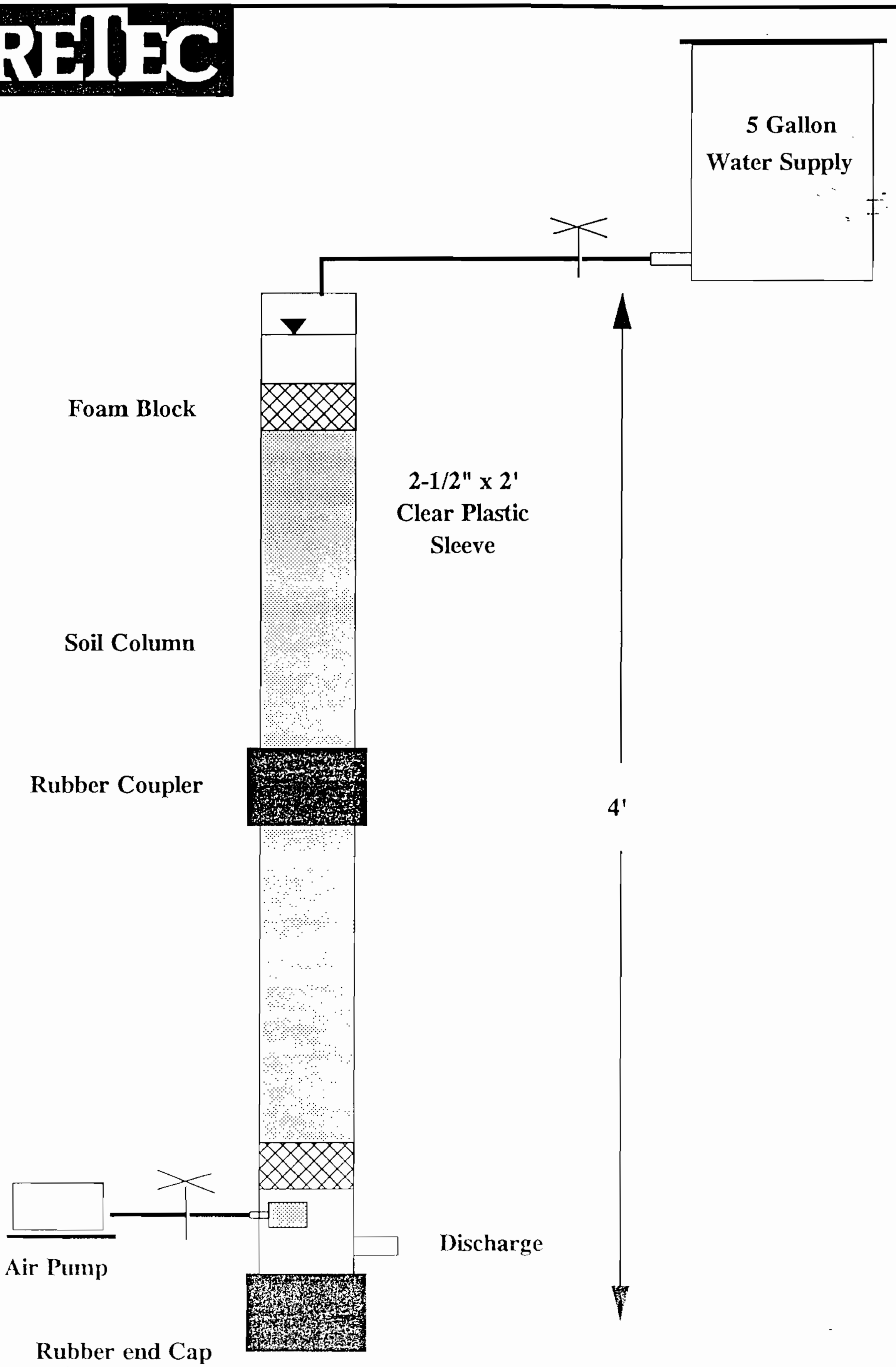

Iron Precipitation Schematic

FIGURE
6-1

locations). The procedures used for microbial enumeration of soil and groundwater samples are described in RETEC Standard Operating Procedure (SOP) #510.

The locations of the soil borings were chosen to reflect the range of soil-phase contaminants and constituent concentrations that exist at the site. B-93-1 was selected to characterize the areas of highest observed contaminant concentrations along the western bulkhead. B-93-2 was located to characterize the soils within the tank farm, which is suspected as a potential source area. B-93-3 was chosen to characterize the soils at the upgradient portion of the site, which the data from the RI suggests may have been impacted from an off-site source of CVOCs.

The depths of the soil samples were chosen to facilitate evaluation of physical, chemical, and microbiological characteristics of three specific zones within the B level:

- near the top (unsaturated) portion of the B level (approximately four feet above the static groundwater elevation);
- at the water table interface;
- approximately three feet below the water table interface (near the bottom of the B level).

The shallow soil sample represents conditions in the vadose zone at a depth that would be addressed by venting/bioventing. The sample collected at the water table interface is most likely to reflect conditions resulting from exposure to LNAPL, and to exhibit the highest contaminant concentrations, and is potentially subject to treatment by *in situ* bio-remediation through the addition of nutrients and appropriate electron acceptor. The sample collected from within the saturated zone was expected to contain lower concentrations of the more soluble contaminants at the site. Remediation of contamination within this level would occur primarily through aqueous flushing, stripping through groundwater sparging, and *in situ* bio-degradation.

6.2.1.1 Initial Microbial Enumerations

The results of the microbial enumeration of the soil samples are presented in Table 6-1. These results confirm the presence of relatively high numbers of total heterotrophic bacteria, ranging from 7.2 x 10^5 colony forming units (CFU) per gram, to over 1 x 10^8 CFU/gm. Numbers of bacteria capable of growth on volatile organic compounds (VOC) were somewhat lower, ranging from 7.6 x 10^3 CFU/gm to 2.6 x 10^6 CFU/gm; however, these are very

TABLE 6-1

Results of Initial Microbial Counts: Soil Samples

Soil Samples	Initial Counts (CFU/gm)
B-93-1 (2-4')	
Heterotrophs	1.1×10^7
VOC Degraders	4.5×10^5
B-93-1 (4-6')	
Heterotrophs	1.02×10^8
VOC Degraders	4.9×10^5
B-93-1 (8-10')	
Heterotrophs	6.4×10^6
VOC Degraders	1.1×10^4
B-93-2 (12-14')	
Heterotrophs	1.4×10^7
VOC Degraders	7.1×10^5
B-93-2 (15-17')	
Heterotrophs	1.5×10^7
VOC Degraders	2.56×10^6
B-93-2 (19-21')	
Heterotrophs	9.1×10^6
VOC Degraders	3.8×10^5
B-93-3 (3-5')	
Heterotrophs	8.5×10^6
VOC Degraders	1.7×10^4
B-93-3 (7-9')	
Heterotrophs	7.2×10^5
VOC Degraders	7.6×10^3
B-93-3 (11-13')	
Heterotrophs	7.8×10^6
VOC Degraders	3.0×10^3

Notes:

CFU: Colony-forming units

VOC: Volatile organic compound

Microbial counts performed according to RETEC SOP #510.

typical of sites containing volatile organic contaminants and represent a healthy microbial population. It should be noted that the two soil samples exhibiting the highest contaminant concentrations (B-93-1, 4-6'; and B-93-2, 15-17') also exhibited the highest densities of total heterotrophic and VOC-degrading bacteria. These samples were collected from the vicinity of the groundwater table interface and, therefore, high concentrations of contaminants having a density less than that of water were expected. Exposure of the micro-organisms to these elevated contaminant concentrations has not produced any bio-toxicity effects.

The results of the microbial enumeration of the three groundwater samples are presented in Table 6-2. These results are generally consistent with the data obtained from the microbial enumeration of the soil samples, and show essentially equal numbers of total heterotrophic bacteria in each of the groundwater samples (approximately 3 x 10^5 CFU/Ml). Numbers of VOC-degrading bacteria were somewhat more variable, ranging from 5 x 10^2 CFU/mL to 7 x 10^4 CFU/mL. Like the results of the soil analyses, these data are suggestive of normal levels of microbial activity that may be stimulated to increase rates of organic constituent biodegradation.

6.2.1.2 Nutrient Stimulation Testing

In order to evaluate the response of the soil microbial populations to enhanced oxygen and nutrient conditions, slurries of water table and saturated zone soil samples were prepared in shake-flasks using deionized water to achieve a solids content of approximately 20%. Duplicate slurries from each sample were prepared: one slurry received inorganic nutrients (100 mg/L nitrogen, 10 mg/L phosphorus), while the other slurry received no additional nutrients and served as an aeration control. All of the flasks were then placed on a shaker table for approximately 48 hours, after which samples of each slurry were collected for microbial enumeration of total heterotrophic and VOC-degrading bacteria. Details of this nutrient stimulation procedure are provided in RETEC SOP #545.

The results of the nutrient stimulation study are shown in Table 6-3. Significant increases (greater than 10x) in total heterotrophs and VOC-degraders resulting from aeration alone were observed only in the saturated zone (8-10' deep) sample from B-93-1. A significant increase in VOC-degraders only, as a result of aeration, was also noted in the water table (4-6' deep) sample from B-93-1. Insignificant additional increases in microbial numbers in these samples were recorded when nutrients were also provided. Essentially no changes in microbial numbers were observed in the samples collected from the northeast portion of the site (boring B-93-3); however, organic analyses of these samples showed very low contaminant

TABLE 6–2

Results of Initial Microbial Counts: Groundwater Samples

Groundwater Samples	Initial Counts (CFU/mL)
WT–93–2	
Heterotrophs	2.7×10^5
VOC Degraders	5.0×10^2
SW–2	
Heterotrophs	3.8×10^5
VOC Degraders	7.0×10^4
SW–6	
Heterotrophs	3.2×10^5
VOC Degraders	1.3×10^4

Notes:

VOC: Volatile organic compound
CFU: Colony–forming units
Microbial counts performed according to RETEC SOP #510

concentrations, suggesting that microbial growth in these samples may be limited by carbon availability, rather than oxygen or nutrient availability.

6.2.2 Chemical Characterization

6.2.2.1 Soil and Groundwater Chemical Analyses

Each of the soil samples were analyzed by GC/MS for volatile organic compounds (EPA Method 8240) with a library search for the 15 highest non-target peaks and for semi-volatile organics (EPA 8270) with a library search for the 15 highest non-target peaks. The soil samples were also analyzed for total nitrogen, total phosphorus, and total iron. Groundwater samples were analyzed for the same parameters as the soil samples, with the exception of TPH and hydrocarbon characterization. The objective of these chemical analyses is to provide an indication of the chemical environment to which indigenous microbial populations have been exposed.

The results of the chemical characterization of the soil and groundwater samples are presented in Table 6-4. These data show that soil contamination is primarily composed of volatile organic compounds, which exist at highest concentrations near the water table interface near the western bulkhead and in the tank farm area. Significant levels of soil contaminants were not found in samples collected from B-93-3, located near the northeastern property boundary. Contaminant concentrations in groundwater samples from these areas of the site were relatively low; only the sample from the tank farm area (WT-93-2) exceeded 1.0 mg/L total organics. As with the soil samples, organic constituents were predominantly volatile organics.

Concentrations of total iron in soils were shown to be relatively low, and were fairly consistent among the samples, ranging from 1.34 mg/kg to 5.77 mg/kg. Iron concentrations in the groundwater samples were higher and were considerably more variable, ranging from 8.62 mg/L (SW-2) to 101 mg/L (WT-93-2). These data do not indicate the form of the iron, and it is not possible to determine from these data the propensity for iron to form precipitates upon exposure to oxygen. Additional laboratory tests, discussed in later sections of this report have been performed to empirically evaluate the potential for the precipitation of iron and other groundwater minerals.

Table 6-4 also shows concentrations of nitrogen and phosphorus, which constitute the principal nutrients required by heterotrophic micro-organisms. Low concentrations of nitrogen and phosphorus, relative to the total mass of bio-degradable organic carbon, may limit microbial growth and, correspondingly, limit rates of contaminant bio-degradation. The optimal ratio of

TABLE 6-3

Microbial Testing

Sample I.D.	Initial Counts (CFU/mL)	O_2 Only (CFU/mL)	O_2 & Nutrients (CFU/mL)
B-93-1 (4-6')			
Total Bacteria	2.04×10^{7}	4.8×10^{7}	6.5×10^{7}
VOC-Degraders	1.0×10^{5}	1×10^{6}	3.8×10^{5}
B-93-1 (8-10')			
Total Bacteria	1.28×10^{6}	1.1×10^{7}	1.4×10^{7}
VOC-Degraders	2×10^{3}	4×10^{4}	3×10^{4}
B-93-2 (15-17')			
Total Bacteria	3.0×10^{6}	5.7×10^{6}	9.4×10^{6}
VOC-Degraders	5.1×10^{5}	1.4×10^{6}	2.9×10^{5}
B-93-2 (19-21')			
Total Bacteria	1.82×10^{6}	2.2×10^{6}	2.5×10^{6}
VOC-Degraders	8×10^{4}	3×10^{4}	7×10^{4}
B-93-3 (7-9')			
Total Bacteria	7.2×10^{5}	2.9×10^{5}	3.2×10^{5}
VOC-Degraders	2×10^{3}	1×10^{3}	1×10^{3}
B-93-3 (11-13')			
Total Bacteria	1.56×10^{6}	1.9×10^{6}	2.5×10^{6}
VOC-Degraders	1×10^{3}	2×10^{3}	3×10^{3}

TABLE 6–4

Summary of Soil and Groundwater Chemical Data For Bioremediation Evaluation

Number	Location	Matrix	8240 TCL	8240 TIC	TOTAL 8240	8270 TCL	8270 TIC	TOTAL 8270	TOTAL ORGANICS	TPH	TOTAL NITROGEN	TOTAL PHOSPHATE	TOTAL IRON	C:N:P
B–93–1, 2–4'	Bulkhead	Soil	147.9	2.0	149.9	1.3	27.8	29.1	179.0	<10.0	72.5	59.3	2.78	100:40:33
B–93–1, 4–6'	Bulkhead	Soil	2,596.0	286.0	2,882.0	9.8	33.0	42.8	2,924.8	NA	<2	160	5.77	100:0.03:5
B–93–1, 8–10'	Bulkhead	Soil	73.1	ND	73.1	0.9	4.0	4.9	78.0	<10.0	<2	19.5	3.81	100:1:25
SW–2	Bulkhead	GW	0.008	ND	0.008	0.005	0.042	0.042	0.050	NA	3.730	0.160	8.620	100:10,000:320
B–93–2, 12–14'	Tank Farm	Soil	0	0.8	0.8	0.4	63.7	64.1	64.9	<10.0	42.5	46.4	3.23	100:66:71
B–93–2, 15–17'	Tank Farm	Soil	809.0	1,735.0	2,544.0	4.1	47.0	51.1	2,595.1	550.0	<2	101	2.21	100:0.04:4
B–93–2, 19–21'	Tank Farm	Soil	0.8	0.7	1.5	0.1	17.2	17.3	18.8	<10.0	18.5	47.2	1.34	100:98:251
WT–93–2	Tank Farm	GW	11.620	0.886	12.506	0.104	0.485	0.589	13.095	NA	1.100	0.120	101.000	100:8:0.9
B–93–3, 3–5'	Northeast	Soil	<0.1	ND	<0.1	0.8	0.4	1.2	1.2	<10.0	37	160	4.4	100:3,080:13,300
B–93–3, 7–9'	Northeast	Soil	<0.1	ND	<0.1	0.5	0.7	1.2	1.2	<10.0	52	147	4.05	100:4,300:12,250
B–93–3, 11–13'	Northeast	Soil	<0.1	ND	<0.1	2.3	0.8	3.1	3.1	<10.0	111	124	5.27	100:3,580:4,000
SW–6	Northeast	GW	0.017	ND	0.017	0.009	0.004	0.013	0.030	NA	7.27	0.290	59.000	100:24,300:1,000

NOTES: Soil data reported in units of mg/Kg.
Groundwater data reported in units of mg/L.
NA = Not Analyzed
8240 = EPA Method 8240 – Volatile Organics
8270 = EPA Method 8270 – Semivolatile Organics
TCC = Target Compound List Constituents
TIC = Tentatively Identified Compounds (Non–Target Compounds)

(carbon:nitrogen:phosphorus for bio-degradation processes is typically about 100:2:0.5. RETEC, 1991). As the table indicates, nitrogen and phosphorus were present at concentrations exceeding the theoretical requirement in all but three of the samples that were evaluated. While all of the nitrogen and phosphorus in these samples may not be biologically available, these data nevertheless suggest that significant concentrations of inorganic nutrients, relative to organic compounds, exist at the site, and that limitation of bio-degradation rates due to ambient nutrient levels may not be a significant problem at the site.

6.2.2.2 Nutrient Adsorption Testing

A simple testing program was used to evaluate the degree to which inorganic nutrients of the type typically added during in situ bioremediation programs may be adsorbed by the soil matrix of the site. This testing consisted of preparing soil slurries using sample material collected from the deep (saturated zone) soil levels. The slurries were spiked with a known concentration of a nitrogen/phosphorus nutrient blend (ammonium chloride, monopotassium and dipotassium phosphates), used for bioremediation applications, which was mixed for several hours after which the nutrient concentrations were re-measured (refer to RETEC SOP #730).

The results of the nutrient adsorption testing are shown in Table 6-5. These data indicate that nutrient adsorption onto the saturated zone soils was generally insignificant. Phosphorus was observed to decrease by 9 percent upon exposure to the saturated zone soil sample collected from boring B-93-1. This degree of nutrient loss does not suggest however, that the transport of nutrients through the site soils will be compromised, in the event that nutrient addition is found to be required to enhance contaminant bio-degradation rates.

6.2.2.3 Nutrient Precipitation Testing

The potential for precipitation due to reaction of introduced nutrients with dissolved minerals (primarily calcium and magnesium) in the groundwater was measured by first filtering two groundwater samples to remove suspended solids, and then spiking the samples with known concentrations of nitrogen (1,000 mg/L nitrogen as NH_4Cl) and phosphorus (500 mg/L phosphorus as KH_2PO_4). The samples were then placed on a rotary shaker, and aliquots collected after 24 and 48 hours for measurement os total suspended solids (TSS), amonia, nitrogen and phosphorous. The results of the nutrient precipitation tests are shown in Table 6-6. Slight increases in TSS were noted at the two sampling times, suggesting the formation of small amounts of precipitate. At the conclusion of the study, analysis of ammonia-nitrogen and phosphorus in filtered samples, however, demonstrated that more than 80% of the original

TABLE 6–5

Results of Nutrient Adsorption Testing

Sample Description	Compound	Measured Concentration (mg/L)			Percent Adsorbed
		Sample A	Sample B	Mean	
Flasks 1 & 2 B–93–1 (8–10')	Ammonia–N Phosphorus	571 326	335 * 317	571 322	2 9
Flasks 3 & 4 B–93–2 (19–21')	Ammonia–N Phosphorus	594 349	615 349	605 349	0 1
Flasks 5 & 6 B–93–3 (11–13')	Ammonia–N Phosphorus	582 341	575 331	579 336	1 4
Flasks 7 & 8 Water Controls	Ammonia–N Phosphorus	578 349	592 354	585 352	-- --

Notes:

Nutrient adsorption testing performed according to RETEC SOP #730. Samples incubated 24 hours on a rotary shaker, then centrifuged and filtered. Filtrate preserved with H_2SO_4 and then analyzed for total Kjeldahl Nitrogen (EPA 353.2) and total phosphorus (EPA 365.2). Samples could not be analyzed for ammonia and ortho–phosphate directly because sample preservative results in precipitation of phosphate.

* This sample not included in calculation of sample mean due to disparity between duplicate samples.

TABLE 6–6

Results of Precipitation Testing

Sample Description	Compound	Measured Concentration (mg/L)		
		TSS (mg/L)	Ammonia	Phosphate
Initial Groundwater Composite (Before Filtering)	Sample A	5,040	--	--
	Sample B	5,000	--	--
	Mean	5,020	--	--
Initial Groundwater Composite (After Filtering)	Sample A	4	--	--
	Sample B	8	--	--
	Mean	6	--	--
8 Hour Samples	Sample A	32	--	--
	Sample B	8	--	--
	Mean	20	--	--
24 Hour Samples	Sample A	40	820	531
	Sample B	28	816	502
	Mean	34	818 (82 % Recovery)	516.5 (103 % Recovery)

Notes:

Composite GW sample filtered, spiked with 1,000 mg/L nitrogen (as NH_4Cl) and 500 mg/L phosphorus (as potassium phosphate). Samples incubated for 24 hours on a rotary shaker, then centrifuged and filtered. Filtrate preserved with H_2SO_4, analyzed for total Kjeldahl Nitrogen (EPA 353.2) and total phosphorus (EPA 365.2). Samples could not be analyzed for ammonia and ortho–phosphate directly because sample preservative results in precipitation of phosphate.

ammonia concentration, and 100% of the original phosphorus concentration, were recovered after 24 hours of shaking. These results indicate that significant losses of added nutrients due to reaction with groundwater constituents, and subsequent precipitation, are not expected and should not interfere with a bioremediation process at the site.

6.2.2.4 Peroxide Stability Testing

The stability of hydrogen peroxide, which is often considered as an oxygen source for *in situ* bio-remediation, was evaluated by spiking the slurries used for the nutrient adsorption study with dilution-grade, 50% hydrogen peroxide (Interox-America) to achieve an initial target peroxide concentration of 500 mg/L. Each of the slurry flasks was placed on a rotary shaker, and samples of the aqueous phase collected at regular intervals for measurement of residual peroxide concentrations. After approximately 24 hours, the slurries were spiked with a second peroxide addition, and the test repeated.

The results of the hydrogen peroxide stability test are presented in Table 6-7, and illustrated graphically in Figures 6-2 and 6-3. Figure 6-2 shows the observed concentration of hydrogen peroxide in the test flask as a function of time. The data suggest that peroxide stability increases with depth, which is fairly common, since the shallow soils tend to contain more organic compounds and therefore more chelated metals than deeper soils. The stability in the presence of soils from the 19-21 foot horizon were very good, indistinguishable from water alone. Figure 6-3 illustrates the second 24 hours of the study. The initial concentrations in this graph are approximately 500 mg/L greater than the concentrations present at the end of the first segment of the test. During this second portion of the test, all of the samples reached a final peroxide concentration of about 500 mg/L, suggesting that some of the losses in the first phase were from consumption rather than catalytic decomposition. This trend suggests that peroxide stability and therefore utilization at this site would improve over time.

These results are consistent with the data obtained from the chemical analyses of the soils, which showed very low concentrations of iron. High iron concentrations in soils are known to catalyze the rapid decomposition of peroxide, which often leads to de-gassing, i.e., the formation of bubbles of oxygen gas. When de-gassing occurs within the subsurface, it can result in poor utilization efficiency of oxygen by the sub-surface microorganisms and, in severe instances, can reduce the permeability of the formation due to plugging of the soil pore spaces with oxygen gas. The results obtained from this test suggest that hydrogen peroxide constitutes a potentially effective oxygen source for *in situ* bio-remediation at the Shore Realty site.

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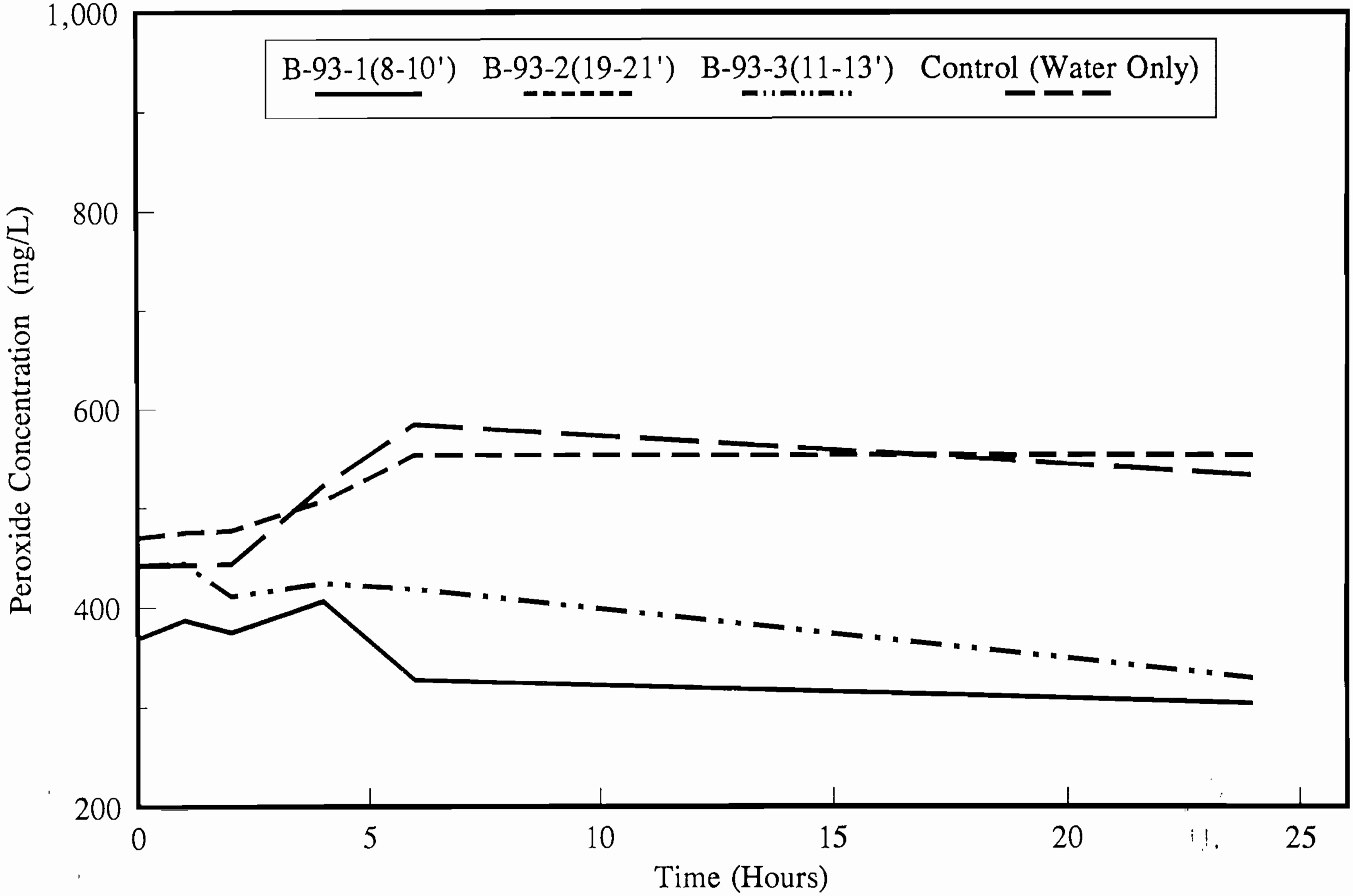

Target spike concentration = 500 mg/L.

PDIR\FIG6-2.DRW

Peroxide Stability Test - Initial Spike

Figure 6-2

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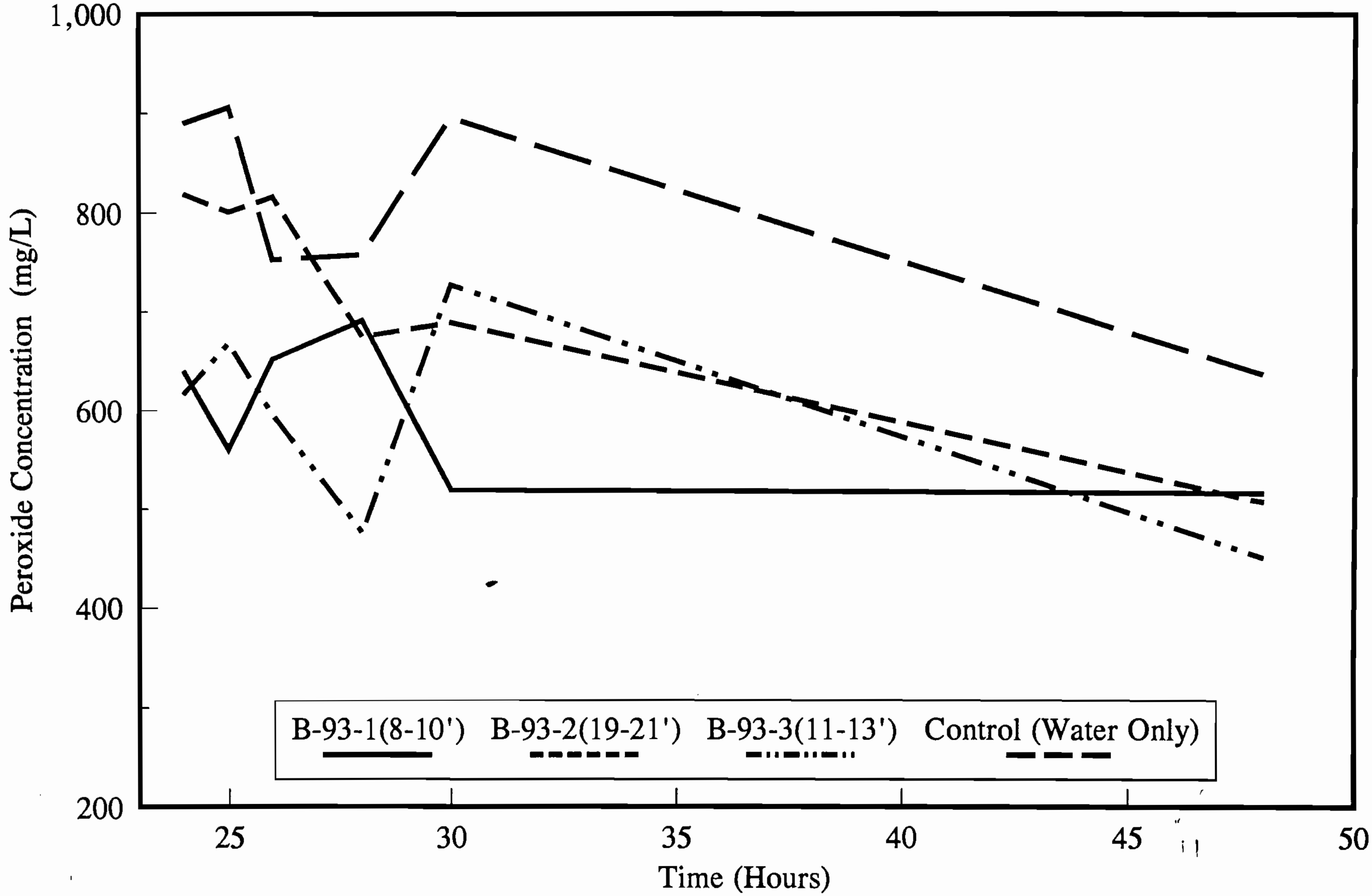


Spike added = 500 mg/L.

PDIR\FIG6-3.DRW

Peroxide Stability Test - Second Spike

Figure
6-3

TABLE 6-7

Results of Peroxide Stability Testing

Sample Description	Spike	Time (hr)	Sample Peroxide Concentration (mg/L)		
			Sample A	Sample B	Mean
Flasks 1 & 2 **B-93-1 (8-10')**	Initial	0	384	354	369
		1	417	358	387
		2	359	391	375
		4	322	490	406
		6	319	336	327
		24	330	279	304
	Repeat	0	624	656	640
		1	644	476	560
		2	645	660	652
		4	761	620	691
		6	483	556	519
		24	548	483	516
Flasks 3 & 4 **B-93-2 (19-21')**	Initial	0	--	--	0
		1	489	460	475
		2	467	486	477
		4	525	490	507
		6	532	574	553
		24	605	502	554
	Repeat	0	814	823	819
		1	711	891	801
		2	823	809	816
		4	568	782	675
		6	677	700	689
		24	538	475	507
Flasks 5 & 6 **B-93-3 (11-13')**	Initial	0	--	--	--
		1	442	446	444
		2	417	405	411
		4	446	403	424
		6	400	435	418
		24	335	323	329
	Repeat	0	613	620	616
		1	705	632	668
		2	559	631	595
		4	415	537	476
		6	707	748	727
		24	461	439	450
Flasks 7 & 8 **Water Controls**	Initial	0	422	462	442
		1	353	354	354
		2	417	469	443
		4	446	597	522
		6	488	679	584
		24	503	563	533
	Repeat	0	851	930	890
		1	907	906	906
		2	721	785	753
		4	855	660	758
		6	855	935	895
		24	610	662	636

Notes:

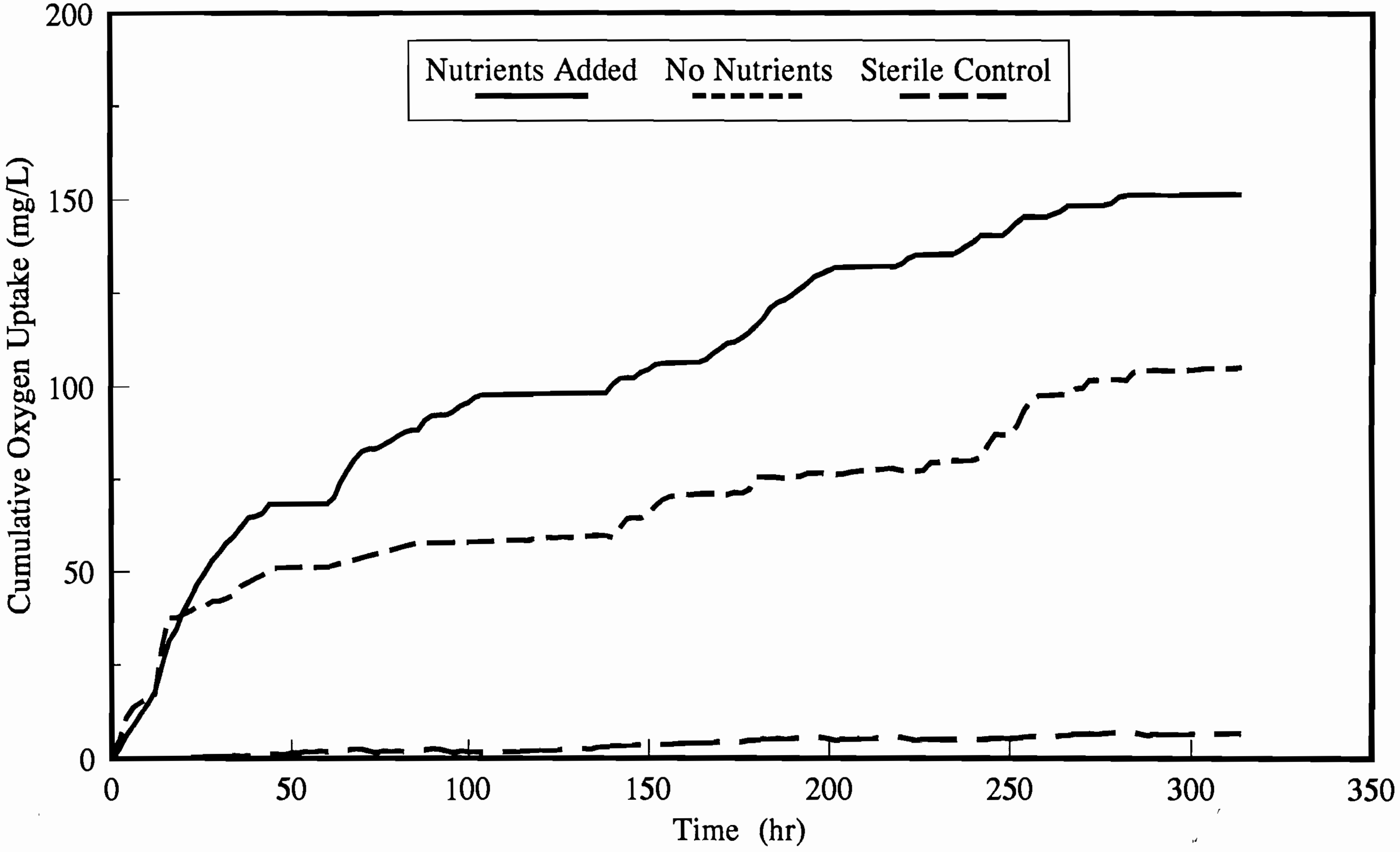
Peroxide testing performed according to RETEC SOP #735 using slurries with a 10 percent solids loading. Slurries were used for nutrient adsorption testing (RETEC SOP #730) prior to initial spiking with hydrogen peroxide. Target spike concentration was 500 mg/L hydrogen peroxide.

6.2.3 Evaluation of Contaminant Bio-degradation - Slurry Respirometry

The bio-degradation of contaminants in the site soils, and the effect of nutrient additions in enhancing the rate and extent of constituent bio-degradation, was evaluated using a slurry respirometry system. A composite soil sample was prepared from the samples collected from the water table interface and from the saturated zone sampling depths. Using the composited sample and groundwater from the site, ten identical slurry mixtures were prepared; five slurries were supplemented with inorganic nutrients (100 ppm nitrogen as KNO_3 and 20 ppm phosphorus as an equimolar mixture of KH_2PO_4 and K_2HPO_4) and the remaining five slurries received no additional nutrients. The slurries were be prepared in electrolytic respirometer flasks (Bioscience Management, Inc., Bethlehem, PA). After preparation, the slurries were allowed to equilibrate and two slurries were sampled for analysis of initial concentrations of aromatic hydrocarbons (Method 8020) and TPH (Method 8015). Two flasks (one receiving nutrients and one without nutrients) were sterilized by addition of mercuric chloride to eliminate biological activity. All of the flasks were then sealed and connected to the electrolytic respirometer instrumentation to continuously monitor oxygen uptake (refer to RETEC SOP #526). As oxygen is used in the biologically active flasks, it is simultaneously replaced by an electrolytic reaction, thus maintaining aerobic conditions within the sealed reactor. Carbon dioxide is removed from each flask using an alkaline trapping agent, which maintains a neutral pH. The sterilized flasks serve as controls to monitor non-biological consumption of oxygen and volatile losses of the contaminants.

The results of the oxygen uptake monitoring during the respirometry study are summarized in Table 6-8, and are presented graphically in Figure 6-4. This figure shows the cumulative consumption of oxygen over a 300-hour respirometry study. The data shows that the slurry reactor containing nutrients consumed approximately 40% more oxygen than the slurry without nutrients. Additionally, the flasks which did not receive nutrients appeared to reach a plateau, at which point significant additional oxygen uptake was not observed, sooner than the slurries that were supplemented with nutrients. The figure shows that sterile conditions were maintained in the control reactors, as evidenced by the insignificant amount of oxygen uptake.

The results of the analyses of contaminant concentrations at the initiation and completion of the slurry respirometry studies are presetned in Tables 6-9 and 6-10, respectively. These data show low levels of total xylenes present in the soil fraction of both the nutrient-amended and no-nutrient slurries at the initiation of the study, while significant concentrations of toluene and



Reactors transferred from stir-plate to rotary shaker after 110 hours due to technical difficulties with stir-plate method.

PDIR\FIG6-4.DRW

Slurry Respirometry Test - Oxygen Uptake

Figure 6-4

TABLE 6–8

Oxygen Uptake Monitoring Data

Time (hr)	Cumulative Oxygen Consumption (mg/L)										
	Bioactive Reactors Nitrogen and Phosphorus Added			Average of Cells 1, 2 and 3	Bioactive Reactors No Nutrients Added			Average of Cells 5, 6 and 7	Sterile Control Reactors		Average of Cells 4 and 8
	Cell 1	Cell 2	Cell 3		Cell 5	Cell 6	Cell 7		Cell 4 No Nut's.	Cell 8 With Nut's	
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	3.2	1.5	2.1	2.3	3.6	4.1	6.7	4.8	0.0	0.0	0.0
4	8.9	3.0	6.0	6.0	8.9	10.8	12.3	10.6	0.0	0.0	0.0
6	13.3	3.0	10.0	8.8	12.0	14.2	14.7	13.6	0.0	0.0	0.0
8	18.2	3.0	13.8	11.7	12.1	15.5	17.1	14.9	0.0	0.0	0.0
10	22.3	3.5	17.3	14.4	12.1	16.7	18.8	15.9	0.0	0.0	0.0
12	27.6	4.5	21.3	17.8	12.1	18.2	20.7	17.0	0.0	0.0	0.0
14	35.1	13.0	26.9	25.0	Reactor	30.0	30.4	30.2	0.0	0.0	0.0
16	42.2	19.1	32.8	31.4	Destroyed	37.9	37.3	37.6	0.0	0.0	0.0
18	45.4	20.7	37.8	34.6	--	37.9	37.4	37.6	0.2	0.2	0.2
20	48.7	27.8	42.1	39.5	--	38.7	38.5	38.6	0.3	0.2	0.2
22	51.8	32.5	45.4	43.2	--	40.0	39.0	39.5	0.5	0.4	0.4
24	55.1	36.5	49.2	46.9	--	42.4	39.1	40.8	0.4	0.3	0.3
26	60.5	36.6	52.3	49.8	--	42.5	39.1	40.8	0.4	0.3	0.3
28	65.4	37.4	56.4	53.1	--	42.4	41.7	42.1	0.4	0.3	0.4
30	69.4	37.4	59.1	55.3	--	42.5	41.7	42.1	0.6	0.4	0.5
32	74.8	37.5	61.1	57.8	--	42.5	43.2	42.9	0.6	0.5	0.6
34	80.0	37.5	61.1	59.5	--	44.6	43.3	43.9	0.9	0.6	0.7
36	85.9	38.3	62.0	62.1	--	46.3	45.9	46.1	0.7	0.5	0.6
38	89.0	40.8	64.1	64.6	--	47.3	46.9	47.1	0.8	0.6	0.7
40	89.0	41.6	64.1	64.9	--	48.3	47.9	48.1	1.1	0.8	1.0
42	88.9	44.5	64.0	65.8	--	49.3	48.9	49.1	1.3	0.9	1.1
44	90.9	47.3	66.6	68.3	--	50.3	49.9	50.1	1.2	0.9	1.1
46	90.9	47.3	66.6	68.3	--	51.3	50.9	51.1	1.3	1.0	1.1
48	90.9	47.3	66.6	68.3	--	51.3	50.9	51.1	1.2	0.8	1.0
50	90.9	47.3	66.6	68.3	--	51.3	50.9	51.1	1.7	1.2	1.5
52	90.9	47.3	66.6	68.3	--	51.3	50.9	51.1	1.7	1.2	1.5
54	90.9	47.3	66.6	68.3	--	51.3	50.9	51.1	2.2	1.5	1.8
56	90.9	47.3	66.7	68.3	--	51.3	50.9	51.1	2.0	1.4	1.7
58	91.0	47.4	66.7	68.4	--	51.4	51.0	51.2	2.3	1.7	2.0
60	91.0	47.4	66.7	68.4	--	51.4	51.0	51.2	2.0	1.4	1.7
62	92.2	49.9	68.0	70.0	--	51.9	51.5	51.7	2.4	1.7	2.1
64	97.0	53.7	72.1	74.3	--	52.4	52.0	52.2	2.5	1.8	2.1
66	100.9	56.7	75.0	77.5	--	52.9	52.5	52.7	2.6	1.9	2.2
68	104.5	59.7	77.4	80.5	--	53.4	53.0	53.2	2.9	2.1	2.5
70	106.8	61.9	78.9	82.5	--	53.9	53.5	53.7	2.6	1.9	2.3
72	107.4	62.7	79.4	83.2	--	54.4	54.0	54.2	2.1	1.5	1.8
74	107.4	62.7	79.4	83.2	--	54.9	54.5	54.7	1.7	1.2	1.5
76	108.7	63.5	80.3	84.2	--	55.4	55.0	55.2	2.2	1.5	1.9
78	109.9	64.3	81.4	85.2	--	55.9	55.5	55.7	2.0	1.4	1.7
80	111.2	65.9	82.4	86.5	--	56.4	56.0	56.2	2.3	1.7	2.0
82	112.7	66.5	83.2	87.5	--	56.9	56.5	56.7	2.0	1.5	1.7
84	113.3	67.2	84.1	88.2	--	57.4	57.0	57.2	2.4	1.7	2.1

TABLE 6–8

Oxygen Uptake Monitoring Data

Time (hr)	Cumulative Oxygen Consumption (mg/L)										
	Bioactive Reactors Nitrogen and Phosphorus Added			Average of Cells 1, 2 and 3	Bioactive Reactors No Nutrients Added			Average of Cells 5, 6 and 7	Sterile Control Reactors		Average of Cells 4 and 8
	Cell 1	Cell 2	Cell 3		Cell 5	Cell 6	Cell 7		Cell 4 No Nut's.	Cell 8 With Nut's	
86	113.2	67.2	84.1	88.2	--	57.9	57.5	57.7	2.5	1.8	2.1
88	Transferred to single shake–flask reactor due to risk of reactor failure.			90.9	Transferred to single shake–flask reactor due to risk of reactor failure.			57.7	Transferred to single shake–flask reactor due to risk of reactor		2.2
90				92.2				57.7			2.5
92				92.3				57.6			2.3
94	--	--	--	92.3	--	--	--	57.7	--	--	1.8
96	--	--	--	93.3	--	--	--	57.8	--	--	1.5
98	--	--	--	94.8	--	--	--	57.8	--	--	1.9
100	--	--	--	95.6	--	--	--	57.9	--	--	1.7
102	--	--	--	97.1	--	--	--	58.1	--	--	1.7
104	--	--	--	97.7	--	--	--	57.9	--	--	1.6
106	--	--	--	97.8	--	--	--	58.1	--	--	1.6
108	--	--	--	97.8	--	--	--	58.3	--	--	1.8
110	--	--	--	97.8	--	--	--	58.4	--	--	1.7
112	--	--	--	97.8	--	--	--	58.4	--	--	1.7
114	--	--	--	97.8	--	--	--	58.4	--	--	1.8
116	--	--	--	97.9	--	--	--	58.3	--	--	1.9
118	--	--	--	97.9	--	--	--	58.8	--	--	1.9
120	--	--	--	98.1	--	--	--	58.8	--	--	2.1
122	--	--	--	98.0	--	--	--	59.2	--	--	2.0
124	--	--	--	98.1	--	--	--	59.0	--	--	2.1
126	--	--	--	98.1	--	--	--	59.3	--	--	2.4
128	--	--	--	98.2	--	--	--	59.1	--	--	2.5
130	--	--	--	98.2	--	--	--	59.3	--	--	2.5
132	--	--	--	98.2	--	--	--	59.5	--	--	2.5
134	--	--	--	98.3	--	--	--	59.5	--	--	2.4
136	--	--	--	98.3	--	--	--	59.8	--	--	2.9
138	--	--	--	98.1	--	--	--	59.6	--	--	2.9
140	--	--	--	100.5	--	--	--	59.2	--	--	3.2
142	--	--	--	102.1	--	--	--	61.7	--	--	3.2
144	--	--	--	102.3	--	--	--	64.3	--	--	3.2
146	--	--	--	102.3	--	--	--	64.5	--	--	3.5
148	--	--	--	103.8	--	--	--	64.5	--	--	3.5
150	--	--	--	104.5	--	--	--	65.6	--	--	3.7
152	--	--	--	105.9	--	--	--	67.9	--	--	3.6
154	--	--	--	106.2	--	--	--	69.5	--	--	3.6
156	--	--	--	106.3	--	--	--	70.3	--	--	3.6
158	--	--	--	106.4	--	--	--	70.6	--	--	3.8
160	--	--	--	106.4	--	--	--	70.9	--	--	3.8
162	--	--	--	106.5	--	--	--	70.8	--	--	4.0
164	--	--	--	106.5	--	--	--	71.0	--	--	3.9
166	--	--	--	107.2	--	--	--	71.1	--	--	4.0
168	--	--	--	108.9	--	--	--	71.1	--	--	4.2
170	--	--	--	110.1	--	--	--	70.9	--	--	4.4

TABLE 6–8

Oxygen Uptake Monitoring Data

Time (hr)	Cumulative Oxygen Consumption (mg/L)										
	Bioactive Reactors Nitrogen and Phosphorus Added			Average of Cells 1, 2 and 3	Bioactive Reactors No Nutrients Added			Average of Cells 5, 6 and 7	Sterile Control Reactors		Average of Cells 4 and 8
	Cell 1	Cell 2	Cell 3		Cell 5	Cell 6	Cell 7		Cell 4 No Nut's.	Cell 8 With Nut's	
172	--	--	--	111.6	--	--	--	70.8	--	--	4.3
174	--	--	--	111.9	--	--	--	71.4	--	--	4.4
176	--	--	--	113.0	--	--	--	71.2	--	--	4.3
178	--	--	--	114.4	--	--	--	72.1	--	--	4.8
180	--	--	--	116.2	--	--	--	75.5	--	--	4.7
182	--	--	--	118.1	--	--	--	75.6	--	--	5.1
184	--	--	--	121.0	--	--	--	75.6	--	--	5.0
186	--	--	--	122.5	--	--	--	75.4	--	--	5.2
188	--	--	--	123.2	--	--	--	75.2	--	--	5.0
190	--	--	--	124.5	--	--	--	75.9	--	--	5.3
192	--	--	--	126.0	--	--	--	75.7	--	--	5.4
194	--	--	--	127.5	--	--	--	76.5	--	--	5.5
196	--	--	--	129.4	--	--	--	76.7	--	--	5.7
198	--	--	--	130.2	--	--	--	76.6	--	--	5.5
200	--	--	--	131.1	--	--	--	76.4	--	--	5.1
202	--	--	--	132.0	--	--	--	76.3	--	--	4.7
204	--	--	--	132.0	--	--	--	76.4	--	--	5.1
206	--	--	--	132.0	--	--	--	76.9	--	--	5.0
208	--	--	--	132.1	--	--	--	77.2	--	--	5.3
210	--	--	--	132.1	--	--	--	77.3	--	--	5.0
212	--	--	--	132.2	--	--	--	77.5	--	--	5.3
214	--	--	--	132.2	--	--	--	77.6	--	--	5.4
216	--	--	--	132.2	--	--	--	77.9	--	--	5.5
218	--	--	--	132.1	--	--	--	77.8	--	--	5.8
220	--	--	--	132.9	--	--	--	77.3	--	--	5.5
222	--	--	--	134.4	--	--	--	77.3	--	--	5.1
224	--	--	--	135.2	--	--	--	77.2	--	--	4.7
226	--	--	--	135.2	--	--	--	77.4	--	--	5.1
228	--	--	--	135.3	--	--	--	79.5	--	--	5.0
230	--	--	--	135.3	--	--	--	79.5	--	--	5.0
232	--	--	--	135.4	--	--	--	79.9	--	--	4.9
234	--	--	--	135.4	--	--	--	80.0	--	--	4.9
236	--	--	--	136.3	--	--	--	80.0	--	--	5.1
238	--	--	--	137.6	--	--	--	79.9	--	--	5.0
240	--	--	--	138.8	--	--	--	80.2	--	--	5.0
242	--	--	--	140.6	--	--	--	81.0	--	--	5.0
244	--	--	--	140.4	--	--	--	84.5	--	--	5.2
246	--	--	--	140.5	--	--	--	87.2	--	--	5.2
248	--	--	--	140.5	--	--	--	87.0	--	--	5.4
250	--	--	--	142.1	--	--	--	87.2	--	--	5.2
252	--	--	--	144.0	--	--	--	89.5	--	--	5.4
254	--	--	--	145.5	--	--	--	93.7	--	--	5.6
256	--	--	--	145.5	--	--	--	96.4	--	--	5.8

TABLE 6–8

Oxygen Uptake Monitoring Data

Time (hr)	Cumulative Oxygen Consumption (mg/L)										
	Bioactive Reactors Nitrogen and Phosphorus Added			Average of Cells 1, 2 and 3	Bioactive Reactors No Nutrients Added			Average of Cells 5, 6 and 7	Sterile Control Reactors		Average of Cells 4 and 8
	Cell 1	Cell 2	Cell 3		Cell 5	Cell 6	Cell 7		Cell 4 No Nut's.	Cell 8 With Nut's	
258	--	--	--	145.5	--	--	--	97.6	--	--	5.7
260	--	--	--	145.5	--	--	--	97.7	--	--	5.8
262	--	--	--	146.3	--	--	--	97.7	--	--	5.6
264	--	--	--	147.0	--	--	--	97.9	--	--	6.1
266	--	--	--	148.5	--	--	--	97.7	--	--	6.1
268	--	--	--	148.5	--	--	--	99.4	--	--	6.5
270	--	--	--	148.5	--	--	--	99.6	--	--	6.4
272	--	--	--	148.5	--	--	--	101.8	--	--	6.6
274	--	--	--	148.5	--	--	--	101.8	--	--	6.4
276	--	--	--	148.7	--	--	--	101.8	--	--	6.7
278	--	--	--	149.2	--	--	--	102.0	--	--	6.8
280	--	--	--	150.8	--	--	--	102.0	--	--	6.9
282	--	--	--	151.2	--	--	--	101.8	--	--	7.1
284	--	--	--	151.4	--	--	--	103.9	--	--	6.9
286	--	--	--	151.4	--	--	--	104.3	--	--	6.5
288	--	--	--	151.3	--	--	--	104.4	--	--	6.1
290	--	--	--	151.3	--	--	--	104.5	--	--	6.5
292	--	--	--	151.3	--	--	--	104.4	--	--	6.4
294	--	--	--	151.2	--	--	--	104.3	--	--	6.4
296	--	--	--	151.3	--	--	--	104.4	--	--	6.2
298	--	--	--	151.5	--	--	--	104.4	--	--	6.3
300	--	--	--	151.5	--	--	--	104.6	--	--	6.5
302	--	--	--	151.5	--	--	--	104.7	--	--	6.4
304	--	--	--	151.5	--	--	--	105.0	--	--	6.4
306	--	--	--	151.5	--	--	--	105.0	--	--	6.4
308	--	--	--	151.6	--	--	--	105.0	--	--	6.6
310	--	--	--	151.6	--	--	--	105.0	--	--	6.6
312	--	--	--	151.6	--	--	--	105.1	--	--	6.8
314	--	--	--	151.4	--	--	--	105.3	--	--	6.6

Notes:

1) Set 2 amended with 100 mg/L nitrate–nitrogen and 20 mg/L phosphorus.

2) Sterile controls amended with 2 percent mercuric chloride (20 g/L).

3) Heavy stir–bar wear observed in all reactors. Iron oxidation visible in sterile control reactors.

4) Reactor operation terminated after 86 hours to prevent reactor destruction and sample compromise.
Samples transferred to shake–flask reactors (4–Liter serum bottles).

Table 6–9

Results of Initial Contaminant Analyses

Shore Realty Site

Glenwood Landing, New York

Analysis	Constituent Concentrations			
	Nutrient Amended Samples		Samples Not Amended With Nutrients	
	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)	Water (ug/L)
TPH (EPA 8015) (1)	< 10.0	< 10000	< 10.0	8000 J
BTEX (EPA 8020)				
Benzene	<0.0012	< 1.0	<0.0012	<5.0
Toluene	0.0042	< 1.0	<0.0012	590
Ethylbenzene	<0.0012	< 1.0	<0.0012	<5.0
Total Xylenes	0.021	< 1.0	0.011	2000

Notes:

1) TPH analysis performed by NEI (Port Washington, NY) using hexane as an extraction solvent.

J – Concentration quantified below detection limit.

xylenes (0.59 mg/L and 2.00 mg/L, respectively) were noted in the aqueous phase of the no-nutrient treatment condition only.

At the conclusion of the respirometry study, all analytes were reduced to below detection limits in the biologically active reators; however, low concentrations of xylenes were detected in both the soil and aqueous phases of the sterile control reactors. Additionally, diesel-range petroleum hydrocarbons were shown to persist in the sterile controls, while these hydrocarbons were not observed in any of the biologically active reactors. These results confirm that biological processes are capable of reducing concentrations of the constituents of concern at the site.

It should be noted that initial constituent concentrations in the soils and groundwater were lower than desirable for this type of study. The soil sample used for the respirometry studies was a composite sample consisting of equal portions of the water table and saturated zone samples from each of the soil borings (a total of six individual samples). Only three of these samples were subsequently found to have significant concentrations of purgeable aromatic compounds detectable by Method 8020, and none of the samples exhibited TPH concentrations detectable by NEI's analyses (Table 6-10). Thus, the concentrations of the target compounds for the respirometry study were reduced through a combination of dilution and volatilization as a result of the formation of the composite sample. Therefore, these data do not allow direct evaluation of the effect of nutrient supplementation on enhanced organic constituent biodegradation. Nevertheless, the increased oxygen utilization resulting from nutrient addition suggests that the rate of organic constituent biodegradation is likely to be increased by supplementing ambient levels of inorganic nutrients. The Basis of Design for the remedy at the site will therefore incorporate nutrient addition as a component of the *in situ* bioremediation process.

6.3 WATER TREATMENT

The objective of the water treatment evaluation was to assess the various treatment processes for the effective removal of the potential constituents-of-interest, specifically iron and various volatile and semi-volatile organic compounds. Many chemicals could be used for the precipitation of iron. However, the principal considerations are the implementability and economics of the process. The study below evaluated iron removal methods for optimum removal of iron. In groundwater, iron is present in its reduced form as ferrous hydroxide. Oxygen oxidizes it and precipitates it as flocculent ferric hydroxide. Under natural conditions, atmospheric oxygen can oxidize ferrous hydroxide, but its oxidation and precipitation are

Table 6-10

Results of Week 3 Contaminant Analyses

Shore Realty Site

Glenwood Landing, New York

Parameters	Constituent Concentrations											
	Nutrient Amended Samples				Samples Not Amended With Nutrients				Sterile Control Samples			
	Sample 1		Sample 2		Sample 1		Sample 2		Sample 1		Sample 2	
	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)	Water (ug/L)	Soil (mg/kg)	Water (ug/L)
NEI Data												
TPH (EPA 8015) (1)	<10.0	<10000	<10.0	<10000	<10.0	<10000	<10.0	<10000	<10.0	<10000	<10.0	<10000
BTEX (EPA 8020)												
Benzene	<0.002	<1.0	<0.0017	<1.0	<0.0012	<1.0	<0.0018	<1.0	<0.0015	<1.0	<0.0018	<1.0
Toluene	<0.002	<1.0	<0.0017	<1.0	<0.0012	<1.0	<0.0018	<1.0	<0.0015	<1.0	<0.0038 B	<1.0
Ethylbenzene	<0.002	<1.0	<0.0017	<1.0	<0.0012	<1.0	<0.0018	<1.0	<0.0015	<1.0	<0.0018	<1.0
Total Xylenes	<0.002	<1.0	<0.0017	<1.0	<0.0012	<1.0	<0.0018	<1.0	<0.0023	2.2	<0.0093	2.2
ARI Data												
TPH (EPA 8015 mod.) (2)												
Gasoline Range	<20	NS	<20	NS	<20	NS	<20	NS	12 J	NS	<20	NS
Diesel Range	<25	NS	<25	NS	<25	NS	<25	NS	100	NS	100	NS

Notes:

1) TPH analysis performed by NEI (Port Washington, NY) using hexane as an extraction solvent.
2) TPH analysis performed by Analytical Resources (Seattle, WA) using methylene chloride as an extraction solvent.
Gasoline range TPH includes C12 to C24 hydrocarbons. Diesel range TPH includes C24 to C36 hydrocarbons.
NS – No sample.
J – Concentration quantified below the detection limit.
B – Detected in method blank.

protracted. Conventional treatment involves the addition of an oxidizing chemical to enhance ferric hydroxide formation. In addition to the oxidants, coagulant aids are often added to improve the settling characteristics of the hydroxide flocs in the solid/liquid separation. Co-oxidation of organics is an indirect benefit achieved in the chemical oxidation. Many chemicals can be used for the precipitation of iron. However, implementability and economy dictate the final choice of chemicals for the removal of iron by chemical precipitation.

Oxygen present in air, ozone (O_3), chlorine (Cl_2 or NaOCl), hydrogen peroxide (H_2O_2), and potassium permanganate ($KMnO_4$) could achieve oxidation of the ferrous iron (Fe^{2+}) to the ferric iron (Fe^{3+}) and its subsequent precipitation as $Fe(OH)_3(s)$. Potassium permanganate ($KMnO_4$) was selected as the oxidant of choice for the following reasons:

(1) Chlorine addition could potentially result in the partial breakdown of specific organics as well as the formation of chlorinated organics (e.g., chloroform). Additionally, chlorine supplied as a gas would require a separate storage building. Also, special handling provisions would be needed to insure against the rupture and subsequent explosion of the gas cylinders.

(2) Air oxidation is relatively slower than the other oxidants near a neutral pH range (i.e., hours as opposed to minutes). Thus, to achieve faster reaction kinetics, pH adjustment of a value greater than 9.0 would be required. After such oxidation of the iron, the groundwater pH would have to be adjusted down to a more neutral range prior to treatment.

(3) Ozone requires significantly more capital equipment than the other oxidants, and would entail use of a contractor, an ozone generator, and cooling water and thus it would be more costly.

(4) Hydrogen peroxide (H_2O_2) is most reactive with iron within a pH range of 4-6; thus, acid addition and pH control would be required to adjust and control the groundwater within this range. Also, H_2O_2 addition could result in partial breakdown products of the specific organics in the Site groundwater as well as result in an increase in the H_2O_2 requirement above the stoichiometric amount required for iron oxidation due to potential reactions with organics in the groundwater.

(5) Potassium permanganate ($KMnO_4$) is a proven and widely-accepted oxidant for iron removal. Additionally, the oxidation potential of $KMnO_4$ is similar to that of Cl_2, O_3, and H_2O_2 and $KMnO_4$ are most reactive within a neutral pH range. Residual levels of manganese are typically less than one mg/L and must be monitored where an effluent manganese limit is applicable. While the reaction generates small amounts of acid, pH adjustment may be necessary when significant levels of iron are present.

Potassium permanganate ($KMnO_4$, FW- 158.0) is a granular crystal having a specific gravity of 2.703 g/cm^3 and a bulk density of 1.607 g/cm^3. Equation 6-1 is the iron oxidation reaction between $KMnO_4$ and Fe^{2+} when they are both at a weight ratio of 1:1. Iron oxidation results in the precipitation of both reduced Mn as MnO_2 and oxidized iron as $Fe(OH)_3$.

$$KMnO_4 + 3Fe^{2+} + 7H_2O \leftarrow MnO_2(s) + 3Fe(OH)_3(s) + 5H^+ + K^+ \qquad (6\text{-}1)$$

This reaction is rapid and independent of pH between a range of 6 to 10. It is noteworthy that since this reaction generates an acid, pH adjustment, via caustic addition, is usually necessary if influent iron levels are significant relative to the influent alkalinity.

6.3.1 Iron Removal Evaluation (Jar Testing)

In order to evaluate the oxidant and coagulant dosages, a series of jar tests was performed using samples of groundwater and various dosages of $KMnO_4$ and coagulant aids. The following equipment and materials were used in the jar test.

- six-paddle stirrer;
- potassium permanganate;
- cationic and anionic polymers;
- acid (usually sulfuric);
- base (usually NaOH);
- pH meter;
- stopwatch;
- glassware (pipettes, beakers, and graduated cylinders);
- jars (plastic and glass); and
- test strips for iron and manganese determination.

The evaluation proceeded in three (3) steps to determine the optimum dosage of chemical required.

Step 1 - Optimization of $KMnO_4$ Dosage

- A 0.2M $KMnO_4$ solution was prepared dissolving 3.16 grams of $KMnO_4$ in 100 ml. Five doses, namely, 50, 75, 100, 125, and 150% of stoichiometric requirements, were evaluated.

- To 500 ml groundwater water samples, a calculated quantity of 0.2 M $KMnO_4$ solution was added. The sample was rapidly mixed at a rate of 100 rpm for 1 minute, then slowly mixed at 20-30 rpm for 5 minutes, and then allowed to settle for 10 minutes. The pH was adjusted to within the range of 7.5 to 8.5, with a 10% by weight solution of NaOH. The volume of solution required was then recorded. The initial and final pH, along with soluble iron and manganese concentrations were measured. Test strips were used to determine the concentration of iron and manganese in the water and to select the best dose. The volume of the supernatant and the sludge were noted. TSS, VSS, and FSS in the supernatant and the sludge were measured, and the sludge production computed. Samples of treated and untreated water were sent to an approved lab for the analysis of soluble iron and manganese.

Step 2 - Optimization of Single Cationic or Anionic or Non-Ionic Polymer

The potential polymers that were evaluated in the jar test are:

- Drewfloc,
- Clearwater,
- Amerfloc, and
- Betz.

In this test, the performance of each polymer was evaluated with the combination of the previously determined optimal $KMnO_4$ dose. The optimum dosage of a polymer was selected from its ability to produce clear supernatant and good settling flocs.

Cationic polymers were first tried at 1, 2, 5, 7.5, 10, and 15 mg/l, and the optimal $KMnO_4$ dose and the best combination dose were selected. Then the anionic polymers were tried at 0.5, 1.0, 1.5, 2.0, and 5.0 mg/L, and the optimal $KMnO_4$ dosage and the best combination were selected. Finally, the non-ionic polymer was tried at 0.5, 1.0, 1.5, 2.0, and 5 mg/L with the optimum $KMnO_4$ dosage.

The test was repeated with the best dosage of each polymer. If a single polymer produced clear supernatant after 20 minutes settling, that polymer was selected for the final use. TSS, FSS, and VSS in the supernatant and the sludge were measured.

Step 3 - Optimization of Polymer Combination

Sometimes a single polymer produced only pin flocs which did not settle within any reasonable time. In such cases, a combination of cationic and anionic polymers was required.

Then as before, an optimum cationic polymer dose was first selected in conjunction with the optimal $KMnO_4$ dose. Various dosages of anionic polymer were tried with the best combined dose of $KMnO_4$ plus cationic polymer. The anionic dose which produced the best settling floc and clear supernatant was selected for the final design. TSS, VSS, and FSS were measured in the supernatant and sludge.

6.3.2 Jar Test Results

The sample as received exhibited a pH of approximately 6.4 units, and contained 25 mg/L soluble iron as determined by the test strips. Six treatability runs were conducted to evaluate pre-treatment of the groundwater for removal of soluble iron. Run #1 was conducted using only pH adjustment to oxidize the soluble iron, with cationic polymer added to enhance separation. Runs #2 through #6 were conducted as previously described. Run #2 was performed to determine the optimal dosage for potassium permanganate ($KMnO_4$) addition in terms of the stoichiometric requirements based on the quantity of soluble iron present. This dosage was identified as 25% of the stoichiometric requirement. Run #3 was performed to determine the optimal cationic dosage to enhance separation of the oxidized iron after $KMnO_4$. This dosage was determined to be 5 mg/L. Runs #4 and #5 were performed to determine the optimal combination of cationic and anionic dosage to enhance separation of the oxidized iron after $KMnO_4$. This combination dosage was determined to be $KMnO_4$ at 25%, cationic polymer at 1 mg/L and anionic polymer at 0.8 mg/L. Run #6 was performed using each of the best performing treatment scenarios identified to compare the results. The three treatment scenarios included pH adjustment to 8.4 with NaOH and cationic polymer addition at 1 mg/L, 25% $KMnO_4$ pH adjustment to >7.5 and 5 mg/L cationic polymer, and 25% $KMnO_4$ with pH adjustment to >7.5, and 1 mg/L cationic polymer followed by 0.8 mg/L anionic polymer. Each of these three scenarios yielded adequate results with no detectable levels of soluble iron present in the supernatant as determined by the test strips. Copies of the laboratory data sheets and results summary sheets are provided as Appendix F. Results of confirming laboratory analysis will be available within two weeks. Since three treatment scenarios appeared to treat the groundwater equally in terms of soluble iron removal, selection will be based upon economic considerations and confirmation of the removal efficiency. Both the technical and cost-benefit evaluations will be incorporated into the Basis of Design Memorandum. Selection of the specific treatment process will be incorporated into the final design process.

7.0 REFERENCES

Cohen, P., O.L. Franke, and B.L. Foxworthy. *An Atlas of Long Island's Water Resources*. New York Water Resources Commission Bulletin 62, 1968.

Ferris, J.G. *Cyclic Water-Level Fluctuations as a Basis for Determining Aquifer Transmissivity*. U.S. Geological Survey Water-Supply Paper 1536-I, pp.305-318, 1963.

Franke, O.L., and P. Cohen. *Regional Rates of Ground-Water Movement on Long Island, New York*. U.S. Geological Survey Professional Paper 800-C, 1972.

Getzen, R.T. *Analog-Model Analysis of Regional Three-Dimensional Flow in the Ground-Water Reservoir of Long Island, New York*. U.S. Geological Survey Professional Paper 982, 1977.

Kilburn, C., and R.K. Krulikas. *Hydrogeology and Ground-Water Quality of the Northern Part of the Town of Oyster Bay, Nassau County, New York, in 1980*. U.S. Geological Survey Water-Resources Investigations Report 85-4051, 1987.

McClymonds, N.E., and O.L. Franke. *Water-Transmitting Properties of Aquifers on Long Island, New York*. U.S. Geological Survey Professional Paper 627-E, 1972.

New York State Department of Environmental Conservation and United States Environmental Protection Agency. *Record of Decision, Applied Environmental Services Site [Shore Realty Site], Nassau County, New York*, ID Number 13006, June, 1991.

NOAA. *Local Climetological Data - New York, LaGuardia Field, New York*. ISSNO198-3636, 1991.

RETEC, Inc. *"Remediation of Soils Containing Petroleum Constituents"*, Petroleum Environmental Research Forum/Conoco, Inc., Ponca City, OK, 1991.

Roux Associates, Inc. *Feasibility Study, Shore Realty Site, Glenwood Landing, New York*, 1991.

Roux Associates, Inc. *Remedial Investigation, Shore Realty Site, Glenwood Landing, New York*, 1991.

Ryan, John R. and R.C. Loehr. *"Bioremediation of Organic Contaminated Soils"*, Journal of Hazardous Materials, 1991.

United States District Court, Eastern District of New York. *Consent Judgment, The State of New York against Shore Realty Corp.*, August, 1992.

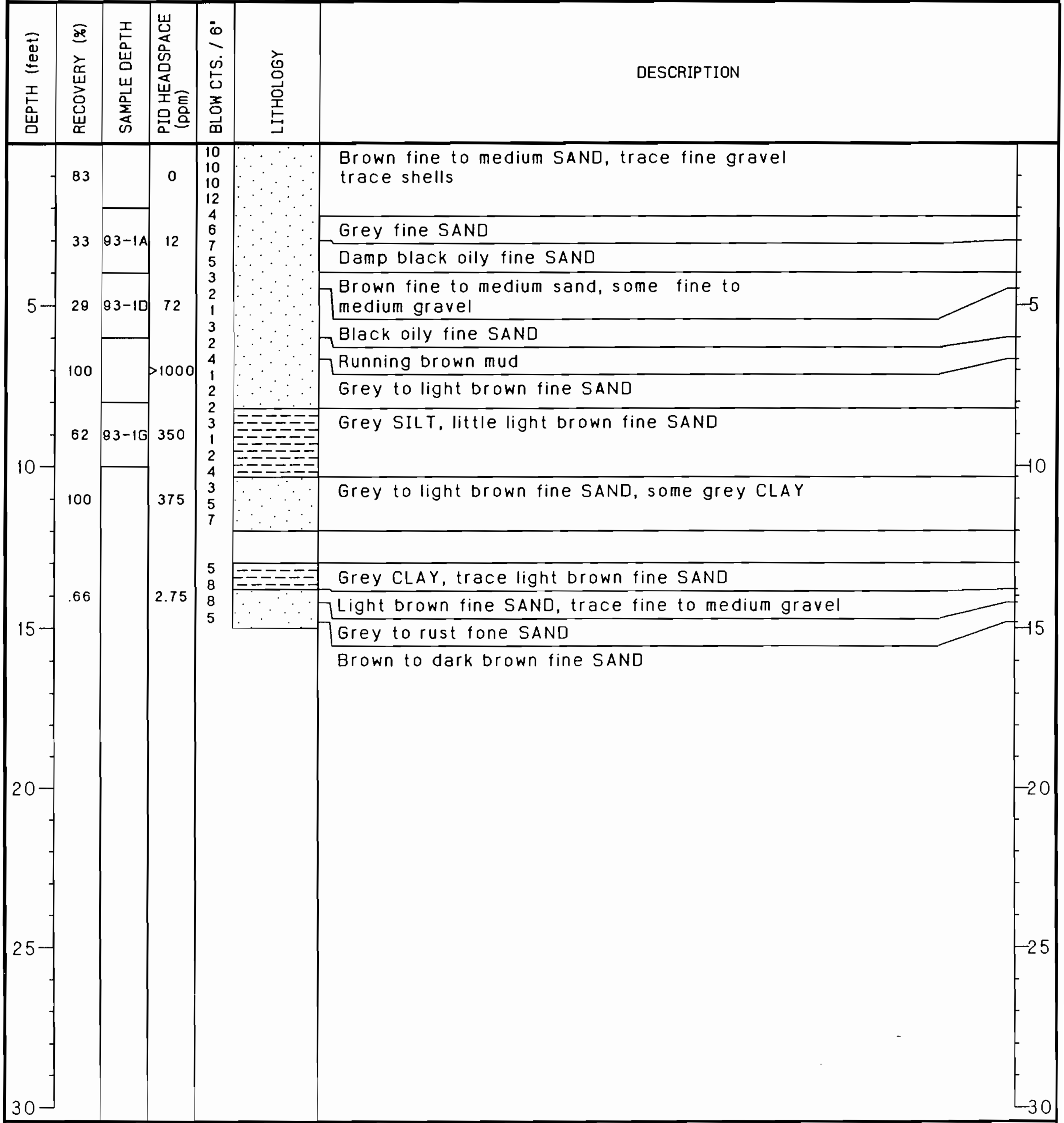
APPENDIX A

Boring Logs

SOIL BORING LOG
B-93-1

9 Pond Lane
Concord, MA 01742
(508)371-1422

PROJECT NO: *3-1033-210*	DRILLING CO.: *Warren George*	MP ELEV.: *' (MSL)*
CLIENT: *Performing Parties Trust*	DRILLER: *Vincent Gandolgo*	TOTAL DEPTH: *15'*
SITE LOCATION: *Glenwood Landing, NY*	BORING ID: *6 3/4*	SURFACE ELEV.: *' (MSL)*
START DATE: *3-9-93* TIME: *9:30*	CASING ID:	WATER LEVEL DURING DRILLING: *5'*
COMPLETION DATE: *3-9-93* TIME: *10:35*	METHOD: *Hollow Stem*	
BORING LOCATION: *Shore Realty*	LOGGED BY: *Dieter Geithner*	



DEPTH (feet)	RECOVERY (%)	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW CTS. / 6"
	83		0	10 10 10 12
	33	93-1A	12	4 6 7 5
5	29	93-1D	72	3 2 1 3
	100		>1000	2 4 1 2
	62	93-1G	350	2 3 1 2
10	100		375	4 3 5 7
	.66		2.75	5 8 8 5
15				
20				
25				
30				

DESCRIPTION

- Brown fine to medium SAND, trace fine gravel trace shells
- Grey fine SAND
- Damp black oily fine SAND
- Brown fine to medium sand, some fine to medium gravel
- Black oily fine SAND
- Running brown mud
- Grey to light brown fine SAND
- Grey SILT, little light brown fine SAND
- Grey to light brown fine SAND, some grey CLAY
- Grey CLAY, trace light brown fine SAND
- Light brown fine SAND, trace fine to medium gravel
- Grey to rust fone SAND
- Brown to dark brown fine SAND

REMARKS.

REMEDIATION TECHNOLOGIES, Inc.

SOIL BORING LOG
B-93-3

9 Pond Lane
Concord, MA 01742
(508)371-1422

PROJECT NO: *3-1033-210*	DRILLING CO.: *Warren George*	MP ELEV.: *' (MSL)*
CLIENT: *Performing Parties Trust*	DRILLER: *Vincent Gandolgo*	TOTAL DEPTH: *49'*
SITE LOCATION: *Glenwood Landing, NY*	BORING ID: *6 3/4*	SURFACE ELEV.: *' (MSL)*
START DATE: *2/26/93* TIME: *10:45*	CASING ID:	WATER LEVEL DURING DRILLING: *7'*
COMPLETION DATE: *2/26/93* TIME: *12:10*	METHOD: *Hollow Stem*	
BORING LOCATION:	LOGGED BY: *Mike Devir*	

DEPTH (feet)	RECOVERY (%)	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW CTS. / 6"	LITHOLOGY	DESCRIPTION
	66	93-3A	0	4 2 2 2		Dark brown loam Damp brown fine to medium SAND
5						Tan to light brown fine to medium SAND
	58	93-3D	2.5	6 5 3 1		Saturated dark brown medium to fine SAND Tan silty fine to medium SAND, little fine to medium gravel
10						
	17	93-3G	N/A	1 0 1 0		Saturated brown fine to medium SAND, trace coarse gravel
				13		
15	83		4	9 8 8		Brown fine to medium SAND, trace fine to medium gravel Redish fine to medium SAND and fine to medium GRAVEL Tan to reddish fine to medium SAND
20						
	100	93-3J	N/A	10 17 17 16		Tan fine to medium SAND Yellow fine to medium SAND
25	100		4	3 4 4 3		Brown fine to medium SAND Light brown to tan fine to medium SAND Light grey to white fine SAND
30				5		

REMARKS.

SOIL BORING LOG
B-93-3

9 Pond Lane
Concord, MA 01742
(508)371-1422

PROJECT NO: *3-1033-210*	DRILLING CO.: *Warren George*	MP ELEV.: *' (MSL)*
CLIENT: *Performing Parties Trust*	DRILLER: *Vincent Gandolgo*	TOTAL DEPTH: *49'*
SITE LOCATION: *Glenwood Landing, NY*	BORING ID: *6 3/4*	SURFACE ELEV.: *' (MSL)*
START DATE: *2/26/93* TIME: *10:45*	CASING ID:	WATER LEVEL DURING DRILLING: *7'*
COMPLETION DATE: *2/26/93* TIME: *12:10*	METHOD: *Hollow Stem*	
BORING LOCATION:	LOGGED BY: *Mike Devir*	

DEPTH (feet)	RECOVERY (%)	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW CTS. / 6"	LITHOLOGY	DESCRIPTION
	92		2	9 20 20		Light brown to tan fine to medium SAND
35	92		8	8 23 25 25		
40	92		6.5	8 20 32 50		Medium to fine SAND Grey fine to medium SAND, little silt
45		93-3K		5 4 7 14		
50						
55						
60						

REMARKS:

APPENDIX B

Chain of Custody

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME

SAMPLERS: *(Signature)*

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CON-TAINERS	VOA	SVOC TPH-[illegible]	[illegible]				REMARKS
B93-2A	[illegible]	[illegible]	B-93-2A 12 to 14'	1	X						
B-93-2B		11:05	B-93-2B 12' to 14'	1		X					
B-93-2D		11:15	B-93-2D 15' to 17'	1	X						
B-93-2C		11:11	B-93-2C 15' to 17'	1		X					
B-93-2G		11:05	B-93-2G 19' to 21'	1	X						
B93-2H		11:08	B-93-2H 19' to 21'	1		X					
B93-2K		4:00	B-93-2KT 31'	1			X				
B-93-2K		4:05	B-93-2KB 35'	1			X				

Relinquished by: *(Signature)*	Date / Time 3-24-93 3:12	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time		

REMARKS:

REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
Damonmill Square
9 Pond Lane
Concord, MA 01742

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
1033	SHORE REALTY

SAMPLERS: *(Signature)* Dale [illegible]

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	VOC+15	VOC+15, TKN, [illegible]	SEMI-PHOSPHATE, [illegible]	MS/MSD			REMARKS
B-93-3A	2-26-93	10:25	B-93-3A 3' to 5'	1	X						
B-93-3B	2-26-93	10:30	B-93-3B 3' to 5'	1		X					
B-93-3D	2-26-93	10:47	B-93-3D 7' to 9'	1	X			X			
B-93-3E	2-26-93	10:50	B-93-3E 7' to 9'	1		X		X			
B-93-3G	2-26-93	11:22	B-93-3G 11' to 13'	1	X						
B-93-3H	2-26-93	11:27	B-93-3H 11' to 13'	1		X					

Relinquished by: *(Signature)* Dale [illegible]	**Date / Time** 2-26-93 / [illegible]	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date / Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date / Time**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date / Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date / Time**	**Received for Laboratory by:** *(Signature)*	**Date / Time** 2-26 / [illegible]		

REMARKS:

REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
Damonmill Square
9 Pond Lane
Concord, MA 01742

CHAIN OF CUSTODY RECORD

PROJ. NO. 1033

PROJECT NAME SHORE REALTY

SAMPLERS: *(Signature)*

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	VOC's	TPH	[illegible]	MS/MSD			REMARKS
3-93-1-A	3-2-93	1.05	B-93-1-A 2' to 4'	1	X						
3-93-1-B	3-2-93	9:50	B-93-1-B 2' to 4'	1		X					
3-93-1-D	3-2-93	10:00	B-93-1-D 4' to 6'	1	X						
3-93-1-E	3-2-93	10:05	B-93-1-E 4' to 6	1							
-93-1-G	3-2-93	10:15	B-93-1 G 8' to 10'	1	X			X			
3-93-1-H	3-2-93	10:20	B-93-1 H 8' to 10'	1		X		X			
-93-1-RB	3-2-93	2:00	B-93-1-RB	5	X	X					

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
	[illegible] / 10:20				

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time

REMARKS:

REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
Damonmill Square
9 Pond Lane
Concord, MA 01742

CHAIN OF CUSTODY RECORD

PROJ. NO. 1033	**PROJECT NAME** SHORE REALTY
SAMPLERS: *(Signature)*	

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	VOC+15	SVOC+15 TIC's [illegible]	[illegible]	TOTAL				REMARKS
WT-14	3-5-93	3:50	WT-14	5	X	X	X					
TB-1	3-2-93		TB-1	2	X							

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time
Dale Gatt	3-5-93 / 5:01		3/5/93 / 17:00

REMARKS:

REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
Damonmill Square
9 Pond Lane
Concord, MA 01742

CHAIN OF CUSTODY RECORD

PROJ. NO. 1033	**PROJECT NAME** SHORE REALTY	
SAMPLERS: *(Signature)*		

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	[illegible]	[illegible]	[illegible]				REMARKS
SW-6	3-8-93	11:45	SW-6	6	X	X	X				
DW-3	3-8-93	12:35	DW-3	6	X	X	X				
SW-5	3-8-93	3:52	SW-5	6	X	X	X				
WT-13	3-8-93	4:35	WT-13	[illegible]	X	X	X				
SW-4	3-9-93	10:16	SW-4	[illegible]	X	X	X				
SW-3	3-9-93	11:35	SW-3	6	X	X	X				
SW-2	3-9-93	2:32	SW-2	5	X	X	X				
~~DW-1~~	~~3-9-93~~		~~DW-1~~	~~5~~	~~X~~	~~X~~	~~X~~				[illegible] 3-9-93
WT-12	3-9-93	4:35	WT-12	5	X	X	X				

Relinquished by: *(Signature)*	**Date / Time** 3-9-93 / 5:08	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date / Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date / Time**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date / Time**	**Received by:** *(Signature)*
Relinquished by: *(Signature)*	**Date / Time**	**Received for Laboratory by:** *(Signature)*	**Date / Time** 3/9/93 / 1738		

REMARKS:

REMEDIATION TECHNOLOGIES
Damonmill Square
9 Pond Lane
Concord, MA 01742

RETEC
REMEDIATION TECHNOLOGIES INC

CHAIN OF CUSTODY RECORD

PROJ. NO. 1033

PROJECT NAME SHORE REALTY

SAMPLERS: *(Signature)* DIETER GEFTINAKER

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	[illegible] 15	SVOC, 15	TKN [illegible]	Total [illegible]	Dissolved [illegible] (LAB FILTERED)	TOTAL [illegible]	REMARKS
WT-6	3-9-93	6:00am	WT-6	6	X	X	X	X	X	X	
WT-93-2	3-10-93	11:33	WT-93-2	6	X	X	X	X	X	X	
DW-1	3-10-93	2:45	DW-1	6	X	X	X	X	X	X	
SW-1	3-10-93	5:30	SW-1	6	X	X	X	X	X	X	
DW-2	3-11-93	2:55	DW-2	6	X	X	X	X	X	X	
DW-2D	3-11-93	1:57	DW-2D	6	X	X	X	X	X	X	
WT-2	3-11-93	2:15	WT-2	6	X	X	X	X	X	X	
WT-5	3-11-93	3:30	WT-5	13	X	X	X	X	X	X	MATRIX SPIKE/MSD
TB-2	3-3-93	—	TB	2	X						
WT-2RB	3-11-93	2:20	WT-2RB	6	X	X	X	X	X	X	

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Dieter Geftinaker	3-11-93 4:57				
					"

Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time
		[illegible]	3/ 93 4:57

REMARKS:

REMEDIATION TECHNOLOGIES
Damonmill Square
9 Pond Lane
Concord, MA 01742

RETEC
REMEDIATION TECHNOLOGIES INC

TOTAL ANALYTICAL SERVICES FOR A SAFE ENVIRONMENT

nytest environmental inc

CHAIN OF CUSTODY RECORD

Page 1 of 1

SHIP TO: Nytest Environmental Inc.
60 Seaview Blvd.
Port Washington, NY 11050
(516) 625-5500
Attn.

REPORT TO: Client Name EETEC
Address 9 Pond Lane
Concord MA 01742
Phone 508 371 1422
Attn. Chris Levkritz

Project No. 3-1033-210	Project Name Shore Realty	Date Shipped 6/23/93	Carrier
Sampler: (Signature) Debbie Finkel	Analytical Protocol	Air Bill No.	Cooler No.

Sample I.D.	Date/Time Sampled		Sample Description	No. Of Con-tainers	ANALYSIS REQUESTED
SH-05-62293	6/22	8:00	off site well	6	VOA
SH-05-62293	6/22	8:05		3	BNA
SH-05-62293	6/22	8:10		3	Fe, Total
SH-05-62293	6/22	8:15		3	Fe, Dissolved
SH-05-62293	6/22	8:20		3	[illegible]
SH-05-62293	6/22	8:25		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		2	[illegible] 1003
SH-05-62293	6/22		TB	2	[illegible]

Relinquished by (Signature)	Date	Time	Rec'd By (Signature)	Date	Time
Print Name			Print Name		
Relinquished by (Signature)	Date	Time	Rec'd by (Signature)	Date	Time
Print Name			Print Name		
Relinquished by (Signature)	Date	Time	Received for Laboratory by (Signature)	Date	Time
Print Name			Print Name		

Special Instructions/Comments

Client Retains Yellow Copy Only

APPENDIX C

Well Point and Monitoring Well Log

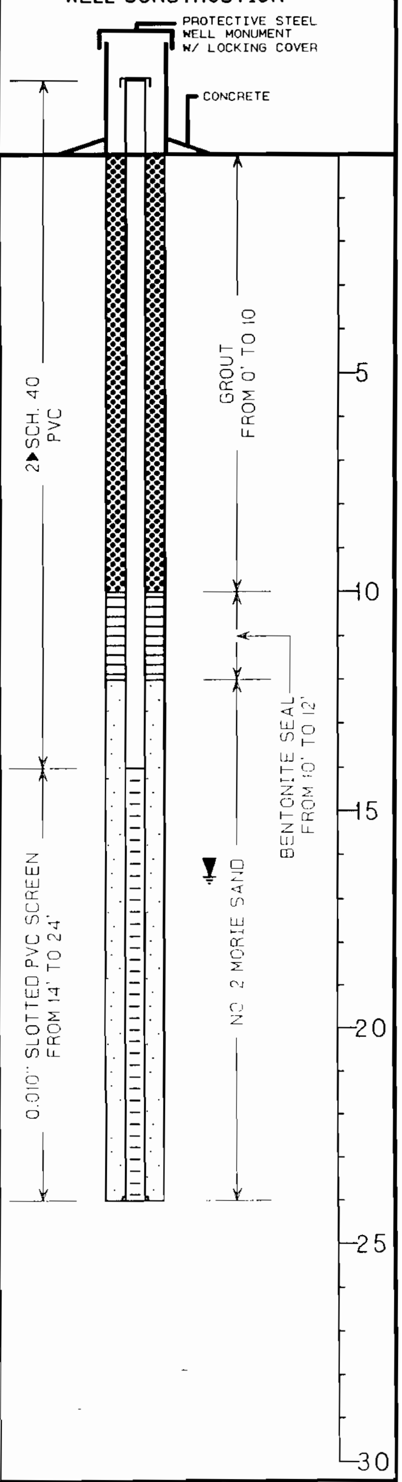
WELL INSTALLATION LOG
Soil Boring WT-93-2

9 Pond Lane
Concord, MA 01742
(508)371-1422

PROJECT NO: 3-1033-210	DRILLING CO.: Warren George	MP ELEV.: ' (MSL) (TOP OF PVC)
CLIENT: Performing Parties Trust	DRILLER: Vincent Gandolgo	TOTAL DEPTH: 52'
LOCATION: Glenwood Landing, NY	BORING ID: 6 3/4"	SURFACE ELEV.: ' (MSL)
START DATE: 2/23/93 TIME: 0945	CASING ID:	WATER LEVEL DURING DRILLING: 16.5'
COMPLETION DATE: 2/24/93 TIME: 1230	METHOD: Hollow Stem	PVC STICK-UP: '
WELL LOCATION: Shore Realty	LOGGED BY: Mike Devir	

DEPTH (feet)	RECOVERY (%)	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW CTS. / 6"	LITHOLOGY	DESCRIPTION
	91.6		0	5 4 2 2		Damp, dark brown fine to medium SAND
5	100		0	4 5 7 7		5' to 5.66' Damp dark brown fine to medium SAND Damp, light brown to tan fine to medium SAND, trace silt
10	96.8		0.2	5 6 6 7		Damp, brown to tan fine to medium SAND Damp, light grey fine to medium SAND
	100	93-2A	200	4 5 7 7		
15	100	93-2D	>1000	3 4 5 7		Saturated, light grey fine to medium SAND Saturated, grey fine to medium SAND, fine to medium subangular gravel
20	100	93-2G	65	9 8 9 8		Saturated tan fine SAND, trace fine to medium subangular gravel
25	0					Grey fine SAND and SILT
	0					
30	100	93-2K		7 7		Light brown fine to medium SAND, trace medium gravel

WELL CONSTRUCTION



REMARKS:

WELL INSTALLATION LOG
Soil Boring WT-93-2

9 Pond Lane
Concord, MA 01742
(508)371-1422

PROJECT NO: *3-1033-210*	DRILLING CO.: *Warren George*	MP ELEV.: ' *(MSL)* *(TOP OF PVC)*
CLIENT: *Performing Parties Trust*	DRILLER: *Vincent Gandolgo*	TOTAL DEPTH: *52'*
LOCATION: *Glenwood Landing, NY*	BORING ID: *6 3/4"*	SURFACE ELEV.: ' *(MSL)*
START DATE: *2/23/93* TIME: *0945*	CASING ID:	WATER LEVEL DURING DRILLING: *16.5'*
COMPLETION DATE: *2/24/93* TIME: *1230*	METHOD: *Hollow Stem*	PVC STICK-UP: '
WELL LOCATION: *Shore Realty*	LOGGED BY: *Mike Devir*	

DEPTH (feet)	RECOVERY (%)	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW CTS. / 6"	LITHOLOGY	DESCRIPTION	WELL CONSTRUCTION
	87.5 91.6	93-2K	>10	6 6 3 3 3 4 2 3 3 3		White to light grey fine SAND, some silt	
35							35
40	100		5	6 5 5 6		Saturated light brown to tan medium to fine SAND White to light grey fine to medium SAND, some silt	40
45	100		0.5	5 7 8 7		Light brown fine to medium running SAND, some silt Grey fine to medium SAND, little silt, trace medium gravel Orange fine to medium SAND, little silt Grey fine to medium SAND	45
50							50
55							55
60							60

REMARKS:

REMEDIATION TECHNOLOGIES, Inc.

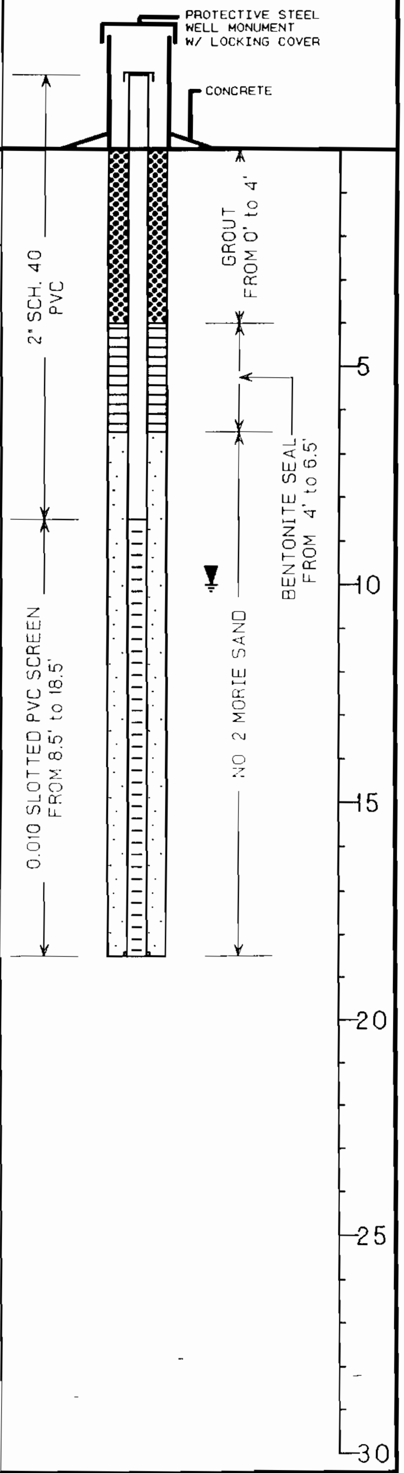
WELL INSTALLATION LOG
Soil Boring WT-93-4

9 Pond Lane
Concord, MA 01742
(508)371-1422

PROJECT NO: *3-1033-210*	DRILLING CO.: *Warren George*	MP ELEV.: *21.38' (MSL) (TOP OF PVC)*
CLIENT: *Performing Parties Trust*	DRILLER: *Vincent Gandolgo*	TOTAL DEPTH: *18.5'*
LOCATION: *Glenwood Landing, NY*	BORING ID: *6-1/4"*	SURFACE ELEV.: *21.38' (MSL)*
START DATE: *6/7/93* TIME:	CASING ID: *4-1/4"*	WATER LEVEL DURING DRILLING: *10'*
COMPLETION DATE: *6/7/93* TIME:	METHOD: *Hollow Stem*	PVC STICK-UP: '
WELL LOCATION: *Shore Realty*	LOGGED BY: *Ken Fantone*	

DEPTH (feet)	RECOVERY (%)	SAMPLE DEPTH	PID HEADSPACE (ppm)	BLOW CTS. / 6"	LITHOLOGY	DESCRIPTION
	50			1 1 1 5		Fill, grass, organic matter, asphalt
	75			5 5 6 6		White to tan well sorted fine to medium SAND, some 1/2" to 1" bands of iron stained sand
5	75			4 5 8 9		
	60			7 8 7 9		
	60			5 4 5 6		White to reddish pink, dry to moist coarse SAND, some fine gravel
10	80			5 6 6 6		Wet coarse SAND, some fine gravel, some bands of iron stained sand
	80			7 8 8 8		Greyish white, wet, coarse SAND
15	25			7 2 2 5		Greyish white, wet, coarse SAND, some bands of iron stained sand, trace silt
	100			2 7 11 15		
20						
25						
30						

WELL CONSTRUCTION



REMARKS: After 30 minutes, water level in borehole is at 12 feet below ground surface.

APPENDIX D

Soil Gas Survey Field Data Sheets

Recyclable

in the Rain" - A unique All-Weather
paper created to shed water and
ce the written image. It is widely used
ughout the world for recording critical field
a in all kinds of weather.

ble in a variety of standard and custom
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al and stapled notebooks, multi-copy sets
mputer papers.

n the Rain" All-Weather Writing Papers
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sheets for printing and photocopying.

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DARLING CORPORATION
OMA, WA 98421-3696 USA

"Rite in the Rain"®

ALL-WEATHER

LINE RULE

Notebook No. 391

SHORE REALITY

Long Island N.Y.

3-1033-210

Pattock
dy Calhoon

ite in the Rain"
EATHER WRITING PAPER ®

ne Protective Slipcovers (Item #31) are available for this style of notebook.
notebook from wear & tear. Contact your dealer or the J. L. Darling Corporation.

3/1/93 8:30 ABanded 1:44 pm

BH 1 in Front of middle Grade Door 0 - 6" concrete

45" Benzene Red < 5ppm 6"–44" Dark Sand x [illegible]

slith discolor 10ppm 48'-45' tan Sands

36" Benzene < 5ppm 45"- 72" 4in Sand cem Dark sa

after pumping water table * 36" water

moved hole twice

BH 2 0 – 8" concrete

24" Benzene > 50ppm 8'– 24" Brown Sand

24" – 44 Brown tan Gr. Sand

44"– 72" Grey Sand Heavy odor

* water 24"

loading station 10:30

BH 3 > 50ppm

30" Benzene 0– 2" organic weeds

2" – 30" Redish Brown Sand Pea Gravel

30"- 42" Darke Grey Sand

Heavy ODOR

* water 34"

11:00 Am End of loading station

BH 4 0 – 2" organic grass

30" Benzone 50ppm 2"-29" Dark Brown Sand

29"–39" Dark Brown Sand & light Tan sand m.

39"–44" light tan Sand

* water 34"

Near Edge soil venting plastic

BH 5 — 0 – 2" organics

36" Benzene > 50 ppm — 2" – 38" Dark Brown Sand gravel

Perchorethylen ND — 38" 44" Charcoal sand

2/9

* water 36"

11:24 am

BH 6

36" — 0 – 2" organics

Benzene > 50 ppm — 2" – 15" gravel sand Brown

Perchorethylen ND — 15" – 44" Black sand some gravel

Trichorethylen ND — Heavy odor

methylene chloride < 100 ppm

* 30" water

12:03 pm

BH 7 Near telephone pole
Near gate

Benzene > 50 ppm — 0 – 2" organics

methylene chloride trace — 2" – 27" Sand & gravel Brown

27" – 42 sand & gravel Dark discolored Heavy odor oilsheen

Tank Pad

BH 8 50' EAST BH 2

22"

Benzene > 50 ppm — * 30" water

Methylene chloride < 100 ppm — 0 – 4" Black TOP

4" – 18" Dark Brown to Black sand gravel

18" – 42 Dark Grey Brown Sa

Faint odor

* 22" water

3:07pm tank Pad

BH9 25' East BH8 0-6" Black Top

45" Benzene TRACE 6"-20" Light Brown sand

20"-33" Dark color sand

30" Benzene TRACE

~~33"-44" Gray sand~~

~~44"-45" concrete~~

methylene chloride ND 45"-67" Gray sand, Brown

* 60" water table

* hole water 30"

3:54pm

BH 10 25' south BH8 0-4" Black Top

20" Benzene 9 ppm 4"-24" Dark Brown Black sand & gravel

methylene chloride ND 24"-42" Dark charcoal sand

* water 32" Table

* water 20" hole

BH 11 25' west BH10

25" Benzene 15 ppm 0-4" Black Top

methylene chloride 4"-21" Black sand & gravel

21"-36" Dark sand & gravel

36"-43" Dark sand

* 29" water

near I Garage Door

BH 12 25' South BH 11

35" Benzene < 5ppm 0-4" Black Top

methylene chloride TRACE 4"-24" Tan sand

24"-38 Dark Brown Sand

38"-43" Grey sand

* water hole 35"

5:45

3/2/93

8:00 IN Garage Floor

BH 13 25' South BH1 0-6" concrete

41" Benzene ND 6"-19" sand gravel Dark

19"-30" Brown Sand

44" Benzene TRACE 30"-39" Black sand

Perchorethylene ND 39"-41" Brown sand

methylene chloride ND 41"-58" Brown Sand

58"-67" Grey Sand

* water table 67"

IN FRONT of Pump station * hole water 44"

BH 14 25' west BH 2

42" Benzene > 50ppm 0-10" Black Top

Perchlorethylene ND 10"-18" Dark Sand + Gravel

methylene chloride > 2000 ppm 18"-29" Dark Sand ODOR

Very Hot Hole 29"-42" Tan Sand

9:46 am

BH 15 25' west BH14

half number of strokes n=10 Benzene > 50 ppm 0 – 4" Black top

methylene chloride > 2000 4"–17" Brown Sand
n=5

very Hot hole 17"–36" Gray & Brown
sand mix
Heavy odor

Beside Trailer Orders 36"–42" light Tan sand

BH 16 25' south BH 15

half number of strokes n=10 Benzene > 50ppm 0 – 6" Black Top

6"–42" Dark Brown & [illegible]
Sand
Heavy odor

10:24 pm

BH 17 25' south BH 16

42" Benzene TRACE 0– 10" Black Top

44" Benzene TRACE 10"–19" sand & gravel
fill

methylene chloride ND 19"–36" sand & gravel
Brown
some staining

Between Trailer and other 36"–42" Brown sand
Cargo 42"–53" Brown sand

53"–67" Gray sand

water table 52"

water hole 48"

Base of Hill

BH 18 25' North BH8

30" Benzene TRACE 0 – 2" organic weeds

2" – 42" Brown sand

* water table 35"

12:53 pm
BASE of hill * water hole 33"

BH 19 25' East BH3

42" Benzene ND 0 – 2" organic weeds

38" Benzene TRACE 2" – 42" Brown sand

42" – 67" Brown sand

* water table 50"

1:02 on hill side * hole water 30"

BH 20 25' EAST BH4

72" Benzene ND 0 – 72" Tan sand

9'6" Benzene 8 ppm 0 – 144 Tan sand

10' Benzene 15 ppm 144" – 168" Gray sand

methane TRACE * water table 12'

2:12 pm * 10' hole water

BH 21 25' East BH5

ON Hill side 0 – 72" Brown Sand

72" Benzene > 50 ppm 72" - 120" Brown Sand

8' Benzene > 50 ppm 120" - 144" Gray Sand

8' Petroleum Hydrocarbon 260 ppm * water 120"

*

BH 22 25' East BH 6

24" Benzene 30 ppm — 0 – 2" Organic Woo.

2" – 41" Dark Brown Black san

at water hole 24"

3/3/93 on top before pipes

8:00

BH 23 50' East BH 20

72" Benzene ND — 0 – 6" Dark organic Sand

144" Benzene > 50 ppm — 6" – 36" Sand organic

216" Petroleum hydrocarbon 1200 ppm — 36" – 72" Sand

72" ~~140~~ 140" Sand

140" – 144" Orange sa

144" – 216" Gray

9:30 corn of dike — Heavy odor

BH 24 25' south B23

72" Benzene > 50 ppm — 0 – 6" Dark organic sand

Petroleum hydrocarbon Trace — 6" – 60" Sand mix of grey orange

60" – 72" grey

144" Benzene > 50 ppm — 72" – 109" grey odor

methane/l chloride — 109" – 139" light to orange Sand

139" – 144" tannish Brown Sand

Near Light 10:30
on dike
BH 25   25' south of BH24
72" Benzene ND   0 - 68" sand w gr
118" Benzene   68"-72" white sand
72"-118" sand w gr
Inside Dike Area   118"-120" concrete Refusal
11:19
BH 26   25' East of BH25
72" Benzene ND   0 - 6" Black sand organic
144" Benzene 750ppm   6"-72" Brown Sand
Black tube
Very Hot   72"-144" Brown sand
144" Petroleum Hydrocarbon 200 ppm   odor

1:36 pm on dike Top
BH 27   50' East of BH 26
0-6" organic Dark sand
144" Benzene ND   6"-72" Brown Sand
18 [illegible] 216" Benzene > 50ppm   72"-144" Brown sand
Petroleum Hydrocarbon 100ppm   144"-180 Brown Sand
180"-216" Dark Brown to Black sand
on Road to tank   Heavy odor
B28   50' East of B27
72" Benzene ND   0 - 3" organic sand
~~108~~ 96" Benzene ND   3"-67" Brown Sand
67"-72" Dark Brown sand
* 8' hole water   72"-138" Dark Brown Sand
* water 11'   138"-144 Dark Brown Sand

Between Tank Road and Dike Top

BH 29 25' East BH27

144" Benzene ND 0-3" organic
216" Benzene > 50ppm 3"-72" Brown sand
72-144" Brown sand
144"-180" Brown sand
180"-216" Black sand
Heavy odor

27
12/
48
2/ Middle at Tank Farm East side Dike Just above water Table

BH 30 100' NORTH BH29

144" Benzene ND 0-3" Organic Sand
216" Benzene ND 3"-72" Brown Sand
22' Benzene 10 ppm 72"-120" Dark Brown sand
120"-144" Dark Sand
144"-180" Dark Sand
5:45 180"-216" Black sand
216"-264" Gray sand
(508) 329-9279 264"-288" Gray sand
~~*~~ 22' water mark
Chris Leuteritz
3/4/93 7:45 3/4/93

BH 31 25' west BH30

144" Benzene > 50ppm 0-3" organic
3"-72" Brown sand
72"-120" Brown sand
120"-144" tan sand

inside Dike on wall Northwest corner

BH 32 180' North BH23

144" Benzene ND 0-6" organic sand

15' Benzene >50ppm 6"-72" Brown sand

18' Petroleum Hydrocarb 100ppm 72"-120" Brown sand

120"-144" light sand gray

144"-216" light sand white

[illegible] odor

on Dike wall water table 17'

BH 33 50' East from BH 32

144" Benzene >50ppm 0-6" organic sand

Pu [illegible] <100ppm 6"-72" Brown sand

72"-109 tan sand

109-120 Red sand

120-144 tan sand

BH 34 50' North BH33

18' Benzene ND 0-6" organic sand

24' Benzene ND 6"-72" Brown sand

72"-144 Brown sand

144"-216" Brown sand

216"-288" Brown sand

APPENDIX E

Bio-treatability Study Data Sheets

RETEC

REMEDIATION TECHNOLOGIES

LABORATORY

TRAVELER NO. 9303-027

DISTRIBUTION

☐ Microbiology

☒ Treatability

☐ Chemical Analysis

PROJECT (CLIENT): Shore-Realty	**DATE RECEIVED:** 3-18-93
PROJECT NUMBER:	**DATE COLLECTED:** 3-10-93
PROJECT CONTACT: Heidi Anderson	Field Samples for Treat. Testing
PHONE: RETEC, Seattle	

DASH	SAMPLE DESCRIPTION	MATRIX	SIZE-QUANT	LOC.
01	WT-93-2 Water	Water	1-L	R-
02	↓	↓	↓	
03	↓	↓	↓	
04	↓	↓	↓	
05	SW-2 Sample	Water	↓	
06	↓	↓	↓	
07	↓	↓	↓	
08	↓	↓	↓	
09	SW-6 Sample	Water	↓	
10	↓	↓	↓	
11	↓	↓	↓	
12	↓	↓	↓	
13	Soil Sample	Soil	2.5 Gal.	W.S.

TABLE

Number of Total and VOA Degrading Microorganisms in Shore Realty Water Sample.

Sample ID[a]	Total Microorganisms CFU/ml of water[b] (10^4)	VOA Degraders[c] CFU/ml of water (10^4)
9303-027-02 Mean +/- Std. Dev.	27 +/- 11	0.05
9303-027-06 Mean +/- Std. Dev.	38 +/- 9	7.0
9303-027-10 Mean +/- Std. Dev.	32 +/- 5	1.3

---

[a] Results represent the mean value and standard deviation of triplicate platings.

[b] Results represent colony forming units (CFU)/ml of sample.

[c] VOA degraders represent the cell growth in the presence of a VOA substrate minus the cell growth in the absence of any carbon substrate.

Released by:

Heidi Anderson
Project Scientist

RETEC
REMEDIATION TECHNOLOGIES

LABORATORY

TRAVELER NO. 9304-016

DISTRIBUTION
☐ Microbiology
☐ Treatability
☐ Chemical Analysis

PROJECT (CLIENT): Shore Realty
DATE RECEIVED: 4-14-93
PROJECT NUMBER: 3-1033-777
DATE COLLECTED: 2-23-93
PROJECT CONTACT: Mark Larsen
PHONE: RETEC, Seattle

Shore Realty Samples from NY Test Labs

DASH	SAMPLE DESCRIPTION		MATRIX	SIZE-QUANT	LOC.
01	B-93-1A	(2'-4')	Soil	4oz	R-4
02	B-93-1B	(2'-4')		8oz	
03	B-93-1D	(4'-6')		4oz	
04	B-93-1E	(4'-6')		8oz	
05	B-93-1G	(8'-10')		4oz	
06	B-93-1H	(8'-10')		8oz	
07	B-93-2A	(12'-14')		4oz	
08	B-93-2B	(12'-14')		8oz	
09	B-93-2D	(15'-17')		4oz	
10	B-93-2E	(15'-17')		8oz	
11	B-93-2G	(19'-21')		4oz	
12	B-93-2H	(19'-21')		8oz	
13	B-93-3A	(3'-5')		4oz	
14	B-93-3B	(3'-5')		8oz	
15	B-93-3D	(7'-9')		4oz	
16	B-93-3E	(7'-9')		8oz	
17	B-93-3G	(11'-13')		4oz	
18	B-93-3H	(11'-13')	↓	8oz	↓

RETEC
REMEDIATION
TECHNOLOGIES INC

Damonmill Square
9 Pond Lane
Concord, MA 01742
Telephone: (508) 371-1422
Facsimile: (508) 369-9279

April 12, 1993

Mr. Mike Brenen
NYTEST
60 Seaview Blvd, P.O. Box 1518
Port Washington, NY 11050

Dear Mike:

Please reference our telephone conversation on March 25, 1993. The following is a list of soil samples that you said you could ship to our Seattle lab:

B-93-1A (2'-4')	15977-01
B-93-1B (2'-4')	15977-06
B-93-1D (4'-6')	15977-02
B-93-1E (4'-6')	15977-07
B-93-1G (8'-10')	15977-03
B-93-1H (8'-10')	15977-08
B-93-2A (12'-14')	15897-01
B-93-2B (12'-14')	15897-04
B-93-2D (15'-17')	15897-02
B-93-2E (15'-17')	15897-05
B-93-2G (19'-21')	15897-03
B-93-2H (19'-21)	15897-06
B-93-3A (3'-5')	15922-01
B-93-3B (3'-5')	15922-06
B-93-3D (7'-9')	15922-02
B-93-3E (7'-9')	15922-07
B-93-3G (11'-13')	15922-05
B-93-3H (11'-13')	15922-10

RETEC's Federal Express account number is 1025-2239-7. Please mark the number 3-1033-210 in the "Your Internal Billing Reference Information" section of the Airbill. These samples should be sent Priority One for delivery on a weekday. The samples should be shipped to:

RETEC
1011 SW Klickitat Way, Suite 207
Seattle, WA 98134
ATTN: Heidi Anderson

Thank you very much for forwarding these samples for me. If you have any questions, please do not hesitate to call me at (508) 371-1422.

Sincerely,

Dieter Geithner mkg

Dieter Geithner

DG/mkg

File: DG-001/3-1033-210

TOTAL ANALYTICAL SERVICES FOR A SAFE ENVIRONMENT

nytest environmental inc

CHAIN OF CUSTODY RECORD

Page 1 of 2

Report to
~~SHIP TO~~: Nytest Environmental Inc.
60 Seaview Blvd.
Port Washington, NY 11050
(516) 625-5500
Attn. TOM Petrella

Ship to.
~~REPORT TO~~: Client Name RETEC
Address 1011 SW Klickitat WAY (suite 207)
Seattle, WA 98134
Phone
Attn. Heidi Anderson.

Project No. 93-19853	Project Name Shore Realty.	Date Shipped 4/13/93	Carrier FED ex priority
Sampler: (Signature)	Analytical Protocol	Air Bill No.	Cooler No. 442

Sample I.D.	Date/Time Sampled	Sample Description	No. Of Con-tainers	ANALYSIS REQUESTED
15977-01		Soil	1	Returning samples to Client
" -06			1	
" -02			1	
" -07			1	
" -03			1	
" -08			1	
15897-01			1	
" -04			1	
" -02			1	
" -05			1	
" -03			1	
" -06			1	

Relinquished by (Signature)	Date / Time		Rec'd By (Signature)	Date / Time	
Print Name Pieri Pierides	4/13	2PM	Print Name		
Relinquished by (Signature)	Date / Time		Rec'd by (Signature)	Date / Time	
Print Name			Print Name		
Relinquished by (Signature)	Date / Time		Received for Laboratory by (Signature)	Date / Time	
Print Name			Print Name		

Special Instructions/Comments Please Return NEI cooler # 442 And ice packs to Above Address via UPS ground service.

Client Retains Yellow Copy Only

TOTAL ANALYTICAL SERVICES FOR A SAFE ENVIRONMENT

NEI nytest environmental inc

CHAIN OF CUSTODY RECORD

Page 2 of 2

Report to ~~SHIP TO~~: Nytest Environmental Inc.
60 Seaview Blvd.
Port Washington, NY 11050
(516) 625-5500
Attn. TOM Petrella

Ship to ~~REPORT TO~~: Client Name RETEC
Address 1011 SW Kickingtway (suite 207)
Seattle, WA 98134
Phone
Attn. Heidi Anderson

Project No. 93-19853	Project Name Shore Realty	Date Shipped 4/13/93	Carrier FedEx Priority
Sampler: (Signature)	Analytical Protocol	Air Bill No.	Cooler No. 442

Sample I.D.	Date/Time Sampled		Sample Description	No. Of Con-tainers	ANALYSIS REQUESTED
15922 -01			Soil	1	Returning Samples to client
" -06				1	
" -02				1	
" -07				1	
" -05				1	
" -10				1	

Relinquished by (Signature)	Date	Time	Rec'd By (Signature)	Date	Time
Print Name Pieri Pierides	4/13	2 PM	Print Name		
Relinquished by (Signature)	Date	Time	Rec'd by (Signature)	Date	Time
Print Name			Print Name		
Relinquished by (Signature)	Date	Time	Received for Laboratory by (Signature)	Date	Time
Print Name			Print Name		

Special Instructions/Comments Please Return NEI cooler # 442 And ice packs to above Address via UPS ground service.

Client Retains Yellow Copy Only

TABLE 1

Number of Total and VOA Degrading Microorganisms in Shore Realty Soil Samples.

Sample ID[a]	Total Microorganisms CFU/g of soil[b] (10^6)	VOA Degraders[c] CFU/g of soil (10^4)
9304-016-01 B-93-1A (2-4') Mean +/- Std. Dev.	11 +/- 3.2	45
9304-016-03 B-93-1D (4-6') Mean +/- Std. Dev.	102 +/- 45	49
9304-016-05 B-93-1G (8-10') Mean +/- Std. Dev.	6.4 +/- 1.0	1.1
9304-016-07 B-93-2A (12-14') Mean +/- Std. Dev.	14 +/- 0.3	71
9304-016-09 B-93-2D (15-17') Mean +/- Std. Dev.	15 +/- 1.6	256

[a] Results represent the mean value and standard deviation of triplicate platings.

[b] Results represent colony forming units (CFU)/g of soil on a wet weight basis.

[c] VOA degraders represent the cell growth in the presence of a VOA substrate minus the cell growth in the absence of any carbon substrate.

Released by:

Heidi Anderson
Project Scientist

TABLE 2

Number of Total and VOA Degrading Microorganisms in Shore Realty Soil Samples.

Sample ID[a]	Total Microorganisms CFU/g of soil[b] (10^6)	VOA Degraders[c] CFU/g of soil (10^4)
9304-016-11 B-93-2G (19-21') Mean +/- Std. Dev.	9.1 +/- 3.1	38
9304-016-13 B-93-3A (3-5') Mean +/- Std. Dev.	8.5 +/- 0.4	1.7
9304-016-15 B-93-3D (7-9') Mean +/- Std. Dev.	0.72 +/- 0.09	0.76
9304-016-17 B-93-3G (11-13') Mean +/- Std. Dev.	7.8 +/- 0.5	0.30

[a] Results represent the mean value and standard deviation of triplicate platings.

[b] Results represent colony forming units (CFU)/g of soil on a wet weight basis.

[c] VOA degraders represent the cell growth in the presence of a VOA substrate minus the cell growth in the absence of any carbon substrate.

Released by:

Heidi Anderson
Project Scientist

RETEC
REMEDIATION TECHNOLOGIES

LABORATORY

TRAVELER NO. 9304-033

DISTRIBUTION
☒ Microbiology
☐ Treatability
☐ Chemical Analysis

PROJECT (CLIENT): Shore-Realty

PROJECT NUMBER: 3-1033-777

PROJECT CONTACT: Mark Larsen

PHONE: RETEC, Seattle

DATE RECEIVED: —

DATE COLLECTED: 4-23

Final (7-Day) Stimulation Test Samples

DASH	SAMPLE DESCRIPTION	MATRIX	SIZE-QUANT	LOC.
01	Stim Test 03/04 A	slurry	200 mL	
02	↓ 03/04 B	↓	↓	
03	05/06 A			
04	05/06 B			
05	09/10 A			
06	09/10 B			
07	11/12 A			
08	11/12 B			
09	15/16 A			
10	15/16 B			
11	17/18 A			
12	17/18 B			

TABLE 1

Number of Total and VOA Degrading Microorganisms in Shore Realty Slurry Samples

Sample ID[a]	Total Microorganisms CFU/mL slurry[b] (10^6)	VOA Degraders[c] CFU/mL slurry (10^5)
9304-033-01		
Mean +/- Std. Dev.	48 +/- 19	10
9304-033-02		
Mean +/- Std. Dev.	65 +/- 10	38
9304-033-03		
Mean +/- Std. Dev.	11 +/- 4.7	0.44
9304-033-04		
Mean +/- Std. Dev.	14 +/- 2.9	0.29
9304-033-05		
Mean +/- Std. Dev.	5.7 +/- 1.1	14
9304-033-06		
Mean +/- Std. Dev.	9.4 +/- 0.8	2.9

[a] Results represent the mean value and standard deviation of triplicate platings.

[b] Results represent colony forming units (CFU)/mL of slurry.

[c] VOA degraders represent the cell growth in the presence of a VOA substrate minus the cell growth in the absence of any carbon substrate.

Released by:

Heidi Anderson
Project Scientist

TABLE 2

Number of Total and VOA Degrading Microorganisms in Shore Realty Soil Samples.

Sample ID[a]	Total Microorganisms CFU/mL slurry[b] (10^6)	VOA Degraders[c] CFU/mL slurry (10^5)
9304-033-07 Mean +/- Std. Dev.	2.2 +/- 0.6	0.30
9304-033-08 Mean +/- Std. Dev.	2.5 +/- 0.8	0.69
9304-033-09 Mean +/- Std. Dev.	0.29 +/- 0.07	0.007
9304-033-10 Mean +/- Std. Dev.	0.32 +/- 0.02	0.014
9304-033-11 Mean +/- Std. Dev.	1.9 +/- 0.6	0.015
9304-033-12 Mean +/- Std. Dev.	2.5 +/- 0.6	0.023

[a] Results represent the mean value and standard deviation of triplicate platings.

[b] Results represent colony forming units (CFU)/mL of slurry.

[c] VOA degraders represent the cell growth in the presence of a VOA substrate minus the cell growth in the absence of any carbon substrate.

Released by: Heidi Anderson

Heidi Anderson
Project Scientist

RETEC
REMEDIATION TECHNOLOGIES

LABORATORY

TRAVELER NO. 9304-026

DISTRIBUTION

☐ Microbiology

☐ Treatability

☒ Chemical Analysis Sub to ARI

PROJECT (CLIENT): Shore-Realty	**DATE RECEIVED:**
PROJECT NUMBER: 34033-777	**DATE COLLECTED:** 4-16
PROJECT CONTACT: Mark Larsen	Nutrient Adsorption + 24 hour Nutrient Precipitation Samples
PHONE: RETEC, Seattle	

DASH	SAMPLE DESCRIPTION	MATRIX	SIZE-QUANT	LOC.
01	Nut. Adsorp. 5/6 Rct 1	water	100 mL	AR1
02	↓			R-4
03	Rct 2			AR1
04	↓ ↓			R-4
05	11/12 Rct 1			AR1
06	↓			R-4
07	Rct 2			AR1
08	↓ ↓			R-4
09	17/18 Rct 1			AR1
10	↓			R-4
11	Rct 2			AR1
12	↓ ↓			R-4
13	Control Rct 1			AR1
14	↓			R-4
15	Rct 2			AR1
16	↓ ↓			R-4
17	Precip 24 hr Samples Rct 1			AR1
18	↓			R-4
19	Rct 2			AR1
20	↓ ↓	↓	↓	R-4

03 May 1993

**ANALYTICAL
RESOURCES
INCORPORATED**

Analytical
Chemists &
Consultants

333 Ninth Ave. North
Seattle, WA 98109-5187
(206) 621-6490
(206) 621-7523 (FAX)

Mark Larsen
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

**RE: Client Project: 3-1033-777 Shore Realty;
ARI Project: #D581**

Dear Mr. Larsen:

Please find enclosed the original chain-of-custody record (COC) and results for the above referenced project. Ten water samples were received on 4/21/93, in good condition. The COC specified analysis for ammonia-N, however the precipitate that was present in the samples prohibited this analysis from being performed without re-filtering the samples. Total Kjeldahl Nitrogen analysis was performed instead, as agreed upon on 4/22. The analyses proceeded without incident of note, and these results were faxed to you earlier today.

A duplicate and spike analysis were performed for both parameters on your sample **...-01**. Results of these QC analyses have been included on the report, as you requested.

A copy of this package will be kept on file with ARI should you require any further information or copies of additional documentation. If you have any questions please feel free to call any time.

Sincerely,

ANALYTICAL RESOURCES, INC.

Kate Stegemoeller

Kate Stegemoeller
Project Coordinator
206-340-2866, ext. 117

Enclosures
cc: file #D581

C

№ 5778

CHAIN OF CUSTODY RECORD

PROJ. NO. 3-1033-777	PROJECT NAME Shore-Realty									SEND RESULTS TO: Mark Larsen
SAMPLERS: Mark Larsen / Uzma S.										
RECEIVING LABORATORY: Analytical Resources										
LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS		Ammonia-N	Phosphate-P			REMARKS
	4-16	1600	9304-026-01	1		✓	✓			
	↓	↓	↓ 03	1		✓	✓			Note:
	↓	↓	↓ 05	1		✓	✓			Samples were
	↓	↓	↓ 07	1		✓	✓			filtered, then
	↓	↓	↓ 09	1		✓	✓			preserved with
	↓	↓	↓ 11	1		✓	✓			H_2SO_4 (pH < 2).
	↓	↓	↓ 13	1		✓	✓			
	↓	↓	↓ 15	1		✓	✓			Do not refilter,
	↓	↓	↓ 17	1		✓	✓			shake to resuspend
	↓	↓	↓ 19	1		✓	✓			any precipitate
										before analyzing.
			Note: Expected conc.							Pricing + scheduling
			~500 mg/L N							per RETEC work
			~500 mg/L P							order.
										Thanks
										Mark

Relinquished by: (Signature) Mark L	Date / Time 4-20 / 1100	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)	
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time 4/21/[illegible] / 8:[illegible]			

Shipper Information

Picked up by ENA Courier

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

RETEC
REMEDIATION TECHNOLOGIES INC

ARI # D551

PINK COPY - Sampler YELLOW COPY - Laboratory WHITE COPY - ReTeC

ANALYTICAL RESOURCES INCORPORATED

Analytical
Chemists &
Consultants

333 Ninth Ave. North
Seattle, WA 98109-5187
(206) 621-6490
(206) 621-7523 (FAX)

Final Report
Laboratory Analysis of Selected Parameters

Matrix: WATER

Project No: 3-1033-777
Shore Realty

Data Release Authorized:

QC Report No: Retec-D581

Report Prepared : 05/03/93 DWN 5-3-93

Date Received: 04/21/93

Sample Data:

		DATE OF ANALYSIS	
		04/26/93	*04/23/93*
	Method Number	*EPA 353.2* *SM 4500-NO3 F*	*EPA 365.2* *SM 4500-P*
Lab ID	Sample Number	TKN (mg-N/L)	TOTAL-P (mg-P/L)
D581 A	9304-026-01	571	326
D581 B	9304-026-03	335	317
D581 C	9304-026-05	594	349
D581 D	9304-026-07	615	349
D581 E	9304-026-09	582	341
D581 F	9304-026-11	575	331
D581 G	9304-026-13	578	349
D581 H	9304-026-15	592	354
D581 I	9304-026-17	820	531
D581 J	9304-026-19	816	502

Method Blank Analysis:

	TKN (mg-N/L)	TOTAL-P (mg-P/L)
Method Blank 1	0.2	<0.010
Detection Limit:	0.1	0.010

Check Standard Analysis:

	(mg-N/L)	(mg-P/L)
Measured Value	496	0.084
"True" Value	500	0.080
% Recovery	99.2%	105%

Duplicate Analysis:

	(mg-N/L)	(mg-P/L)
Sample ID	D581A	D581A
Original	571	326
Duplicate	577	323
RPD	1.05%	0.92%

Spike Analysis:

	(mg-N/L)	(mg-P/L)
Sample ID	D581A	D581A
Original	571	326
Spike	675	336
Spike Level	100	10.0
% Recovery	104%	100%

Comments:

RETEC
REMEDIATION TECHNOLOGIES

LABORATORY

TRAVELER NO. 9305-003

DISTRIBUTION

☐ Microbiology

☐ Treatability

☒ Chemical Analysis Sub to NY Test Labs

PROJECT (CLIENT): Shore Realty

DATE RECEIVED: —

PROJECT NUMBER: 3-1033-777

DATE COLLECTED: 5-4-93

PROJECT CONTACT: Mark Larsen

PHONE: RETEC, Seattle

T=0 Shore Respirometry Samples

DASH	SAMPLE DESCRIPTION	MATRIX	SIZE-QUANT	LOC.
01	T=0 Reactor #9 BTEX	Water	2×VOA	NYTEST
02	↓ TPH	Water	2×VOA	↓
03	BTEX/TPH	Soil	1×60mL	
04	Archives	Water	1×500mL	
05	T=0 Reactor No.10 BTEX	Water	2×VOA	NYTEST
06	↓ TPH	Water	2×VOA	↓
07	BTEX/TPH	Soil	1×60mL	
08	Archives	Water	1×500mL	
09	Composite T=0 soil	Soil	1 8×250mL	ARI

**ANALYTICAL
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Analytical
Chemists &
Consultants

333 Ninth Ave. North
Seattle, WA 98109-5187
(206) 621-6490
(206) 621-7523 (FAX)

07 May 1993

Mark Larsen
Remediation Technologies Inc.
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134

**RE: Client Project: 3-1033-777 Shore Realty;
ARI Project: #D702**

Dear Mr. Larsen:

Please find enclosed the original chain-of-custody record (COC) and results for the above referenced project. One soil sample was received on 5/5/93, in good condition. The analysis proceeded without incident of note, and these results were reported to you verbally yesterday.

As we discussed in our telephone conversation, the hydrocarbons in this sample appear to match the diesel pattern. The reported gas-range concentration is actually diesel, eluting at the early end of the pattern. I've enclosed the method blank and sample chromatograms to assist in your evaluation of the results. Also enclosed is a blank spike recovery report to provide QC documentation for the analysis.

A copy of this package will be kept on file with ARI should you require any further information or copies of additional documentation. If you have any questions please feel free to call any time.

Sincerely,

ANALYTICAL RESOURCES, INC.

Kate Stegemoeller

Kate Stegemoeller
Project Coordinator
206-340-2866, ext. 117

Enclosures

cc: file #D702

№ 5376

CHAIN OF CUSTODY RECORD

PROJ. NO. 3-1033-777	PROJECT NAME Shore Realty
SAMPLERS: Mark Larsen	
RECEIVING LABORATORY: Analytical Resources	

SEND RESULTS TO: Mark Larsen

LAB I.D. NO.	DATE	TIME	SAMPLE NO.	NO. OF CONTAINERS		WTPH-HCID						REMARKS
	5-4	1900	9305-003-09	1		✓						Need HCID
												data ASAP (by Thurs
												/AM
												Thanks
												Mark
												A.R.I. # D702

Relinquished by: (Signature) Mark L	Date / Time 5-5-93 800	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature) Jon Helkins	Date / Time 5/5/93 1210		

Shipper Information Picked up by ARI Courier

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
1011 S.W. Klickitat Way
Suite 207
Seattle, WA 98134
(206) 624-9349

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(206) 621-7523 (FAX)

TOTAL PETROLEUM HYDROCARBONS
WA HCID Method by GC/FID

Matrix: Soils/Sediments

Client: RETEC
Project: 3-1033-777
Shore Realty

ARI LAB ID: D702

Data Release Authorized ________
Data Prepared: 05/06/93 MAC: Gat

VTSR: 05/05/93

Date Extracted: 05/05/93

Lab ID	Client Sample ID	Date Analyzed	Dilution Factor	Gas Range†	Diesel Range*	Oil Range°	Surrogate Recovery
D702 MB0505	*Method Blank*	05/06/93	-	20 U	25 U	50 U	96.7%
D702 A	9305-003-09	05/06/93	-	41	150	50 U	117%

Surrogate is Me-Arachidate.
Values reported in ppm (mg/kg).

GC Data Reporting Qualifiers

U	Indicates compound was analyzed for but not detected at the given detection limit.
X	Indicates a value above the linear range of the detector. Dilution required.
J	Indicates an estimated value when the value is less than the calculated detection limit.
S	Indicates no value reported due to saturation of the detector. Dilution required.
D	Indicates that surrogate was not detected because of dilution of the extract.
C	Indicates a probable value which is unable to be confirmed due to matrix interference.
NR	Indicates no recovery due to matrix interference and/or dilution.
†	Value based on total peaks in the range from Toluene to C12.
*	Value based on total peaks in the range from C12 to C24.
°	Value based on total peaks in the range from C24 to C32.

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Seattle, WA 98109-5187
(206) 621-6490
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TOTAL RANGE HYDROCARBON SPIKE BLANK RECOVERY

Matrix: Soils/Sediments

ARI Job No: D702

Date Extracted: 05/05/93
Date Analyzed: 05/06/93

Client: RETEC
Project: 3-1033-777
Shore Realty

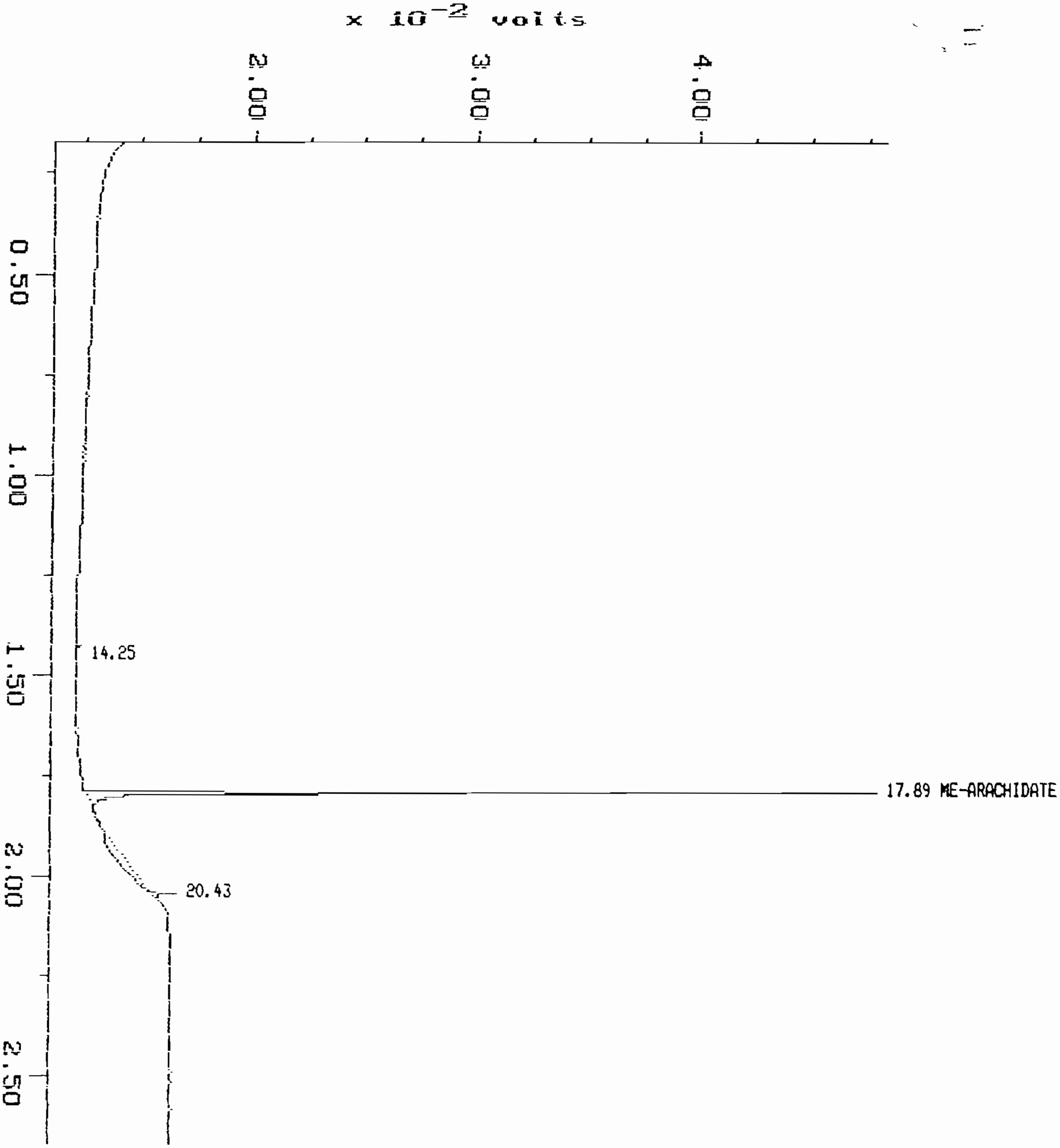
COMPOUND	SPIKE ADDED (mg/kg)	SB CONC. (mg/kg)	SB % REC
Diesel	574	659	115%

	Surrogate % rec.
Methyl Arachidate	111

Comments:

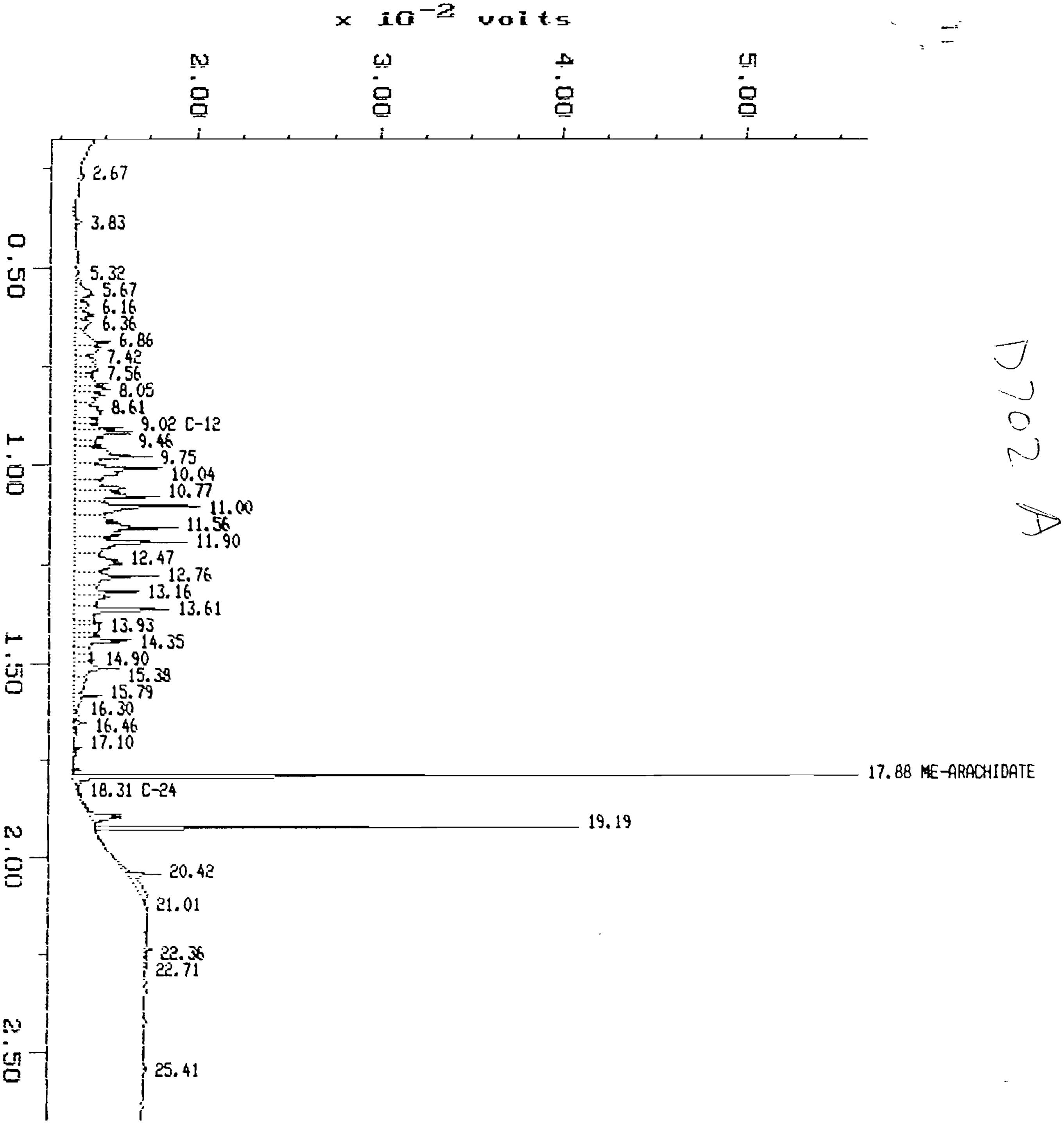
Report prepared: 05/06/93 MAC:GaT

Sample: 050524 **Channel:** FID 2-DB5M **Filename:** 050524
Acquired: 06-MAY-93 14:55 **Method:** C:\MAX\HCID3\MAY05 **Operator:** BC



D702 mb 5/5

Sample: 050518 **Channel:** FID 2-DB5M **Filename:** 050518
Acquired: 06-MAY-93 11:01 **Method:** C:\MAX\HCID3\MAY05 **Operator:** BC



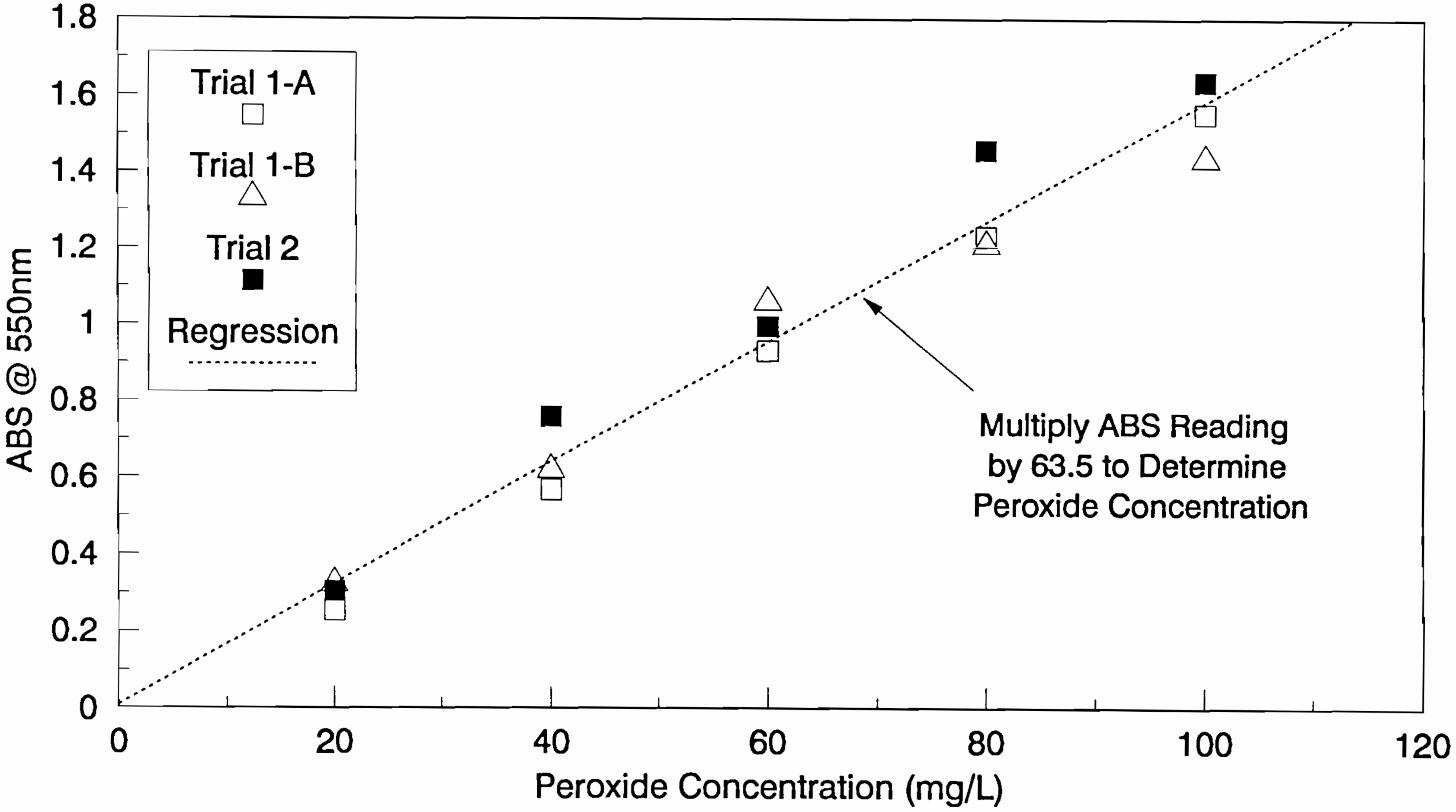
D702 A

Results of Peroxide Stability Testing

Sample Description	Spike	Time (hr)	Sample Peroxide Concentration (mg/L)		
			Sample A	Sample B	Mean
Flasks 1 & 2 **B-93-1 (8-10')**	Initial	0	384	354	369
		1	417	358	387
		2	359	391	375
		4	322	490	406
		6	319	336	327
		24	330	279	304
	Repeat	0	624	656	640
		1	644	476	560
		2	645	660	652
		4	761	620	691
		6	483	556	519
		24	548	483	516
Flasks 3 & 4 **B-93-2 (19-21')**	Initial	0	--	--	0
		1	489	460	475
		2	467	486	477
		4	525	490	507
		6	532	574	553
		24	605	502	554
	Repeat	0	814	823	819
		1	711	891	801
		2	823	809	816
		4	568	782	675
		6	677	700	689
		24	538	475	507
Flasks 5 & 6 **B-93-3 (11-13')**	Initial	0	--	--	--
		1	442	446	444
		2	417	405	411
		4	446	403	424
		6	400	435	418
		24	335	323	329
	Repeat	0	613	620	616
		1	705	632	668
		2	559	631	595
		4	415	537	476
		6	707	748	727
		24	461	439	450
Flasks 7 & 8 **Water Controls**	Initial	0	422	462	442
		1	353	354	354
		2	417	469	443
		4	446	597	522
		6	488	679	584
		24	503	563	533
	Repeat	0	851	930	890
		1	907	906	906
		2	721	785	753
		4	855	660	758
		6	855	935	895
		24	610	662	636

Notes:

Peroxide testing performed according to RETEC SOP #735 using slurries with a 10 percent solids loading. Slurries were used for nutrient adsorption testing (RETEC SOP #730 prior to initial spiking with hydrogen peroxide. Target spike concentration was 500 mg/L hydrogen peroxide.



Two-tablet method used. Absorbance read after 3 minutes of color development. Samples vortex mixed at least twice during reaction.

Peroxide Testing Standard Curve Shore Realty Project (3-1033-777) Vizma (4-19-93)	**FIGURE**

PEROXIDE STABILITY TESTING: SUMMARY

SAMPLE NUMBER	SAMPLE DESCRIPTION	Actual Time	TIME (Hours)	ABS @ 3 min.	Dilution Factor	SAMPLE PEROXIDE CONC. (ppm)
T=0 Data	Flasks Spiked	12:50 PM	0			
#1	Sample 5/6 A	1:10 PM	0	0.605	10	384.175
		2:05 PM	1	0.656	10	416.56
		3:05 PM	2	0.565	10	358.775
		5:07 PM	4	0.507	10	321.945
		7:05 PM	6	0.502	10	318.77
		1:10 PM	24	0.519	10	329.565
T=0 Data	Flasks Spiked	2:40 PM	0			
#1	Sample 5/6 A	2:55 PM	0	0.983	10	624.205
		3:57 PM	1	1.014	10	643.89
		4:57 PM	2	1.015	10	644.525
		6:55 PM	4	1.199	10	761.365
		8:57 PM	6	0.76	10	482.6
		3:00 PM	24	0.863	10	548.005
T=0 Data	Flasks Spiked	12:50 PM	0			
#2	Sample 5/6 B	1:10 PM	0	0.558	10	354.33
		2:05 PM	1	0.563	10	357.505
		3:05 PM	2	0.616	10	391.16
		5:07 PM	4	0.771	10	489.585
		7:05 PM	6	0.529	10	335.915
		1:10 PM	24	0.44	10	279.4
T=0 Data	Flasks Spiked	2:40 PM	0			
#2	Sample 5/6 B	2:55 PM	0	1.033	10	655.955
		3:57 PM	1	0.75	10	476.25
		4:57 PM	2	1.039	10	659.765
		6:55 PM	4	0.977	10	620.395
		8:57 PM	6	0.876	10	556.26
		3:00 PM	24	0.761	10	483.235
T=0 Data	Flasks Spiked	12:50 PM	0			
#3	Sample 11/12 A	1:10 PM	0	0.628	10	398.78
		2:05 PM	1	0.77	10	488.95
		3:05 PM	2	0.736	10	467.36
		5:07 PM	4	0.827	10	525.145
		7:05 PM	6	0.838	10	532.13
		1:10 PM	24	0.953	10	605.155
T=0 Data	Flasks Spiked	2:40 PM	0			
#3	Sample 11/12 A	2:55 PM	0	1.282	10	814.07
		3:57 PM	1	1.12	10	711.2
		4:57 PM	2	1.296	10	822.96
		6:55 PM	4	0.894	10	567.69
		8:57 PM	6	1.066	10	676.91
		3:00 PM	24	0.848	10	538.48

T=0 Data	Flasks Spiked	12:50 PM	0			
#4	Sample 11/12 B	1:10 PM	0	1.64	10	1041.4
		2:05 PM	1	0.725	10	460.375
		3:05 PM	2	0.765	10	485.775
		5:07 PM	4	0.771	10	489.585
		7:05 PM	6	0.904	10	574.04
		1:10 PM	24	0.791	10	502.285
T=0 Data	Flasks Spiked	2:40 PM	0			
#4	Sample 11/12 B	2:55 PM	0	1.296	10	822.96
		3:57 PM	1	1.403	10	890.905
		4:57 PM	2	1.274	10	808.99
		6:55 PM	4	1.232	10	782.32
		8:57 PM	6	1.103	10	700.405
		3:00 PM	24	0.748	10	474.98
T=0 Data	Flasks Spiked	12:50 PM	0			
#5	Sample 17/18 A	1:10 PM	0	0.053	10	33.655
		2:05 PM	1	0.696	10	441.96
		3:05 PM	2	0.657	10	417.195
		5:07 PM	4	0.703	10	446.405
		7:05 PM	6	0.63	10	400.05
		1:10 PM	24	0.528	10	335.28
T=0 Data	Flasks Spiked	2:40 PM	0			
#5	Sample 17/18 A	2:55 PM	0	0.965	10	612.775
		3:57 PM	1	1.11	10	704.85
		4:57 PM	2	0.881	10	559.435
		6:55 PM	4	0.654	10	415.29
		8:57 PM	6	1.113	10	706.755
		3:00 PM	24	0.726	10	461.01
T=0 Data	Flasks Spiked	12:50 PM	0			
#6	Sample 17/18 B	1:10 PM	0	0.439	10	278.765
		2:05 PM	1	0.703	10	446.405
		3:05 PM	2	0.638	10	405.13
		5:07 PM	4	0.634	10	402.59
		7:05 PM	6	0.685	10	434.975
		1:10 PM	24	0.509	10	323.215
T=0 Data	Flasks Spiked	2:40 PM	0			
#6	Sample 17/18 B	2:55 PM	0	0.976	10	619.76
		3:57 PM	1	0.995	10	631.825
		4:57 PM	2	0.994	10	631.19
		6:55 PM	4	0.845	10	536.575
		8:57 PM	6	1.178	10	748.03
		3:00 PM	24	0.691	10	438.785

APPENDIX F

Water Pretreatment Study Data Sheets

REMEDIATION TECHNOLOGIES, INC.

MEMORANDUM

TO: D. Miller
DATE: July 12, 1993
FROM: B. Ross
RE: Jar Tests - Shore Realty (3-1033)

Sample Receipt:

A 5 gallon water sample from Shore Realty was received in RETEC's Pittsburgh Laboratory on June 7, 1993. Upon arrival it was inspected for integrity and then it was logged in. The water sample was used for the laboratory experiments on the same day. Care was taken to keep the water container closed all the time to minimize atmospheric oxidation of the soluble iron in the water sample.

Procedure:

In order to evaluate the oxidant and coagulant dosages, a series of jar tests was performed using samples of the groundwater and various dosages of $KMnO_4$ and coagulant aids. The experimental set up is shown in Figure 1. The apparatus and materials used in the jar test were:

- six paddle stirrer,
- potassium permanganate (0.1 M solution),
- cationic polymer (Klar Aid 2400),
- anionic polymer (Aqua Floc 800),
- base (10% w/w NaOH solution),
- pH meter,
- stop watch,
- glassware (pipets, beakers, and graduated cylinders), and
- test strips for dissolved iron and manganese determination.

The water sample was first analyzed for iron, manganese (using test strips) and pH. The concentration of iron was approximately 25 mg/L and the level of manganese non-detectable. The pH of the water was 6.4 standard units. Two water samples were preserved with acid and sent to Wadsworth/Alert Laboratory (W/A Lab) for the analyses of iron and manganese, an additional sample (as received) was sent for determination of alkalinity. The results indicated approximately 25 to 40 mg/L iron, 2.5 mg/L manganese, and 290 mg/L alkalinity reported as calcium carbonate.

The evaluation of the physical/chemical process proceeded in three steps to determine the optimum dosage of chemicals required for the oxidation and removal of iron in the groundwater.

Step 1 - pH Adjust with Polymer Enhancement

To provide a basis for comparison, a sample of groundwater was first adjusted to pH 8.5 with 10% w/w NaOH solution and various cationic polymer (Klar Aid 2400) dosages were added to enhance gravity separation. Visual observation and test strips measurements for iron determined the optimal dosage to be 1 mg/L cationic polymer. A confirming sample was sent to the W/A Lab for total metals analysis. Results indicated iron at 3.5 mg/L and manganese at 4 mg/L.

Step 2 - Optimization of Potassium Permanganate ($KMnO_4$) Dosage with Polymer Enhancement

Since the concentration of iron in the water was approximately 25 mg/L, a 0.1 M $KMnO_4$ solution was used. The 0.1 M $KMnO_4$ solution was prepared by dissolving 1.58 g of $KMnO_4$ in 100 mL. Five doses namely, 25, 50, 75, 100, and 125% of stoichiometric requirements were evaluated.

To 500 mL groundwater samples, the calculated quantity of 0.1 M $KMnO_4$ solution (ranging from 0.4 to 1.0 mL) was added. The sample was rapid mixed (100 rpm) for one minute, slow mixed (20-30 rpm) for ten minutes and then allowed to gravity settle for twenty minutes. The pH was adjusted to within the range of 7.5 to 8.5 with a 10% by weight solution of NaOH. The volumes of $KMnO_4$ and NaOH added were recorded. The initial and final pH along with iron concentration were measured. The residual concentration of iron after $KMnO_4$ addition and prior to pH adjustment was also recorded. Test strips were used to determine the concentration of dissolved iron in the water.

The optimal dosage was the one which utilized the minimum chemicals yet oxidized the iron. A dosage of 25% stoichiometric $KMnO_4$ met these requirements. It was observed that the $KMnO_4$ reduced the iron concentration from 25 to 10 mg/L and the subsequent pH adjustment reduced the remaining 10 mg/L to non-detectable levels via the test strips. One unfiltered treated sample was sent to the W/A Lab for the analysis of total iron and manganese.

Optimization of Cationic Polymer

In this test, the performance of Klar Aid 2400, a cationic polymer, was evaluated with the combination of previously determined optimal $KMnO_4$ dose. The cationic polymer for this test was tried at 1, 2, 5, 10, and 15 mg/L. The optimal dosage was visually determined by the ability of the chemicals to produce clear supernatant and good settling flocs.

Since the supernatant was very clear, no attempt was made to evaluate the total suspended solids (TSS) in the supernatant. The sample treated with 25% $KMnO_4$ plus 1.0 mL/L weight 10% NaOH plus 5 mg/L Klar Aid 2400 cationic polymer gave the best results in terms of iron oxidation and sludge settling. The volume of dry sludge produced was 691 mg/L. The treated was sent to the W/A Lab for the analysis of total iron and manganese, results indicated approximately 3 mg/L for both metals.

Optimization of a Combination Cationic/Anionic Polymer Enhancement

Quite often, anionic polymers produce only pin flocs when they are used alone without the combination of any other cationic polymer. In order to find whether a lower dose of cationic polymer would give similar result with a combination of an anionic polymer, namely Aqua Floc 408, a test run was made with two samples. Each sample had 25% $KMnO_4$ in common. Additionally, the first sample had 1.0 mg/L cationic polymer and 1.0 mg/L anionic polymer whereas the second polymer had 2.0 mg/L cationic polymer and 2 mg/L anionic polymer. Both samples had no residual iron and the sludge exhibited good settling characteristics. Therefore it was decided to perform another Jar Test with 25% $KMnO_4$ and 1.0 mg/L cationic polymer in common with varying dosages of the anionic polymer. In this Jar Test, the optimal anionic dosage was found to be 0.8 mg/L. The volume of dry sludge produced was 902 mg/L. A sample of the unfiltered treated water was sent to W/A Lab for the analysis of total iron and manganese, results were approximately 1 mg/L iron and 3 mg/L manganese.

Comparison of Individual Runs:

From the above three runs, three optimal dosages, one from each run, were selected. Since the three runs were run independently, it was not possible to select one as the best of the three optimal dosages. Therefore, in the final Jar Test, three water samples were taken and they were treated with the three optimal dosages identified previously. At the end of the experiment each sample was analyzed for residual iron. In addition, visual observations were made on floating and settled sludges, turbidity and color. In this final Jar Test, 25% $KMnO_4$ plus 1.0 mL/L 10% w/w NaOH plus 5.0 mg/L cationic polymer gave the best results, in terms of visual observation and test strips.

Summary:

The optimal dosage identified by each run is as follows:

- ph Adjust to 8.5 (approx. 1.4 mL/L) 10% w/w NaOH plus 1 mg/L cationic polymer (Klar Aid 2400),

- 25% stoichiometric $KMnO_4$ plus 1.0 mL/L 10% w/w NaOH plus 5.0 mg/L cationic polymer (Klar Aid),

- 25% stoichiometric $KMnO_4$ plus 1.0 mL/L 10% w/w NaOH plus 1.0 mg/L cationic polymer (Klar Aid 2400) plus 0.8 mg/L anionic polymer (Aqua Floc 408).

It was observed that all the optimal dosages performed in an equivalent manner regarding the ability to oxidize dissolved iron present in the water samples. The sludge formation in all the three samples was good. However, the pH adjusted sample followed by cationic polymer addition produced the most suspension with a dry sludge production of 71 mg/L. The sample treated with 25% stoichiometric $KMnO_4$ followed by 1.0 mL/L 10% w/w NaOH plus 5.0 mg/L cationic polymer exhibited minimal floaters. The dry sludge produced was 691 mg/L. The 25% $KMnO_4$, NaOH, cationic polymer, and anionic polymer produced the most floaters with a dry sludge production of 902 mg/L.

Discussion of Results:

The analytical results are summarized in Table 1, copies of the W/A Lab reports are provided as Attachment A, copies of the treatability laboratory data sheets are provided as Attachment B. The results for the untreated water show total iron ranged from 23 to 38 mg/L. The variation in iron concentration could be due to the non homogeneity of the water samples. Such variations occur whenever iron is present in both soluble and insoluble forms. These results , however, compare fairly well with the test strip result of 25 mg/L. The concentration of manganese was 2.4 mg/L for the two samples and increased slightly in the treated samples, indicating no change in manganese levels. The test strips did not identify the presence of manganese. The results show that the treated water small amounts (less than 5 mg/L) of iron and manganese. The differences in the concentration among the samples is not appreciable. The results indicate that the a dosage slightly higher than the 25% of stoichiometric may be required to fully oxidize the iron and manganese, however, since only total metals analysis was performed, it can not be conclusively stated whether the chemical dosage was insufficient or the physical gravity separation was responsible for residual iron and manganese concentration (i.e. whether the metals are present in soluble or insoluble form).

Figure 1

Test Apparatus

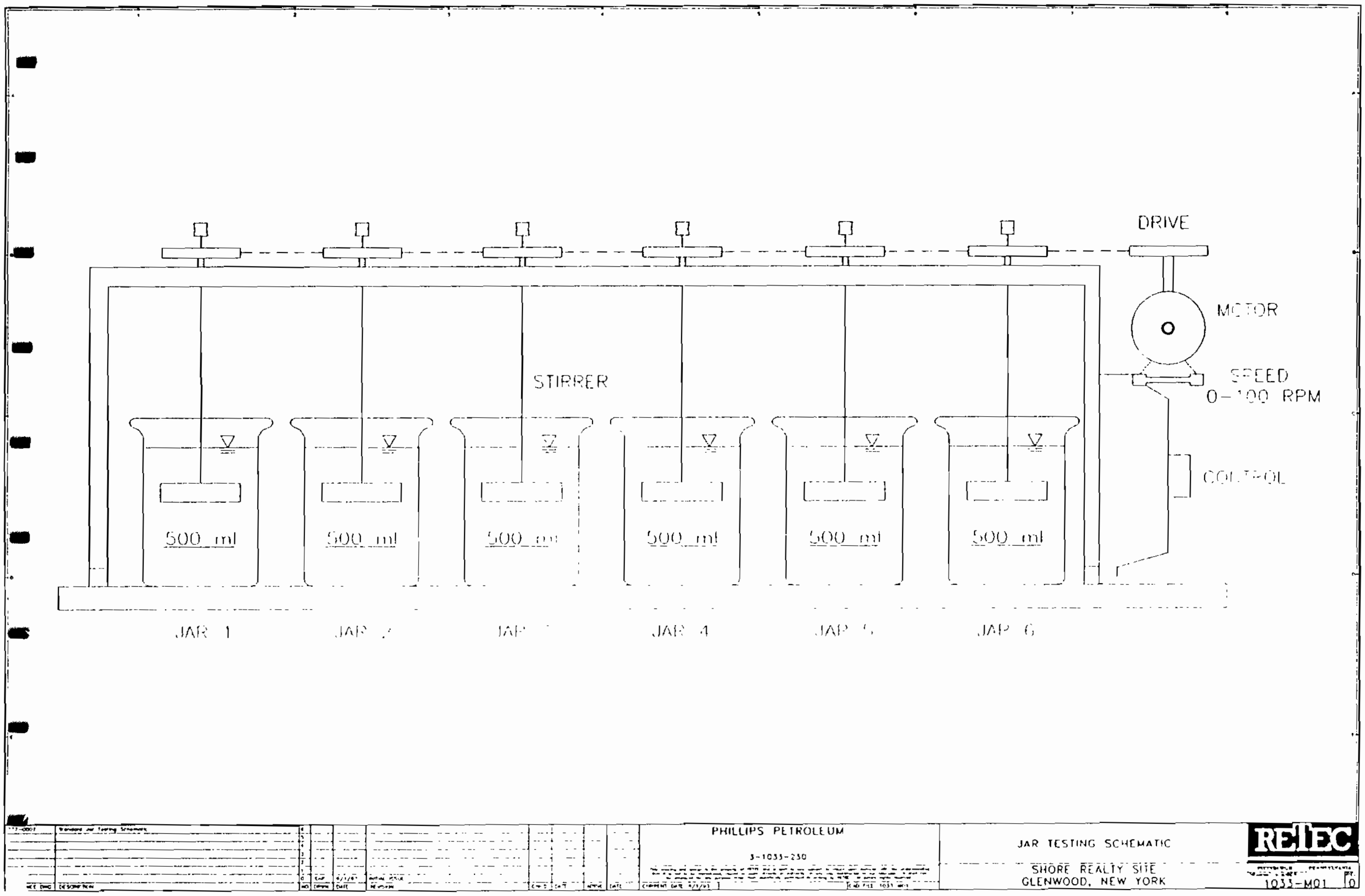


Table 1

Summary of Analytical Results

Description	Total Iron (mg/L)	Total Manganese (mg/L)	Alkalinity as mg/L $CaCO_3$
Initial			
Sample 1	38.0	2.4	Not Applicable
Sample 2	23.0	2.4	Not Applicable
As Recieved	Not Analyzed	Not Analyzed	290
pH Adjusted with Cationic Polymer Enhancement	3.4	4.1	Not Applicable
25% $KMnO_4$ with 5 mg/L Cationic Polymer	2.8	3.6	Not Applicable
25% $KMnO_4$ with 1 mg/L Cationic and 0.8 mg/L Anionic Polymer	0.9	2.7	Not Applicable

ATTACHMENT A

Wadsworth/Alert Laboratory Reports

WADSWORTH/ALERT Laboratories
Division of Enseco Incorporated

450 William Pitt Way
Pittsburgh, PA 15238

412-826-5477
FAX 412-826-5571

ANALYTICAL REPORT

PROJECT NUMBER 3-1033-250

ENSECO-WADSWORTH/ALERT PROJECT NUMBER 1252

Presented to :

Robin Weightman

REMEDIATION TECHNOLOGIES INC.

ENSECO-WADSWORTH/ALERT LABORATORIES

Thomas Tomayko

Thomas Tomayko
Project Manager

Renée M Gigliotti

Renee' Gigliotti
Quality Assessment Group Leader - Pittsburgh

June 30, 1993

A Corning Company

NARRATIVE

The following report contains the analytical results for samples submitted to ENSECO-Wadsworth/ALERT Laboratories. The samples were received into the laboratory in accordance with documented sample acceptance procedures.

ENSECO-Wadsworth/ALERT Laboratories utilizes USEPA approved methods and instrumentation in all analytical work. The methods used for the analyses presented in this study can be found on the following pages.

The following codes are utilized in various analyses of this report:

ND	(None Detected)
J	(Detected, but below quantitation limit; estimated value)
B	(Compounds detected in method blank associated with this sample)
DIL	(Diluted Out)
MI	(Matrix Interference)

ANALYTICAL METHODS

ENSECO-Wadsworth/ALERT Laboratories utilizes only USEPA approved analytical methods and instrumentation. The analytical methods used in the analyses of these samples are listed below.

Parameters	Methods
Metals:	
Iron	EPA 200.7
Manganese	EPA 200.7

EPA: Methods for Chemical Analysis of Water and Wastes EPA 600/4-79-020, March 1983.

COMPANY : REMEDIATION TECHNOLOGIES INC.　　**DATE RECEIVED:** 6/10/93
LAB #: 1252-81873
MATRIX : WATER

SAMPLE ID : INTIAL A 6-9-93

METALS ANALYTICAL REPORT
SELECTED LIST

Total Metals

Total metals analysis results - as received

ELEMENT	**PREPARATION - ANALYSIS DATE**	**RESULT**	**DETECTION LIMIT**	
Iron	6/17- 6/21/93	38000	100	ug/l
Manganese	6/17- 6/21/93	2400	15	ug/l

NOTE: ND (None Detected)

COMPANY : REMEDIATION TECHNOLOGIES INC. **DATE RECEIVED:** 6/10/93
LAB #: 1252-81874
MATRIX : WATER

SAMPLE ID : INTIAL B 6-9-93

TOTAL METALS

METALS ANALYTICAL REPORT
SELECTED LIST

Total metals analysis results - as received

ELEMENT	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Iron	6/17- 6/21/93	23000	100	ug/l
Manganese	6/17- 6/21/93	2400	15	ug/l

NOTE: ND (None Detected)

COMPANY : REMEDIATION TECHNOLOGIES INC.
LAB #: 1252-81877
MATRIX : WATER

DATE RECEIVED: 6/10/93

SAMPLE ID : NAOH 1MG/L 6-9-93

pH adjust to 8.4 and
1 mg/L Cationic
Total Metals

METALS ANALYTICAL REPORT
SELECTED LIST

Total metals analysis results - as received

ELEMENT	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Iron	6/17- 6/21/93	3400	100	ug/l
Manganese	6/17- 6/21/93	4100	15	ug/l

NOTE: ND (None Detected)

COMPANY : REMEDIATION TECHNOLOGIES INC. DATE RECEIVED: 6/10/93
LAB #: 1252-81876
MATRIX : WATER

SAMPLE ID : 25% LU 04 5 MG/L 6-9-93

25% $KMnO_4$ with 5 mg/L cationic

METALS ANALYTICAL REPORT
SELECTED LIST

TOTAL METALS

Total metals analysis results - as received

ELEMENT	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Iron	6/17- 6/21/93	2800	100	ug/l
Manganese	6/17- 6/21/93	3600	15	ug/l

NOTE: ND (None Detected)

COMPANY : REMEDIATION TECHNOLOGIES INC.

DATE RECEIVED: 6/10/93

LAB #: 1252-81875

MATRIX : WATER

SAMPLE ID : 25% LU 04 1 MG/L 6-9-93

25% $KMnO_4$ with 1mg/L cationic
and 0.8mg/L anionic

METALS ANALYTICAL REPORT
SELECTED LIST

TOTAL METALS

Total metals analysis results - as received

ELEMENT	**PREPARATION - ANALYSIS DATE**	**RESULT**	**DETECTION LIMIT**	
Iron	6/17- 6/21/93	900	100	ug/l
Manganese	6/17- 6/21/93	2700	15	ug/l

NOTE: ND (None Detected)

№ 0003

CHAIN OF CUSTODY RECORD

Destination: WADS

P.O. No. 930072

PROJ. NO. 3-1033-250

PROJECT NAME: Shore Realty

PROJECT ~~MANAGER~~ Contact: Robin Weightman

SAMPLERS: (Signature) Alan Rupert

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CONTAINERS	Fe	mn	Alkanity
Initial A	6-8-93		As IS	1	X	X	X
Initial B	6-8-93		As IS	1	X	X	X
[illegible]	6-8-93		pH adjust to 8.4; 1mg/L Cat	1	X	X	
KMnO4 single	cat.		KMnO4; CAT 5mg/L	1	X	X	
To KMnO4	-1mg	cat	5mg Ant KMnO4; CAT; AN	1	X	X	

Relinquished by: (Signature) Alan Rupert — Date / Time 6-8-93 4:14 — Received by: (Signature)

Relinquished by: (Signature) — Date / Time — Received by: (Signature)

Relinquished by: (Signature) — Date / Time — Received by: (Signature)

Relinquished by: (Signature) — Date / Time — Received by: (Signature)

Relinquished by: (Signature) — Date / Time — Received for Laboratory by: (Signature) — 6-10-93 8:50

REMARKS:

RETEC
REMEDIATION TECHNOLOGIES INC

REMEDIATION TECHNOLOGIES
3040 WILLIAM PITT WAY
PITTSBURGH, PA 15238
(412) 826-3340
FAX (412) 826-3409

WHITE - SAMPLE YELLOW - PROJECT MANAGER PINK - RI

WADSWORTH/ALERT Laboratories
Division of Enseco Incorporated

450 William Pitt Way
Pittsburgh, PA 15238

412-826-5477
FAX 412-826-5571

ANALYTICAL REPORT

PROJECT NUMBER 3-1033-250

ENSECO-WADSWORTH/ALERT PROJECT NUMBER 1262

Presented to :

Robin Weightman

REMEDIATION TECHNOLOGIES INC.

ENSECO-WADSWORTH/ALERT LABORATORIES

Thomas Tomayko
Thomas Tomayko
Project Manager

Renée M Gigliotti
Renee' Gigliotti
Quality Assessment Group Leader - Pittsburgh

June 17, 1993

NARRATIVE

The following report contains the analytical results for samples submitted to ENSECO-Wadsworth/ALERT Laboratories. The samples were received into the laboratory in accordance with documented sample acceptance procedures.

ENSECO-Wadsworth/ALERT Laboratories utilizes USEPA approved methods and instrumentation in all analytical work. The methods used for the analyses presented in this study can be found on the following pages.

The following codes are utilized in various analyses of this report:

ND	(None Detected)
J	(Detected, but below quantitation limit; estimated value)
B	(Compounds detected in method blank associated with this sample)
DIL	(Diluted Out)
MI	(Matrix Interference)

ANALYTICAL METHODS

ENSECO-Wadsworth/ALERT Laboratories utilizes only USEPA approved analytical methods and instrumentation. The analytical methods used in the analyses of these samples are listed below.

Parameters	Methods
Inorganics:	
Alkalinity	EPA 310.1

EPA: Methods for Chemical Analysis of Water and Wastes EPA 600/4-79-020, March 1983.

COMPANY : REMEDIATION TECHNOLOGIES INC. **DATE RECEIVED:** 6/11/93
LAB #: 1262-81993
MATRIX : WATER

SAMPLE ID : INITIAL 6-11-93 10:00

ANALYTICAL REPORT

PARAMETER	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Alkalinity (CaCO3 to pH 4.5)	6/14/93	290	1.0	mg/l

NOTE: ND (None Detected)

№ 0004

CHAIN OF CUSTODY RECORD

Destination: WADS

P.O. No. 930074

PROJ. NO. 3-1033-250	PROJECT NAME: Sheer Realty PROJECT ~~MANAGER~~: Contact Robin Weightman	
SAMPLERS: (Signature)		

SAMPLE NO.	DATE	TIME	SAMPLE LOCATION	NO. OF CON-TAINERS	PARAMETERS Alkalinity															
Initial	6-11-93	10:00		1	X															

Relinquished by: (Signature) Alan Rupert	Date / Time 6-11-93 10:00	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature) J. [illegible]	6-11-93 10:00		
REMARKS:					

RETEC
REMEDIATION
TECHNOLOGIES INC.

REMEDIATION TECHNOLOGIES
3040 WILLIAM PITT WAY
PITTSBURGH, PA 15238
(412) 826-3340
FAX (412) 826-3409

WHITE - SAMPLE YELLOW - PROJECT MANAGER PINK - RETEC

ATTACHMENT B

Treatability Laboratory Data Sheets

1 A 8

pH adjusted to 8.4 *
No KMnO4
+ Cationic Polymer

JAR TESTING
CATIONIC POLYMER SCREENING

Project Name: Shore Realty

Project No.: 3-1033-220

Project Mgr.: REK / DCM

Date: 6-9-93

Operator: ALK / BSR

Cationic Polymer: KLARAID 2400

Best Dose KMnO4= 0 % stoichiometric dose = 0 mg/500ml = 0 ml KMnO4

1. Initial Screening

1. Add ____________ ml KMnO4 to one 500ml sample, rapid mix 1 minute.
2. Add cationic polymer in incremental doses as indicated below, noting visual observations w/each addition.
3. Continue rapid mixing.

1mg/L = 0.05 ml polymer/500ml (0.05ml)	20mg/L = 1 ml polymer/500ml (+0.5ml)	Try higher or in
5mg/L = 0.25 ml polymer/500ml (+0.2ml)	50mg/L = 2.5 ml polymer/500ml (+1.5ml)	between doses
10mg/L = 0.5 ml polymer/500ml (+0.25ml)	100mg/L = 5 ml polymer/500ml (+2.5ml)	if necessary

Best cationic polymer dose: ____________

2. Standard Cationic Screening

Repeat steps 1–3 above using separate beakers for each polymer dose (0X to 2X the best dose as determined above).

					Visual Observations
Bkr 1:	0	ml cationic polymer/500ml =	0	mg/L (control)	
Bkr 2:	[illegible]	ml cationic polymer/500ml =	1	mg/L	very clear no floating solids
Bkr 3:	[illegible]	ml cationic polymer/500ml =	2	mg/L	1% of pin floc still suspended
Bkr 4:	[illegible]	ml cationic polymer/500ml =	5	mg/L	very very clear no suspended solids
Bkr 5:	[illegible]	ml cationic polymer/500ml =	10	mg/L	99% settled in 2 min no suspended solids
Bkr 6:	[illegible]	ml cationic polymer/500ml =	15	mg/L	99% settled in 2 min no suspended solids

Best cationic polymer dose: ____________

NOTES: No KMnO4 used. small floc Imediately After ph Adjustment to 8.4. No Fe concentration After ph Adjustment.

1 min Rapid mix 10 min slow mix 20 min. settling
BK 5 & 6 - Floc settled immediately After 10 mix slow mix.
BK 2-4 - very small pin floc suspended After 4 mins settling.

BK 2 = Best dosage visually .05 ml of cationic (1 mg/L)

* For 3.5 L, 4.8 mL 10% NaOH added to raise pH from

JAR TESTING
KMnO4 ADDITION

Project Name: Shore Reality

Project No.: 3 - 1033 -260

Project Mgr.: REK / DLM

Date: 6-9-93

Operator: ALK / BSR

1. pH of Composite

Initial pH: 6.4 (if < 6, increase to ~7 using 10% NaOH)

Adjusted pH: 8.4 , 4.8 mls of 10% NaOH/10% H2SO4 used.

Adjusted ~350ml then Poured into Individual Beakers.

2. Fe/Mn Content

Fe content of composite: 25 [illegible] mg/500ml

Mn content of composite: mg/500ml

3. KMnO4 Addition

- 1 ml of 0.1 molar KMnO4 solution = 15.8 mg KMnO4

Stoichiometric Dose of 0.1M KMnO4 equals the stoichiometric dose for Fe (1mg Fe : 1mg KMnO4) plus the stoichiometric dose for Mn (1mg Mn : 2mg KMnO4). Used 0.01m KmnO4

Bkr 1: 0% of stoichiometric dose = mg/500ml= ml KMnO4

Bkr 2: 15% of stoichiometric dose = mg/500ml= ml KMnO4

Bkr 3: 25% of stoichiometric dose = mg/500ml= ml KMnO4

Bkr 4: 50% of stoichiometric dose = [illegible] mg/500ml= 0.48 ml KMnO4 4.8 mL NaOH

Bkr 5: 100% of stoichiometric dose = mg/500ml= ml KMnO4

Bkr 6: 125% of stoichiometric dose = mg/500ml= ml KMnO4

After addition, rapid mix for 5 minutes, adjust pH if <6, note amount of acid/caustic solution used to adjust pH.

After Rapid Mixing:

Check for:	Beaker 1 Dose: 0%	Beaker 2 15%	Beaker 3 25%	Beaker 4 50%	Beaker 5 100%	Beaker 6 125%
pH						
Fe						
Mn						

Visual Observations:

Bkr 1

Bkr 2

Bkr 3

Bkr 4

Bkr 5

Bkr 6

NOTES:

2. ph Adjusted After KMnO4 Dosage. (xx) color could be due to excess KMnO4.

JAR TESTING
KMnO4 ADDITION

Project Name: Shore Realty
Project No.: 3-1033-2501
Project Mgr.: REK / DLM

Date: 6-9-93
Operator: ALR / BJR

1. pH of Composite

Initial pH: 6.4 (if < 6, increase to ~7 using 10% NaOH)
Adjusted pH: ______ , ______ mls of 10% NaOH/10% H2SO4 used.

2. Fe/Mn Content

Fe content of composite: 25 mg/500ml
Mn content of composite: ______ mg/500ml

3. KMnO4 Addition

- 1 ml of 0.1 molar KMnO4 solution = 15.8 mg KMnO4

Stoichiometric Dose of 0.1M KMnO4 equals the stoichiometric dose for Fe (1mg Fe : 1mg KMnO4) plus the stoichiometric dose for Mn (1mg Mn : 2mg KMnO4).

Bkr 1: 0% of stoichiometric dose = ______ mg/500ml= 0 ml KMnO4
Bkr 2: ~~15%~~ of stoichiometric dose = ______ mg/500ml= .2 ml KMnO4 .4ml of NAOH 8.5
Bkr 3: ~~25%~~ of stoichiometric dose = ______ mg/500ml= .4 ml KMnO4 .2ml of NAOH 8.2
Bkr 4: ~~50%~~ of stoichiometric dose = ______ mg/500ml= .6 ml KMnO4 .3ml of NAOH 8.0
Bkr 5: 100% of stoichiometric dose = ______ mg/500ml= .8 ml KMnO4 .5ml of NAOH 8.5
Bkr 6: ~~125%~~ of stoichiometric dose = ______ mg/500ml= 1.0 ml KMnO4 .4ml of NAOH 8

After addition, rapid mix for 5 minutes, adjust pH if <6, note amount of acid/caustic solution used to adjust pH.

After Rapid Mixing:

Check for:	Beaker 1 Dose: 0%	Beaker 2 25%	Beaker 3 50 ~~25%~~	Beaker 4 75 ~~50%~~	Beaker 5 100%	Beaker 6 125%
pH	6.4	6.5	6.6	6.6	6.6	6.6
Fe	25	10	0	0	0	0
Mn	0	0	0	0	0	0

Visual Observations: 25 0 0 0 0 Fe After 20 m

Bkr 1 ~~After~~ ~~[illegible]~~ — Cloudy after 20 mts. settling.

Bkr 2 ~~Clear~~ Very clear.

Bkr 3 Clear with 1-2% pin flocs floating.

Bkr 4 overdose - Floc settled immediately After ph Adjustment. small Amount of floating solids — Supernatant very slightly colored.

Bkr 5 overdose - Same as Bkr 4 - Supernatant slightly colored.

Bkr 6 overdose - Floc settled after pH adj. Small quantity of floating solids. Supernatant - Slightly colored

NOTES:

25% KMnO4

(*) No 2 Beaker shows best settling. No suspended

After 20

No3. Kmn O4 + KlAR A.D 2400, pH adj

BEST DOSAGE
25% KMnO4
+5 mg/L CATIONIC Polym

JAR TESTING
CATIONIC POLYMER SCREENING

Project Name: Shore Realty
Project No.: 3-1033-250
Project Mgr.: REK / DLM

Date: 6-9-93
Operator: ACR / BJR

Flocs settled at the centre as part-[illegible].

Cationic Polymer: KlAR A.D 2400

Best Dose KMnO4= 25 % stoichiometric dose = ______ mg/500ml = .2 ml KMnO4

1. Initial Screening

1. Add .2 ml KMnO4 to one 500ml sample, rapid mix 1 minute.
2. Add cationic polymer in incremental doses as indicated below, noting visual observations w/each addition.
3. Continue rapid mixing.

1mg/L = 0.05 ml polymer/500ml (0.05ml)	20mg/L = 1 ml polymer/500ml (+0.5ml)	Try higher or in
5mg/L = 0.25 ml polymer/500ml (+0.2ml)	50mg/L = 2.5 ml polymer/500ml (+1.5ml)	between doses
10mg/L = 0.5 ml polymer/500ml (+0.25ml)	100mg/L = 5 ml polymer/500ml (+2.5ml)	if necessary

Best cationic polymer dose: ______

2. Standard Cationic Screening

Repeat steps 1–3 above using separate beakers for each polymer dose (0X to 2X the best dose as determined above).

			Visual Observations
Bkr 1:	0 ml cationic polymer/500ml =	0 mg/L (control)	
Bkr 2:	.05 ml cationic polymer/500ml =	1 mg/L	
Bkr 3:	.1 ml cationic polymer/500ml =	2 mg/L	
Bkr 4:	.25 ml cationic polymer/500ml =	5 mg/L	
Bkr 5:	.50 ml cationic polymer/500ml =	10 mg/L	
Bkr 6:	.75 ml cationic polymer/500ml =	15 mg/L	

Best cationic polymer dose: KlAR A.D 2400 .25ml or 5mg/L

For control no NaOH added

NOTES:

	Fe after KMnO4+Cat	pH	NaOH added ml	Adj. pH	
①	25	6.2	0.5 mL	8.3	CONTROL cloudy
②	0	6.2	0.4 mL	8.4	Settled well, But small % pin flocs in the supernatant
③	0	6.3	0.5 mL	8.5	Settled well A small % present as pin flocs in the supernatant
④	0	6.3	0.5	8.3	Flocs well settled, Clean Supernatant.
⑤	0	6.4	0.5	8.5	Settled well. A [illegible] % flocs in the supernatant.
⑥	0	6.3	0.5		Same as ⑤

2 in 4

JAR TESTING
ANIONIC POLYMER SCREENING

Project Name: Shore Realty
Project No.: 3-1033-050
Project Mgr.: REK/DLM

Date: 6-9-93
Operator: ALA/BJR

Cationic Polymer: KlarAid 2400
Anionic Polymer: Aqua floc 408

Best Dose KMnO4= 25 % stoichiometric dose = ______ mg/500ml = .2 ml 0.1M KMnO4
Best Dose Cationic Polymer= .25 ml/500ml = ______ mg/L

1. Following instructions in work request, add KMnO4, adjust pH and add best determined dose of cationic polymer to each of five beakers. Beaker 1 is a control and should NOT have any additions.
2. Rapid mix 1 minute, note visual observations.
3. Add anionic polymer as instructed in work request, rapid mix 1 minute, slow mix @30rpm for 10 minutes.
4. Let settle for 30 minutes, note visual characteristics. Check pH, Fe and Mn content of each sample.

	Visual Observations (while slow mixing)
Bkr 1: 0 ✓ ml anionic polymer/500 ml = 0 mg/L	
Bkr 2: 0.25 ✓ ml anionic polymer/500 ml = 0.5 mg/L	
Bkr 3: 0.5 ✓ ml anionic polymer/500 ml = 1.0 mg/L	
Bkr 4: 1.0 ✓ ml anionic polymer/500 ml = 2.0 mg/L	
Bkr 5: 2.5 ✓ ml anionic polymer/500 ml = 5.0 mg/L	
Bkr 6: 5.0 ✓ ml anionic polymer/500 ml = 10 mg/L	

	pH	Fe	Mn	Visual Observations after Settling
Beaker 1 CONTROL				cloudy – No change.
Beaker 2 25% KMnO$_4$ + 1mg/L cat + ~~.5~~ 1.0mg/L Anionic				— Very clear
Beaker 3 25% KMnO$_4$ + 2mg/L cat + 2mg/L Anionic				— Very Clear
Beaker 4				
Beaker 5				
Beaker 6				

Best Anionic Polymer Dose: AquaFloc 408 .5ml or 1.0mg/L

NOTES: Large clump of Solid on Bottom After 7½ min slow mix, supernatant very clear.

5

25 % KMnO4 → 0.2 ml
1 mg/L cat → 005 ml

JAR TESTING
ANIONIC POLYMER SCREENING

Project Name: Shore Realty
Project No.: 3-1033-250
Project Mgr.:

Date: 6-9-93
Operator: ACR/BJR

Cationic Polymer: KlarAid 2400
Anionic Polymer: Aqua Floc 408

Best Dose KMnO4= 25 % stoichiometric dose = ______ mg/500ml = 0.2 ml 0.1M KMnO4
Best Dose Cationic Polymer= .05 ml/500ml = 1 mg/L

1. Following instructions in work request, add KMnO4, adjust pH and add best determined dose of cationic polymer to each of five beakers. Beaker 1 is a control and should NOT have any additions.
2. Rapid mix 1 minute, note visual observations.
3. Add anionic polymer as instructed in work request, rapid mix 1 minute, slow mix @30rpm for 10 minutes.
4. Let settle for 30 minutes, note visual characteristics. Check pH, Fe and Mn content of each sample.

	Visual Observations (while slow mixing)
Bkr 1: 0 ml anionic polymer/500 ml = 0 mg/L	Small pin floc
Bkr 2: ~~0.25~~ .2 ml anionic polymer/500 ml = ~~0.5~~ .3 mg/L	small pin floc, clear suspended solids, floating
Bkr 3: ~~0.5~~ .3 ml anionic polymer/500 ml = ~~1.0~~ .6 mg/L	~~clear~~ Small pin floc ~~cl~~ suspended, clear, floating
Bkr 4: ~~1.0~~ .4 ml anionic polymer/500 ml = ~~2.0~~ .8 mg/L	clear, no pin floc, no floating suspended solids
Bkr 5: ~~2.5~~ .5 ml anionic polymer/500 ml = ~~5.0~~ 1.0 mg/L	clear, no pin floc, no floating
Bkr 6: ~~5.0~~ .6 ml anionic polymer/500 ml = ~~10.0~~ 1.2 mg/L	Clear, no pin floc, no ~~clear~~ floating

	pH	Fe	Mn	Visual Observations after Settling
Beaker 1	8.2	0		
Beaker 2	8.2	0		
Beaker 3	8.2	0		
Beaker 4	8.2	0		
Beaker 5	8.2	0		
Beaker 6	8.2	0		

Best Anionic Polymer Dose: AQUA Floc 408 .3ml OR .6mg/L

NOTES: Beaker 4. Best Dosage. .4ml or .8mg/L

Send Samples
5 Samples Alkanity
2 - Dut
1 - Best Polymer
1 - Best $KMnO_4$
1 - Best $KMnO_4$ + Best Polymer

-9-93 Shore Realty

Received 5gal Sample

Initial Fe 25ppm Final - 0.3 ppm

Initial Mn 0 ppm

Ph. - 6.4

Adjusted Ph - 8.4 48mls of 10% NAOH 3500ml

3500ml

~~After ph was Adjusted. Iron oxidized and fell out. Sample was no good.~~

Fe fell out at Ph between 7.2 - 8.5

made A 0.01m solution of $KMnO_4$ (10ml of .1m solution / 90ml H_2O)

1 No $KMnO_4$ Added Just Klaraid 2400 Cationic

		Sample I is	
	NaOH + Cationic 1mg/L.	25% $KMnO_4$ 1.0mg/L 10% NaOH 5mg/L Cation	25% $KMnO_4$ 1mg/L 10% NaOH 1 mg/L cation +0.8mg/L Anion.
Initial weight. Before drying	1.1131	1.1146	1.1126
Final weight After drying	1.1488	1.4600	1.5637
Sludge produced	0.0357g	0.3454g	0.4511 g
water	500 mL	500mL	500 mL
Sludge produced	71 mg/L	69[illegible] mg/L	902 mg/L

SLUDGE PRODUCTION.

	Adjust pH to 8.4 with NaOH + 1mg/L Cal (0.05ml)	25% KMnO4 (0.2ml) + 0.5ml NaOH & + 5mg/L Cal (0.25ml)	25% KMnO4 (0.2 m + 0.5ml NaOH + 1mg/L cal (0.05 + 0.8mg/L Anioni (0.4ml)
Fe Initial mg/L	25	25	25.
~~ase separation: ranked relatively (most floaters)~~	~~3.~~	~~1~~	~~2~~
0% ~~NaOH~~ Initial pH	6.3	6.3	6.3
% NaOH mL	0.7		
pH	8.4		
~~[illegible]~~ KMnO4		0.8	0.2
NaOH		0.5	0.5
pH	8.	8.2	8.2.
	Floc formation good. Thin/pin flocs. Still present during slow mixing.	Floc formation very good. Flocs suspended during slow mixing.	Floc formation very good. Most of the flocs settled during slow mixing during 5 mins.
larity ranked relatively (All acceptable)	most suspensions 3.	least floaters 2	1 most floater

roject Name SHORE REALTY
roject Number 3-1033-250
Project Scientist BJR/ALR
Date: 6-9-93.

Stoichiometric Potassium Permangante Dosage

KMnO	~~30%~~ 25%	50 ~~35%~~	75% ~~100%~~	100% ~~125%~~	125% ~~150%~~
sual Observations	No suspended flocs. Supernatant clear without color	Supernatant no color but 1-2% pin flocs	Floating solids and ~~an~~ colored supernatant	Floating solids and colored supernatant.	Floating solids + colored supernatant.
st Strip Iron Concentration	0	0	0	0	0

KMnO, Concentration: 0.1 Molar
Optimum (Stoichiometric Dosage: 25 %
10% NaOH added 0.4 mL/L.

Cationic Polymer (Klar Aid) Dosage

(with KMnO @ 25 % Stoichiometric)

Cationic Polymer	1 mg/L	2 mg/L	5 mg/L	~~15 mg/L~~ 10 mg/L	15 ~~10 mg/L~~	15 mg/L
sual Observations	Pin flocs in supernatant. Good sludge settling	Pin flocs in supernatant. Good sludge settling	Clear supernatant. Good sludge settling	Pin flocs in supernatant. Good sludge settling	Pin flocs in the supernatant. Good sludge settling	
st Strip Iron Concentration	0	0	0	0	0	0

Polymer Name Klar Aid 2400
Optimum Dosage: 5 mg/L
10% NaOH added 1.0 mL/L.

Anionic Polymer Dosage

(with KMnO @ ______ %)

Anionic Polymer	0.5 mg/L	1 mg/L	1.5 mg/L	2 mg/L	5 mg/L
al Observations					
t Strip Iron Concentration					

Polymer Name ______
Optimum Dosage ______ %

Non-ionic Polymer Dosage

(with KMnO @ ______ %)

Non-ionic Polymer	0.5 mg/L	1 mg/L	1.5 mg/L	2 mg/L	5 mg/L
al Observations					
t Strip Iron Concentration					

Polymer Name ______
Optimum Dosage: ______ %

Stoichiometric Combination Polymer Dosage

(with KMnO @ 25% + Cationic Polymer at 1 mg/L)

Anionic Polymer	0.3 ~~0.5~~ mg/L	0.6 ~~1~~ mg/L	0.8 ~~1.5~~ mg/L	1.0 ~~2~~ mg/L	1.2 ~~5~~ mg/L
al Observations	Floating and pin flocs in the supernatant	Pin flocs + floating in the supernatant	Clear. No floating or pin flocs.	Clear. No floating or pin flocs	Clear. No floating or pin flocs
Strip Iron Concentration					

~~onic Polymer Name Klar Aid~~ ~~2400~~ 2400
Optimum ~~Dosage~~ 0.8 mg/L

nic Polymer ~~Name~~ Aqua Floc 408

Table ___

Volume of water sample 3,500 mL
Initial Fe ___ 25 mg/L Mn 0 mg/L
Initial pH ___ 8.4
10% (wt) NaOH solution added } ~~[illegible]~~ 4.8 mL.
Final pH ___ 6.4
Final Fe ___ 0 mg/L
Mn ___ 0. mg/L.

APPENDIX G

Soil Analytical Data

PRE-REMEDIAL DESIGN INVESTIGATION REPORT

for the

Shore Realty Superfund Site
Glenwood Landing, New York

Volume II
Appendix G

Copy of Appendix G is maintained
in both NYSDEC's and RETEC's files.

APPENDIX H

Groundwater Analytical Data

PRE-REMEDIAL DESIGN INVESTIGATION REPORT

for the

Shore Realty Superfund Site
Glenwood Landing, New York

Volume III
Appendix H

Copy of Appendix H is maintained
in both NYSDEC's and RETEC's files.