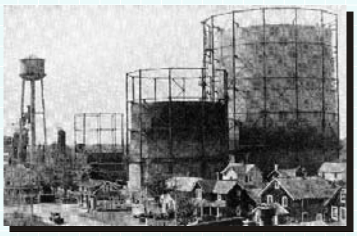
NOTE:

This January 2003 “Final RI Report is misnamed. It does not supercede the April 2002 “RI Report” which is actually the final RI report.

This January 2003 report should have been titled “Final Supplemental RI Report,” as it contains supplemental information not included in the April 2002 report.

KEYSPAN



Bay Shore/Brightwaters Former Manufactured Gas Plant Site

FINAL REMEDIAL INVESTIGATION REPORT

VOLUME 1

JANUARY 2003

Prepared for:

KEYSPAN
One MetroTech Center
Brooklyn, New York

Prepared by:

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KeySpan Corporation
Environmental Asset Management
175 East Old County Road
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January 9, 2003

Amen M. Omorogbe, P.E., Project Manager
New York State Department of Environmental Conservation
Bureau of Western Remedial Action
Division of Environmental Remediation
625 Broadway
Albany, NY 12233-7017

Re: Bay Shore/Brightwaters Former MGP Site
Final Remedial Investigation Report

Dear Mr. Omorogbe:

Enclosed please find two (2) copies of Volumes 1 and 2 of the following final report:

"Bay Shore/Brightwaters Former Manufactured Gas Plant Site
Final Remedial Investigation Report
January 2003"

In addition, enclosed is one (1) electronic copy of the report on compact disc (CD).

By copy of this letter, the above-referenced document has also been forwarded to the parties named below.

If you should have any questions, please do not hesitate to contact me at (516) 545-2563.

Very truly yours,

Theodore O. Leissing, Jr.
Director, MGP Program - Long Island
KeySpan Corporation

TOL/ESK/ld
Enclosures
cc: W. Parish, NYSDEC Region 1 (1 copy)
W. Kuehner, NYSDOH (2 copies, 1 CD)
S. Robbins, SCDHS (1 copy)
L. Liebs, KSE (1 CD)

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BAY SHORE / BRIGHTWATERS
FORMER MANUFACTURED GAS PLANT SITE

FINAL REMEDIAL INVESTIGATION REPORT

VOLUME 1

Prepared for:

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JANUARY 2003

BAY SHORE/BRIGHTWATERS FORMER MANUFACTURED GAS PLANT SITE FINAL REMEDIAL INVESTIGATION REPORT

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EXECUTIVE SUMMARY

Introduction

KeySpan Corporation (KeySpan) entered into an Order on Consent (Index No. D1-0002-98-11) with the New York State Department of Environmental Conservation (NYSDEC) to conduct a remedial investigation of a former manufactured gas plant (MGP) site located in Bay Shore and the Incorporated Village of Brightwaters, Suffolk County, New York. As required by the Order on Consent, a field investigation was completed in the Fall of 2000 as documented in the report entitled, "Bay Shore/Brightwaters Former Manufactured Gas Plant Site Remedial Investigation Report," dated April 2002. Based on the findings of the completed field program, additional sampling activities were recommended. As a result, a supplemental field investigation was subsequently completed in accordance with the scope of work presented in the Supplemental Field Investigation Work Plan for the Bay Shore/Brightwaters Former Manufactured Gas Plant Site, dated February 8, 2002. Additionally, a Qualitative Human Exposure Assessment and an evaluation of environmental risks were performed.

In addition to the remedial investigation, a number of other related investigation and remedial activities were completed or are currently in progress as Interim Remedial Measures (IRMs). IRMs are undertaken on an accelerated schedule to investigate, evaluate and remediate chemical constituents present in the environment that are attributable to a site. The implemented IRMs associated with the site include: the Cut and Plug IRM; the Brightwaters Yard Underground Storage Tank (UST) Removal/Closure IRM/Investigation; the Watchogue Creek/Crum's Brook IRM/Investigation; and the Brightwaters Yard Groundwater Plume IRM/Investigation.

This final remedial investigation report presents: introductory and background information related to the site; an overview of historic and current site operations; a discussion of the completed investigation programs; a discussion of the geology and hydrogeology of the investigation area; discussions of the nature and extent of chemical constituents in the environment related to the site; and a summary of the findings of the two field programs and associated IRMs. In addition, the data and results of the field programs were used to prepare a final Qualitative Human Exposure Assessment and to perform a Fish and Wildlife Resources Impact Analysis (FWRIA) for the site and surrounding area.

KeySpan and the NYSDEC are developing a Remedial Action Plan (RAP) to address the environmental implications associated with the Bay Shore/Brightwaters former MGP site. That Plan will include a number of remedial measures, both within the site boundaries and in the community, to eliminate, reduce or contain sources of the MGP-related contaminants that are found in the defined groundwater plumes in the community and to eliminate or limit the pathways through which residents, workers and other members of the public could be exposed to the contaminants associated with the former MGP operations. The Plan will include a number of remedial measures designed to protect public health and the environment.

Summary of Findings

The site exhibits the characteristics expected of a former MGP site. These characteristics have had impacts both on the actual former site and on groundwater to the south or downgradient of the site. However, it is important to note:

1. The presence of chemical constituents in soil and groundwater is reasonably consistent with that expected of a former MGP site that had operated for the time period, length of time and in the way the Bay Shore/Brightwaters site operated.

2. The presence of trace amounts of some observed chemical constituents are attributable to sources other than the site, including chemicals produced by car and truck traffic, other commercial and industrial operations and the operation of internal combustion engines for lawn maintenance equipment, boats and other typical activities in the community.

3. There are no findings indicating that chemical constituents from the site have impacted currently used drinking water supplies in the community.

4. Groundwater containing chemical constituents attributable to the site migrates in a southerly direction from the site and enters Lawrence Creek.

5. The remedial investigation and Qualitative Human Exposure Assessment have indicated that there are pathways through which people on the site and in the community may possibly be exposed to potentially hazardous materials related to former MGP activities; however, no imminent hazards were identified. The potential for this exposure should be evaluated for possible reduction through remedial actions. Therefore, KeySpan has initiated, with NYSDEC approval and under NYSDEC supervision, some IRMs, and will develop long-term remedial actions in the next phase of this program, the development of a Remedial Action Plan. These IRMs and subsequent remedial actions will address properties that are currently or potentially impacted by the site (including the site itself) to ensure future valuable use of these properties.

6. The remedial investigation and FWRIA have indicated that there are pathways through which fish and wildlife could be exposed to potentially hazardous materials related to former MGP activities. However, because of the level of urbanization in the community and the transient nature of wildlife present, remedial activities specifically directed at fish and wildlife exposure are not required.

<u>Site Location and Description</u>

The Bay Shore/Brightwaters former MGP site is located in Bay Shore and the Incorporated Village of Brightwaters, located in the Town of Islip, Suffolk County, New York. The site is approximately 10 acres in area and is bisected by Clinton Avenue. The Long Island Rail Road (LIRR) - Montauk Branch borders the site to the south with Fifth Avenue to the east, and Orinoco Drive to the north.

The site consists of several parcels, including the Bay Shore Site, Bay Shore West Parcel, Bay Shore West Storage Lot Parcel, Brightwaters East Parcel and the Brightwaters Yard Site. For the purpose of this report, the parcels have been grouped into two general areas. The first area comprises the Bay Shore Site and Bay Shore West Parcel. The second area includes the Brightwaters Yard Site, Brightwaters East Parcel and the Bay Shore West Storage Lot Parcel. Additionally, the Watchogue Creek/Crum's Brook area is located approximately 400 feet east of the site.

The Bay Shore Site includes an active KeySpan gas regulator station, a decommissioned Long Island Power Authority (LIPA) electric substation and a small storage building, all of which are located in the northern part of the site. The southern portion of the Bay Shore Site is vacant and generally covered with grass, small trees and other low vegetation. The Bay Shore West Parcel is currently vacant and was previously covered with relatively dense vegetation. The parcel was cleared of vegetation in February 2002 and most of the parcel is covered with dolostone/crushed stone. The parcel is used for storage of equipment and materials in support of utility operations. The Bay Shore West Storage Lot Parcel is utilized for the storage of equipment and materials used to support gas construction activities based at the

Brightwaters Yard Site. The Brightwaters Yard Site and Brightwaters East Parcel extend into the Incorporated Village of Brightwaters and support an active KeySpan gas construction facility.

The area surrounding the Bay Shore/Brightwaters former MGP site is typically suburban, with a variety of land uses including residential, commercial and light industrial. The site is bounded on the east, north, and west by residences and small commercial businesses, and to the south by the LIRR. Immediately south of the LIRR are a number of residences, as well as the adjacent KeySpan-owned parcel that was formerly used as a commercial lumber property. Properties further south are principally single-family residential homes; however, some commercial properties exist along Union Boulevard.

Topography at the site is relatively flat, with the land surface sloping less than one percent southward toward the Great South Bay. Site elevation ranges from roughly 20 to 24 feet above mean sea level (msl). Storm water within the site infiltrates to subsurface soil. In general, the storm water drainage systems in the Bay Shore/Brightwaters area in the vicinity of the site are designed to convey flows to local surface water bodies and, ultimately, the Great South Bay. There are no naturally occurring or manmade surface water bodies within the boundaries of the site. Two natural streams, and several artificially impounded lakes and ponds are located within a half mile of the site between the site and the Great South Bay. The surface water bodies nearest to the site include Watchogue Creek/Crum's Brook (north of Montauk Highway), Watchogue Creek (south of Montauk Highway), Lawrence Creek, Lawrence Lake and O-Co-Nee Pond.

The site is directly underlain by a fill unit, which ranges in thickness across the site from 2 to 7 feet and consists mostly of sand and gravel with minor occurrences of silt and clay, and varying amounts of brick, concrete, cinders, clinker, wood and ash. In addition, a number of concrete slabs and other subsurface structures associated with the former MGP facility are located throughout the property. Underlying the fill unit within the southwestern portion of the Brightwaters Yard Site exists a recent-aged (post-glacial) clay-silt unit varying in thickness from 2 to 6 feet. The clay-silt unit appears to be relatively thin and discontinuous beneath the Bay Shore Site. Underlying the fill unit and clay/silt unit, where present, are native glacial outwash sands and to a lesser extent, gravels characteristic of the Upper Glacial aquifer, which is approximately 70 feet in thickness beneath the site. Beneath this exists a low permeable formation consisting of a fine sand with varying amounts of clay and silt, which forms the upper surface of the Magothy formation. This formation includes the Magothy aquifer, which is the primary source of public water supply in Nassau and Suffolk Counties.

Groundwater beneath the site ranges in depth from approximately 4 to 8 feet below ground surface (bgs) and generally flows in a southerly direction throughout the site. Horizontal groundwater velocities within the Upper Glacial aquifer at and downgradient of the site have been estimated to range from between 2.1 and 2.5 feet per day. On-site and downgradient monitoring well clusters indicate horizontal groundwater flow within the Upper Glacial aquifer. The only substantial vertical flow was observed at a well cluster located in close proximity to Lawrence Creek where a significant upward vertical gradient was observed, indicating an area of groundwater discharge.

A total of two active public water supply wells are located within a 1/2-mile radius of the site. The wells extract water from the Magothy aquifer at depths of 595 feet and 803 feet bgs. There is no evidence to indicate that the public supply wells have been impacted by the site. Based on the results of a private well survey completed by KeySpan in areas located downgradient (south) of the Bay Shore/Brightwaters former MGP site, only four private wells were reported and confirmed in this area. Only one of the wells was determined to be active with use limited to irrigation purposes. Additional details concerning the completed private well survey are provided later in this section.

Site History

Operations

The site opened as a gas plant in 1889 under the ownership of the Mutual Gas and Light Company. The Suffolk Gas and Electric Light Company owned and operated the site from 1889 to 1917. In 1918, the Long Island Lighting Company (LILCO) became the legal owner. Gas manufacturing reportedly occurred between 1889 and approximately 1973, when the plant was demolished. In 1918, LILCO began operating a carbureted water gas plant. Later in the life of the plant, it was converted to an oil-gas process. Manufacturing operations were conducted on the Bay Shore property, while the Brightwaters Yard property was used to support gas manufacturing and distribution operations. Since approximately the 1920s to the early 1970s, it is believed that the former Bay Shore MGP discharged storm water and treated process wastewater to an industrial Cesspool in the Watchogue Creek/Crum's Brook area.

Previous Site Investigations

Between 1979 and 2000, there were several environmental investigations completed at and in the vicinity of the site, including:

- 1979 Groundwater Investigation, Geraghty and Miller, Inc.
- 1989 Preliminary Assessment, NUS Corporation
- 1992 Field Investigation of Bay Shore Site, Brightwaters Yard and Adjacent Properties, Malcolm Pirnie, Inc.
- 1997 Lanier Lane Investigation, Fenley and Nicol Environmental
- 1997 Subsurface Investigation of Brightwaters/Bay Shore Site, GEI Consultants, Inc.
- 1999-2000 Investigation of Bay Shore Site Groundwater Plume Discharge to Lawrence Creek, Suffolk County Department of Health Services

The investigations determined that chemical constituents were present in soil and groundwater on-site and that there were two separate groundwater plumes emanating from the site, one originating from the Bay Shore Site and one from the Brightwaters Yard Site. The investigations indicated that the sources of the plumes were associated with former MGP operations on the Bay Shore Site and Brightwaters Yard Site. The investigations determined that the chemical constituents detected in on-site soil and groundwater, as well as in off-site groundwater, were primarily benzene, toluene, ethylbenzene and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs). In addition, the data from the initial field program completed in the Fall of 2000 indicated that the Bay Shore Site groundwater plume is discharging to Lawrence Creek through the bottom sediments of the creek.

Bay Shore/Brightwaters Former MGP Site Remedial Investigation

As discussed above, an initial field program was completed by KeySpan in the Fall of 2000, the results of which are documented in the report entitled, "Bay Shore/Brightwaters Former MGP Site Remedial Investigation Report." dated April 2002. Based on KeySpan's assessment of data presented in this report and discussions with the NYSDEC and Suffolk County Department of Health Services (SCDHS), it was determined that additional data was needed to further refine understanding of the nature and extent of MGP-related chemical compounds and residuals present in the subsurface environment and to develop a remedial strategy for the site and off-site areas. Therefore, a supplemental field investigation scope of work was developed.

The objectives of the remedial investigation, Qualitative Human Exposure Assessment and FWRIA were to:

- Sufficiently characterize the site to achieve an understanding of the nature and extent and migration of chemical constituents in the environment;
- Identify the potential human exposure pathways and environmental risks associated with chemical constituents found in the environment in order to determine the need for remedial action; and
- Provide sufficient environmental information to determine the need for remedial action and evaluate remedial alternatives leading towards the design and implementation of selected remedies.

The remedial investigation field programs included the following activities:

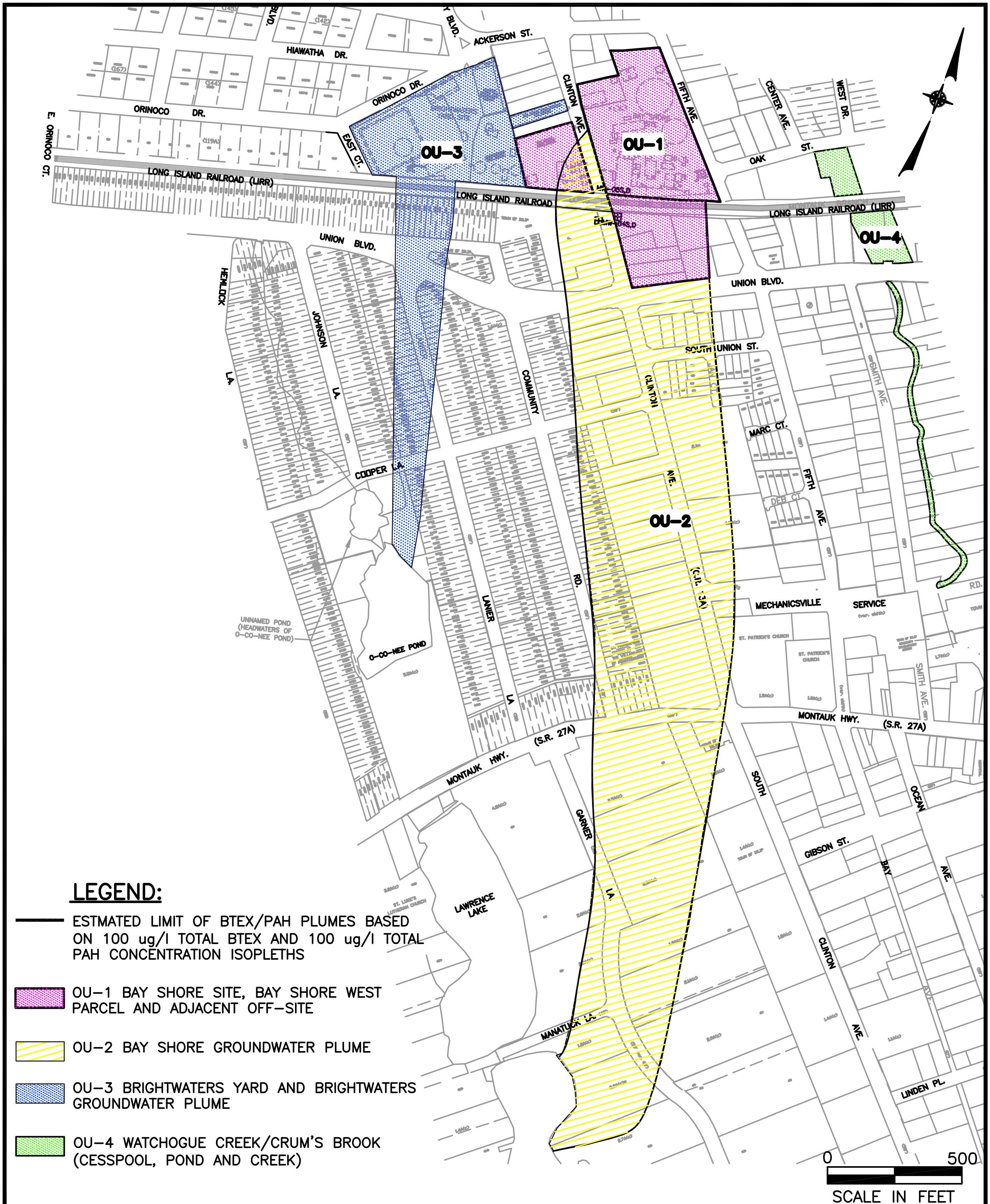
- Soil vapor sampling;
- Surface soil sampling;
- Subsurface soil sampling;
- Monitoring point inventory, assessment and initial groundwater sampling;
- Groundwater probe installation and sampling;
- Groundwater monitoring well installation and sampling;
- Pore water sampling;
- Surface water and surface water sediment sampling;
- Storm water runoff and sediment sampling;
- Ambient air and indoor air sampling;
- Private groundwater well sampling;
- Test pits;
- Perimeter and location-specific air monitoring; and
- Surveying and mapping.

Operable Unit Designations

In an effort to manage the remediation of the Bay Shore/Brightwaters former MGP site, the site has been divided into four operable units (OUs), including:

- *Operable Unit 1* - Bay Shore Site, Adjacent Off-site Areas north of Union Boulevard and Bay Shore West Parcel.
- *Operable Unit 2* - Bay Shore Site Groundwater Plume.
- *Operable Unit 3* - Brightwaters Yard and Groundwater Plume.
- *Operable Unit 4* - Watchogue Creek/Crum's Brook.

The geographic boundaries of each operable unit are provided on **Figure ES-1**. Note that Operable Unit 4, Watchogue Creek/Crum's Brook, is located approximately 400 feet east of the Bay Shore Site. A



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

OPERABLE UNIT DESIGNATIONS

FIGURE ES-1

\\Nt4\CADwork\1620B12C\OU Figure -2000- 072202-2.dwg, 10/29/02 03:15:54 PM, APostyn former Cesspool located at the headwaters of Watchogue Creek was the historical discharge point for treated wastewater generated at the Bay Shore MGP Site.

Remedial Investigation Findings

Bay Shore Site and Adjacent Off-site Locations (Operable Unit 1)

With the exception of the former industrial cesspool area located immediately southwest of the former Gas Holder, the northern third of the Bay Shore Site does not contain elevated levels of BTEX, PAHs or nonaqueous phase liquid (NAPL)/tar at saturated levels. In addition, the southeastern portion of the Bay Shore Site is free of these MGP-related constituents. The highest concentrations of BTEX and PAHs within the Bay Shore Site are found in shallow subsurface soil (not exceeding 12 feet in depth), located southwest of the former Relief Holder and within the general vicinity of a former Naphthalene Scrubber. This area extends south to the former locations of the Effluent Water Treatment Facilities, Tar Separators and Tar Settling and Tar Holding Tanks. A second area of elevated BTEX and PAHs in subsurface soil is located in the vicinity of the former Tar and Drip Oil Collecting Pits and the former Tar Well located within the southwest corner of the site.

NAPL/tar observed in subsurface soil in the central third of the site is generally limited to approximately 20 to 30 feet below ground surface (bgs). The sources of this relatively shallow NAPL/tar are former MGP structures. The occurrence of NAPL/tar in deeper soils (greater than 30 feet bgs) is generally limited to the southern third of the site and adjacent downgradient areas. The observed distribution of NAPL/tar in subsurface soil indicates a southerly migration of this material from on-site source areas primarily located in the southernmost third of the site to downgradient areas. NAPL/tar migration appears to be predominantly horizontal in nature at and below the water table; however, in the vicinity of the southern property boundary, a significant downward vertical migration component appears to have been present. As a result, there appears to be a deep NAPL/tar zone located above the Glacial/Magothy formation interface from the property boundary to approximately 250 feet south of the site.

Analytical results of samples collected during the initial field program indicated metal concentrations in subsurface soil within the Bay Shore Site to be at or below typical background concentrations. Of the samples analyzed, the only anomaly was lead, detected in the general area of the former industrial Cesspool located southwest of the Main Holder at a concentration of 1,210 mg/kg. The vast majority of subsurface soil samples collected within the Bay Shore Site were found to be either free of detectable levels of total cyanide or exhibited total cyanide concentrations below 1.0 mg/kg with a maximum total cyanide concentration of 9.3 mg/kg.

Shallow groundwater (i.e., from the water table to 26 feet bgs) present in the southern half of the Bay Shore site contains BTEX and PAHs with the highest concentrations observed southwest of the former Relief Holder, downgradient of the former Tar Separators/Effluent Treatment House, the 54,000 Cubic Foot Gas Holder/Heavy Oil Tank and the former Tar and Drip Oil Collection Pit. In addition, BTEX and PAH compounds are present downgradient of the former Tar Well located in the southwestern portion of the site. While the former industrial Cesspool located southwest of the former Gas Holder contains levels of BTEX and PAHs in subsurface soil, groundwater data from downgradient of this former structure indicates relatively low concentrations of BTEX and PAHs. On-site deep groundwater (from a depth of 50 to 80 feet bgs) exhibited nondetectable to trace levels of BTEX and PAHs, with total BTEX concentrations not exceeding 5.0 ug/l and total PAH concentrations not exceeding 50.0 ug/l. However, samples collected along the southern property boundary contained higher levels of BTEX and PAHs.

Bay Shore West Parcel (Operable Unit 1)

Sampling conducted within the Bay Shore West Parcel identified an area of subsurface soil that exhibited BTEX with total BTEX concentrations observed up to 495.0 mg/kg. Based on available data, this area is approximately 400 square feet and appears to be centered around the locations of two former Oil Storage Tanks. The BTEX in this area appears to be relatively shallow with concentrations of total BTEX not exceeding 0.1 mg/kg below a depth of 12 feet.

Analytical results of samples collected during the initial field program indicated metal concentrations in subsurface soil within the Bay Shore West Parcel to be at or below typical background concentrations. The vast majority of subsurface soil samples collected within the Bay Shore West Parcel were found to be either free of detectable levels of total cyanide or exhibited total cyanide concentrations below 1.0 mg/kg.

BTEX compounds were detected in shallow groundwater along the southern property boundary with total BTEX concentrations of up to 21,500.0 ug/l. Groundwater sample locations collected off-site and immediately downgradient of the Bay Shore West Parcel exhibited total BTEX concentrations in shallow groundwater of between 353.0 ug/l and 4,500.0 ug/l. BTEX compounds were not detected above 81.0 ug/l within groundwater deeper than 26 feet below grade. Based on the southerly flow of groundwater and the location of sample points, the likely source of the BTEX present in shallow groundwater is subsurface soil located in the vicinity of the former oil tanks described above.

Bay Shore Site Groundwater Plume (Operable Unit 2)

The sources of BTEX and PAH compounds in off-site groundwater downgradient of the Bay Shore Site appear to be primarily located within the central and southern portions of the site and are associated with the former MGP operations conducted at the site. The Bay Shore West Parcel appears to be a minor contributor of these compounds to off-site groundwater.

The BTEX/PAH plume associated with the Bay Shore Site appears to be migrating in the direction of the natural flow of groundwater, south to southeast, extending from the Bay Shore Site to the southeast corner of the Bay Shore West Parcel: a width of approximately 500 feet. The total length of the plume is estimated to be approximately 3,400 feet with the plume discharging to Lawrence Creek, a tidally influenced surface water body located south of Montauk Highway. Although the plume discharges to Lawrence Creek, analysis of surface water samples collected from the suspected discharge area indicated BTEX and PAHs to be at relatively low concentrations.

While the plume appears to extend throughout the vertical extent of the Upper Glacial aquifer immediately downgradient of the Bay Shore Site, the low permeable fine sands, silt and clay underlying this aquifer restrict the vertical migration of the plume. Therefore, impact to the underlying Magothy aquifer should not occur. Also limiting the downward migration is the transition from a predominantly horizontal flow regime to an "upward" or discharging flow regime in the Upper Glacial aquifer downgradient of the site. This is supported by the fact that BTEX and PAHs were found to be nondetectable in groundwater samples collected from below the low permeable clay of the Magothy formation.

The elevated concentrations of carbon dioxide and the almost complete absence of dissolved oxygen within the defined plume strongly support the conclusion that microbial respiration is occurring within the plume. Based on this data, it is apparent that BTEX and PAHs are being used as organic substrates by the microbes and are being metabolized. It is expected that these natural processes will continue and will reduce BTEX/PAH concentrations in the future.

While the Bay Shore Site groundwater plume appears to be well defined, groundwater data and NYSDEC records documenting petroleum releases downgradient of the site suggests that there are other sources contributing BTEX and PAHs to groundwater in the vicinity of the former MGP site.

Metals analysis of groundwater samples collected during the initial field program from monitoring wells located downgradient of the Bay Shore Site indicated that the majority of RCRA listed metals were generally within concentration ranges that would be considered typical of ambient groundwater quality for the Upper Glacial aquifer given the commercial and industrial land use within the area.

Total cyanide concentrations in the majority of groundwater samples collected during the initial field program from wells located downgradient of the Bay Shore Site were found to be below instrument detection limits or the Contract Required Detection Limit (CRDL) of 20 ug/l. The maximum observed concentrations did not exceed 70 ug/l. Free cyanide analysis was generally consistent with the total cyanide results with the majority of samples exhibiting free cyanide concentrations below the instrument detection limit or the CRDL of 20 ug/l. The maximum observed concentrations did not exceed 60 ug/l.

Brightwaters Yard and Groundwater Plume (Operable Unit 3)

Surface and subsurface soil in the Brightwaters Yard Site does not appear to exhibit elevated levels of chemical constituents, with the exception of subsurface soil in two areas. Subsurface soil in the vicinity of the former underground storage tanks (USTs) located on the Brightwaters East Parcel adjacent to the Gas Construction and Maintenance Facility (GCMF) building, as well as in the vicinity of the former H-Fuel tank in the southwestern portion of the Brightwaters Yard Site, exhibited elevated levels of BTEX and PAHs. However, as part of an IRM conducted in the Spring of 2002, KeySpan has remediated impacted subsurface soil associated with the UST area through soil excavation and follow-up treatment with in-situ chemical oxidation. Furthermore, as part of a second IRM, KeySpan has treated the source area associated with the former H-Fuel Tank through the removal of NAPL, as well as the use of in-situ chemical oxidation. The effectiveness of this IRM is currently being evaluated.

Groundwater beneath the Brightwaters Yard Site, Brightwaters East Parcel and Bay Shore West Storage Lot Parcel does not appear to exhibit elevated levels of BTEX and PAHs with the exception of groundwater in the vicinity and downgradient of the former H-fuel tank on the Brightwaters Yard Site and the former USTs on the Brightwaters East Parcel, discussed above.

Air samples collected at locations within the GCMF building exhibited detectable concentrations of BTEX. The GCMF is an active operation and equipment and supplies are stored within the garage area of this building. Typical items stored within the garage area may include equipment with gasoline engines. Therefore, detecting trace concentrations of benzene, xylene and toluene in interior air would be expected.

The Brightwaters Yard plume consists of dissolved-phase BTEX and PAH compounds originating from the H-Fuel area located in the southwest corner of the site as described above. The plume has been determined to be approximately 200 feet wide at the site boundary and approximately 1,400 feet long. Starting in September 2000, KeySpan began actively treating the plume with an oxygen injection technology. As part of this IRM, a line of oxygen injection points were installed perpendicular to the plume along the southern shoulder of Union Boulevard. The review of quarterly BTEX and PAH groundwater data collected from monitoring wells located along the plume centerline indicates reductions in BTEX/PAH concentrations downgradient of the oxygen injection points. It is expected that these reductions will continue in the future and will propagate downgradient along with the natural flow of groundwater effectively treating the entire dissolved-phase plume.

Investigations conducted to date indicate the plume discharges to the lower portion of O-Co-Nee Pond. However, BTEX and PAHs were only detected sporadically and at trace concentrations in surface water samples collected from this area. This is attributable to:

- mixing through dispersive forces and reduction of chemical mass through natural biodegradation processes.

- groundwater containing BTEX and PAHs that may discharge to the pond is further diluted as the result of mixing with the surface water and other water sources discharging to the pond.

- BTEX dissolved in surface water would have a propensity to volatilize from the water and undergo additional biological decay, resulting in further reduction of concentrations.

Watchogue Creek/Crum's Brook (Operable Unit 4)

The investigation activities associated with Operable Unit 4 were primarily conducted in two general areas, one being the former cesspool area and the other being the former pond area and headwaters of Watchogue Creek/Crum's Brook.

Former Cesspool Area

Surface soil samples collected in the vicinity of the former Cesspool did not exhibit chemical constituents at elevated levels. Subsurface soil samples collected from this area exhibited elevated levels of BTEX and PAHs within and immediately downgradient (south) of the cesspool area. For samples collected during the initial field program, RCRA metals analysis of subsurface soil samples indicated all targeted metals to be generally at or below typical background concentrations for soil in the eastern United States. Total cyanide analysis indicated the majority of soil samples to be free of detectable levels of total cyanide or exhibit cyanide at concentrations less than the CRDL of 1.0 mg/kg. Groundwater in the vicinity and downgradient of the former Cesspool exhibits detectable levels of BTEX and PAHs. However, concentrations are relatively low and there is no measurable plume beyond the immediate vicinity of the former Cesspool.

Former Pond Area and Watchogue Creek/Crum's Brook Headwaters

Surface soil samples collected in the former pond area and headwaters of Watchogue Creek/Crum's Brook did not exhibit chemical constituents at elevated levels. Subsurface soil samples collected from this area exhibited elevated levels of BTEX and PAHs. Both BTEX and PAH concentrations rapidly decrease with increasing depth. The highest BTEX and PAH concentrations in subsurface soil appear to be present in stream and pond sediments associated with the former pond area. These sediments are currently overlain by several feet of sand that were apparently used to fill in the pond. The sand used to backfill this area was found to contain little to no BTEX and PAHs.

For subsurface soil samples collected during the initial field program, RCRA metals analysis indicated that the majority of targeted metals were within or below typical background concentrations for soil in the eastern United States. Total cyanide analysis indicated that the majority of soil samples did not exhibit detectable levels of total cyanide or exhibited total cyanide at concentrations below the CRDL.

BTEX compounds and PAHs were detected at low concentrations in groundwater samples collected in the vicinity of the former pond area and headwaters of Watchogue Creek/Crum's Brook. Based on the results of the investigation, subsurface soil within the former pond area appears to be a minor contributor of BTEX and PAHs to groundwater.

Surface water samples collected from the former pond area and headwaters of Watchogue Creek/Crum's Brook between the LIRR and Union Boulevard and samples collected from within the main body of the creek between Union Boulevard and Mechanicsville Service Road did not exhibit detectable levels of BTEX compounds. Several PAHs were detected at trace levels in the main body of the creek. Surface water sediment samples collected from the main body of the creek exhibited detectable concentrations of BTEX, PAHs and metals. However, in general, the concentrations of the chemicals detected in surface water and sediment would be considered typical of surface water and sediment that receives storm water from suburban roadways and surrounding commercial and light industrial properties.

Private Property Air Sampling Program

Air sampling was conducted at 16 off-site locations during the remedial investigation. At one location, two rounds of sampling were conducted and at another location, three rounds of sampling were conducted. A total of 67 samples were collected and each sample was analyzed for 61 volatile organic compounds. The majority of the volatile organic compounds for which analysis was performed were not detected. The majority of those compounds that were detected were detected at concentrations within the range of background levels as reported by the New York State Department of Health (NYSDOH) and those compounds detected above NYSDOH background levels are generally those not typically associated with MGP impacts. Additionally, naphthalene, the compound most commonly associated with potential MGP impacts, was not detected in any of the samples. The analytical results obtained were reviewed by the NYSDOH and the detected compounds were found to be at acceptable levels.

Private Well and Basement Survey

A Well and Basement Survey was performed of properties within, between and in the immediate vicinity of the two groundwater plumes, as defined in the remedial investigation. Results of 145 questionnaires completed thus far have identified a very small number of properties at which the potential for indoor air exposure exists. The owners of these properties have been contacted. This survey information, coupled with results of the indoor air sampling performed to date, indicates that potential exposures to site-related chemicals via inhalation of indoor air in the vicinity of the site are minimal.

Seventeen of the 145 survey respondents reported the presence of a groundwater well on their property. The presence of a well was confirmed at four properties: one of these wells is in active use for irrigation purposes and three wells were confirmed to be inactive (i.e., not in use) for a period of several years. KeySpan attempted to sample all four wells. Two wells could not be sampled due to access issues (i.e., piping setup). Sampling of the other two wells, the active irrigation well and one inactive well, was performed. With the exception of methyl tert-butyl ether (MTBE), a common gasoline additive, no VOCs or SVOCs were detected in the sample collected from the active irrigation well. Several VOCs and SVOCs, including naphthalene, were detected in the inactive well. This well is not currently used as a source of water for any purpose and the pump is currently inoperable. Additionally, 144 of the 145 survey respondents indicated that they do not use groundwater wells for domestic purposes (i.e., cooking, bathing). Consequently, exposure to potentially site-related constituents that may be present in groundwater does not occur for these individuals (i.e., domestic use of groundwater is an incomplete exposure pathway).

Additional details regarding the completed well and basement survey are provided in **Appendix F (the Qualitative Human Exposure Assessment)**.

Qualitative Human Exposure Assessment Findings

Under current and future site use conditions, the potentially exposed populations (i.e., potential receptors) are those that might come into contact with site-related chemicals of potential concern (COPCs). These receptor populations and the potential exposure pathways associated with each population are summarized in Tables 2-2A through 2-2K of **Appendix F (the Qualitative Human Exposure Assessment)**. Additional information concerning the potential for these exposures to occur is provided in Tables 2-3A through 2-3E (**Appendix F**).

For this Executive Summary, potential on-site exposures refer to those occurring on the Bay Shore Site, Bay Shore West Parcel, the Brightwaters Yard and the Bay Shore West Storage Lot Parcel. Potential off-site exposure scenarios include those associated with Watchogue Creek/Crum's Brook and the Bay Shore and Brightwaters groundwater plumes.

Under current site use conditions and based upon the best available information, the on-site trespasser population may receive exposure to surface soil via the ingestion (oral) and dermal routes. On-site KeySpan workers are assumed to spend time both outdoors and indoors and, consequently, may be exposed to chemicals in surface soil (during outdoor activities) and also to COPCs in indoor air (during indoor activities). Adult nearby off-site utility workers may be exposed to site-related COPCs in surface and subsurface soil via ingestion and dermal contact and groundwater via dermal contact. Potential exposure for nearby off-site utility workers is possible because of the presence of subsurface sewer, telephone, gas, water and railroad lines/facilities in the areas immediately adjacent to the site.

Under future site use conditions and based upon the best available information, potentially exposed human populations include on-site and off-site construction workers and on-site adult commercial workers, adult and child visitors, and on-site adult and child residents. Exposure for the construction worker is possible because virtually any site re-development would involve some kind of construction activity. Potential on-site exposure media for the construction worker includes surface soil (via ingestion and dermal contact), subsurface soil (via ingestion and dermal contact), and groundwater (via dermal contact). Off-site construction worker exposure to the former cesspool area and former pond area of Watchogue Creek/Crum's Brook also may be possible. Potential exposure media and pathways for the off-site construction worker are identical to those of the future on-site construction worker.

Off-site residents living downgradient of the site may be exposed to chemicals volatilizing from groundwater and into indoor air. Based on indoor air sampling performed to date and the results of the Well and Basement Survey, see details in **Appendix F**, a very small number of properties, at which the potential for indoor air exposure exists, have been identified. The owners of these properties have been contacted. Additionally, these residents may be exposed to site-related chemicals in groundwater if they are using groundwater for domestic purposes. The results of the survey identified only one private well in active use. This well is used for irrigation purposes and is located to the south of the Brightwaters Site. As discussed previously, with the exception of MTBE, a common gasoline additive, no VOCs or SVOCs were detected in the sample collected from this well.

Potentially complete exposure pathways associated with O-Co-Nee Pond and Lawrence Creek for off-site residents include ingestion and dermal contact with sediment and surface water. Additionally, the consumption of fish and crabs from O-Co-Nee Pond and Lawrence Creek may occur. Potential exposure to site-related chemicals due to the consumption of fish and crabs from these surface water bodies is expected to be minimal because:

- BTEX and PAH compounds generally were not detected or were detected at relatively low concentrations in surface water; and
- The chemicals present in the surface water, pore water and sediment do not tend to bioconcentrate or bioaccumulate.

Potential exposures along Watchogue Creek/Crum's Brook include the following populations: adult and child residents living along the creek in the former Pond area and trespassers in the creek south of Union

Boulevard. Potential exposure media for these off-site residents and trespassers includes surface soil (via ingestion and dermal contact); and potential exposure to surface water and sediment via ingestion and dermal contact. As part of an IRM, the creek south of Union Boulevard has undergone restoration efforts, including the removal of shallow sediments and channel realignment.

Fish and Wildlife Resources Impact Analysis Findings

Following the Appendix 1C Decision Key in the NYSDEC's Fish and Wildlife Resources Impact Analysis (FWRIA) Document, a FWRIA was deemed required. The analysis focuses on risks associated with site-related chemicals detected in soil, surface water, sediment, and groundwater. The complete FWRIA can be found in **Appendix F**.

The site reconnaissance conducted as part of this analysis indicates that the site and surrounding area are poor quality environmental resources, due to the limited presence of vegetation. The site is partially covered with buildings, blue stone and asphalt. Wildlife species, typically present are adapted to an urban setting. Due to the size of the vegetated areas, only a few individual animals will be present.

However, remediation is suggested to at least abate entry of the Bay Shore plume into Lawrence Creek and to prevent entry of the Brightwaters plume into O-Co-Nee Pond. IRMs that address the Brightwaters plume already are underway and remedial actions currently are being developed to address the Bay Shore plume.

1.0 INTRODUCTION

KeySpan Corporation (KeySpan) entered into an Order on Consent (Index No. D1-0002-98-11) with the New York State Department of Environmental Conservation (NYSDEC) to conduct a Remedial Investigation (RI) at the Former Manufactured Gas Plant (MGP) site located in Bay Shore and Brightwaters, Suffolk County, New York. The initial field program was completed in the Fall of 2000 as documented in the report entitled, "Bay Shore/Brightwaters Former Manufactured Gas Plant Site Remedial Investigation Report," dated April 2002 (herein referred to as the April 2002 RI Report). Based on the findings of the completed field program, additional sampling activities were recommended. As a result, a supplemental field investigation was subsequently completed in accordance with the scope of work presented in the Supplemental Field Investigation Work Plan for the Bay Shore/Brightwaters Former Manufactured Gas Plant Site, dated February 8, 2002. This Final Remedial Investigation Report presents the findings of the supplemental field program, which are built upon the understanding of the site gained through the completion of the initial field program. The Final RI Report includes:

- Background information related to the site;
- A summary of findings associated with the initial field program;
- Objectives of the supplemental field program;
- The geology and hydrogeology of the investigation area;
- The findings of the supplemental field program;
- A summary discussion as to the nature and extent of MGP-related chemical compounds and residuals based on all data collected as part of the initial field program and the supplemental field program; and
- A Qualitative Human Exposure Assessment (QHEA) and Fish and Wildlife Resources Impact Analysis (FWRIA) that has been updated to reflect the findings of the supplemental field program.

1.1 Supplemental Field Program Objectives

Based on KeySpan's assessment of the existing data as summarized in **Section 1.4** and discussions with the NYSDEC and Suffolk County Department of Health Services (SCDHS), it was determined that additional data was needed to further refine understanding of the nature and extent of MGP-related chemical compounds and residuals present in the subsurface environment and to develop a remedial strategy for the site and off-site areas. Therefore, a supplemental field program scope of work was developed. The objectives of the supplemental field program included:

- Further delineate the presence of BTEX and PAHs in subsurface soil and groundwater in suspected source areas;
- Define the vertical and areal extent of NAPL within suspected source areas;
- Provide additional data as to the potential mobility and recoverability of identified NAPL;
- Define the nature and extent of off-site NAPL downgradient of the Bay Shore Site;
- Obtain additional data needed to evaluate the potential applicability/effectiveness of various remedial technologies under a Remedial Action Plan (RAP);
- Provide additional data needed to design and implement an IRM to mitigate the migration of the Bay Shore Site groundwater plume to Lawrence Creek;
- Provide additional data needed to design and implement an IRM to address the presence of BTEX and PAHs within the area of Watchogue Creek (a/k/a Crum's Brook) located between Oak Street and Union Boulevard;
- Determine if the Brightwaters Yard groundwater plume is entering O-Co-Nee Pond and/or its headwaters;
- Determine whether unregistered private water supply wells exist downgradient of the Bay Shore Site and Brightwaters Yard and, if wells are identified, determine whether they are impacted by the groundwater plumes.
- Determine whether potential exposure pathways exist via infiltration of impacted groundwater into basements of private residences downgradient of the Bay Shore Site and Brightwaters Yard within the areas of the groundwater plumes.

1.2 Overview of Report Organization

The Final RI Report is organized as follows:

- **Executive Summary:** Summarizes and provides an overview of the findings of all the data collected as part of the initial field program completed in 2000 and the supplemental field program.

- **Section 1.0 - Introduction:** Presents background information and a description of the physical setting of the site and its surroundings. This section also provides a summary of the field program completed in 2000 and the specific objectives of the supplemental field program. Finally, this section also presents the "operable unit" concept used to manage on-going and future remedial actions associated with the site.

- **Section 2.0 - Field Investigation Program:** Provides an overview of the field activities associated with the supplemental field program. Additionally, it discusses data management and chemical data validation/usability.

- **Section 3.0 - Site Geology and Hydrogeology:** Presents a discussion of the geology and hydrogeology of the site and immediately surrounding areas based on geologic data collected as part of the initial and supplemental field programs. However, the discussion focuses on those aspects of site/area geology and hydrogeology that have been clarified based on the findings of the supplemental field program.

- **Section 4.0 - Findings:** This section provides a discussion of the chemical compounds and other MGP residuals identified in on-site and off-site areas based on the supplemental field program. Where appropriate, data from the initial field program as well as historical data has been used in conjunction with supplemental field program data to provide a better understanding as to the nature and extent of MGP-related chemical compounds and residuals associated with the site.

- **Section 5.0 - Conclusions:** Provides conclusions based on the findings of **Section 4.0** in conjunction with **Section 3.0** findings.

- **Section 6.0 - Conceptual Summary:** This section provides an overall summary of the chemical and physical data collected as part of the supplemental field program in addition to the initial field program. This section summarizes the nature and extent of MPG-related chemical compounds and residuals, the fate and transport of these chemicals and materials, and the identification of potential exposure pathways.

- **Section 7.0 - References:** Lists all documents and other sources of information utilized in the preparation of this report.

1.3 Site Description and History

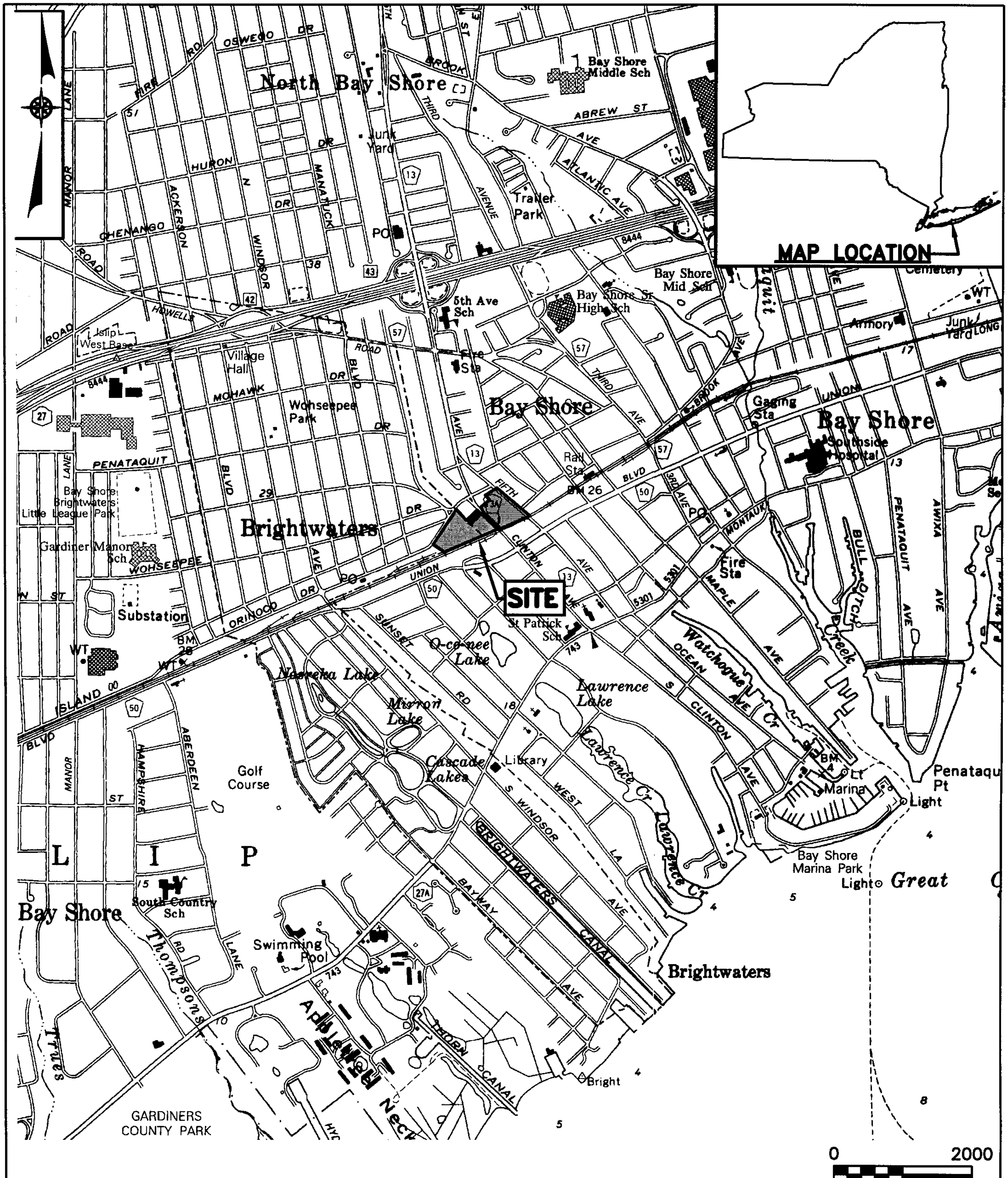
The Bay Shore/Brightwaters former MGP site is located in Bay Shore and the Incorporated Village of Brightwaters, located in the Town of Islip, Suffolk County, New York (see **Figure 1-1**). The site is approximately 10 acres in area and is bisected by Clinton Avenue. The Long Island Rail Road (LIRR) - Montauk Branch borders the site to the south, Fifth Avenue to the east, and Orinoco Drive to the north. A site map showing the site and surrounding areas, current structures, and other relevant site features is provided in **Figure 1-2**.

The area surrounding the Bay Shore/Brightwaters Former MGP site is typically suburban, with a variety of land uses including residential, commercial and light industrial. The site is bounded on the east, north, and west by residences and small commercial businesses, and to the south by the LIRR. Immediately south of the LIRR are a number of residences, as well as the adjacent KeySpan-owned parcel that was formerly used as a commercial lumber property. Properties further south are principally single-family residential homes; however, some commercial properties exist along Union Boulevard.

Operational History

The site opened as a gas plant in 1889 under the ownership of the Mutual Gas and Light Company. The Suffolk Gas and Electric Light Company owned and operated the site from 1889 to 1917. In 1918, the Long Island Lighting Company (LILCO) became the legal owner. Gas manufacturing reportedly occurred between 1889 and approximately 1973, when the plant was demolished. In 1918, LILCO began operating a carbureted water gas plant. Later in the life of the plant, it was converted to an oil-gas process. Manufacturing operations were conducted on the Bay Shore property, while the Brightwaters Yard property was used to support gas manufacturing and distribution operations. Additional details regarding the history of the site are provided in the April 2002 RI Report.

Since approximately the 1920s to the early 1970s, it is believed that the former Bay Shore MGP discharged storm water and treated process wastewater under a permit issued by the New



SOURCE: USGS BAY SHORE WEST QUADRANGLE, 1969

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

SITE LOCATION MAP

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE 1–1

F:\1620\BS\BWLOCATION MAP1.dwg, 10/23/02 04:13:40 PM, LGlubiak

SOURCE: BASE MAP PREPARED FROM INTERPRETATION OF AERIAL PHOTOGRAPH DATED APRIL 4, 1994.

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

SITE MAP

Dvirka and Bartilucci
CONSULTING ENGINEERS
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FIGURE 1-2

\\N4\cadwork\1620B12C\11X17\FIG-1.dwg, 10/25/02 02:34:02 PM, CScharkopf

York State Department of Health to Watchogue Creek/Crum's Brook located approximately 600 feet southeast of the site. The wastewater from the former MGP discharged to a 6-inch diameter drain line located near the southeast corner of the site. The 6-inch diameter drain line crossed beneath Fifth Avenue (from west to east) running east along the south side of Oak Street and was conveyed to an adjacent Cesspool located approximately 410 feet east of the site. In addition, it appears that in approximately 1947 the 6-inch drain was replaced with an 8-inch diameter cast iron drain line which also crossed beneath Fifth Avenue from west to east along the south side of Oak Street. However, it is believed that this replacement line conveyed flows to a drainage culvert/catch basin along Oak Street adjacent to the original Cesspool. Additional details regarding the history of the Watchogue Creek/Crum's Brook area are provided in the April 2002 RI report.

Current Site Conditions

The site consists of several parcels, including the Bay Shore Site, Bay Shore West Parcel, Bay Shore West Storage Lot Parcel, Brightwaters East Parcel and the Brightwaters Yard Site. For the purpose of this Final RI Report, and consistent with previous reports, the parcels have been grouped into two general areas, as shown on **Figure 1-2**. The first area comprises the Bay Shore Site and Bay Shore West Parcel. The second area includes the Brightwaters Yard Site, Brightwaters East Parcel and the Bay Shore West Storage Lot Parcel. The Watchogue Creek/ Crum's Brook area is also included on **Figure 1-2**.

The Bay Shore Site includes an active KeySpan gas regulator station, a decommissioned Long Island Power Authority (LIPA) electric substation and a storage building, all of which are located in the northern part of the site. The southern portion of the Bay Shore Site is vacant and generally covered with grass, small trees and other low vegetation. The Bay Shore West Parcel is currently vacant and was previously covered with relatively dense vegetation. The parcel was cleared of vegetation in February 2002 and most of the parcel is covered with dolostone/crushed stone. The parcel is used for storage of equipment and materials in support of utility operations. The Bay Shore West Storage Lot Parcel is utilized for the storage of equipment and materials used to support gas construction activities at the Brightwaters Yard Site. The Brightwaters Yard

Site and Brightwaters East Parcel extend into the Incorporated Village of Brightwaters and support an active KeySpan gas construction facility.

Physical Setting and Hydrogeology

Topography at the site is relatively flat, with the land surface sloping less than one percent southward, toward the Great South Bay. Site elevation ranges from roughly 20 to 24 feet above mean sea level (msl). Storm water within the site infiltrates to subsurface soil. In general, the storm water drainage systems in the Bay Shore/Brightwaters area in the vicinity of the site are designed to convey flows to local surface water bodies and, ultimately, the Great South Bay. There are no naturally occurring or manmade surface water bodies within the boundaries of the site. Two natural streams, and several artificially impounded lakes and ponds are located within a half mile of the site between the site and the Great South Bay. The surface water bodies nearest to the site include Watchogue Creek/Crum's Brook (north of Montauk Highway), Watchogue Creek (south of Montauk Highway), Lawrence Creek, Lawrence Lake and O-Co-Nee Pond.

Groundwater beneath the site ranges in depth from approximately 6 to 8 feet below ground surface (bgs) and generally flows in a southerly direction throughout the site. Horizontal groundwater velocities within the Upper Glacial aquifer at and downgradient of the site have been estimated to range from between 2.1 and 2.5 feet per day. On-site and downgradient monitoring well clusters indicate horizontal groundwater flow within the Upper Glacial aquifer. The only substantial vertical flow was observed at a well cluster located in close proximity to Lawrence Creek where a significant upward vertical gradient was observed, indicating an area of groundwater discharge.

Additional details regarding the physical setting and hydrogeology of the site are provided in the April 2002 RI Report.

1.4 Previous Site Investigations

Between 1979 and 2000, several environmental investigations were completed at and in the vicinity of the site. The results of these investigations indicate that chemical constituents were present in soil and groundwater on-site and were used to identify two separate groundwater plumes emanating from the site: one originating from the Bay Shore Site and one from the Brightwaters Yard Site. The results of the investigations also indicated that the sources of the plumes were associated with former MGP operations at the Bay Shore Site and Brightwaters Yard Site, respectively. The investigations determined that the chemical compounds detected in on-site soil and groundwater, as well as in off-site groundwater, were primarily benzene, toluene, ethylbenzene and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs). Additional details regarding the previously completed investigations are presented in the April 2002 RI Report.

The following discussion presents a summary of findings related to the initial field program which are discussed in greater detail in the April 2002 RI Report.

Bay Shore Site and Bay Shore West Parcel

Surface soil within the Bay Shore Site is generally free of chemical constituents at elevated concentrations. However, elevated concentrations of BTEX and PAHs were detected in subsurface soil in the southern and central portions of the Bay Shore Site. The highest levels were found immediately downgradient of a former Naphthalene Scrubber and Oil Separation Tank. In general, BTEX and PAH concentrations in soil decrease rapidly with increasing depth. However, soil samples recovered from several borings within the southernmost portion of the Bay Shore Site exhibited naphthalene/hydrocarbon-like odors, staining, sheens and tar/oil droplets or blebs as deep as 62 feet bgs.

Surface soil on the Bay Shore West Parcel did not exhibit chemical constituents at elevated levels. In addition, subsurface soil within the majority of the site did not exhibit chemical constituents at elevated levels. However, BTEX compounds were detected in subsurface soil within the vicinity of two former aboveground Oil Storage Tanks in the southeastern portion of the parcel.

Metal concentrations in subsurface soil within the Bay Shore Site and Bay Shore West Parcel were found to be at or below typical background concentrations. Of the samples analyzed, the only anomaly was lead, detected in the general area of the former industrial Cesspool located southwest of the Main Holder at a concentration of 1,210 mg/kg.

The vast majority of the subsurface soil samples collected within the Bay Shore Site and Bay Shore West Parcel were found to be either free of detectable levels of total cyanide or exhibited total cyanide concentrations below 1.0 mg/kg with a maximum total cyanide concentration of 9.3 mg/kg.

As with subsurface soil, groundwater beneath the Bay Shore Site contains levels of BTEX and PAHs with the highest concentrations generally observed beneath the southern half of the Bay Shore Site where the former gas works were located. The highest total BTEX concentration (65,400 micrograms per liter [ug/l]) and highest total PAH concentration (18,606 ug/l) were detected in shallow groundwater in this area. Separate-phase nonaqueous phase liquid (NAPL) was observed in one monitoring well located within the southern portion of the Bay Shore Site.

<u>Brightwaters Yard Site, Brightwaters East Parcel and Bay Shore West Storage Lot Parcel</u>

With the exception of subsurface soil in two areas of the site, surface and subsurface soil did not exhibit elevated levels of chemical constituents. Subsurface soil in the vicinity of the former underground storage tanks (USTs) located on the Brightwaters East Parcel adjacent to the Gas Construction and Maintenance Facility (GCMF) building, as well as in the vicinity of the former H-Fuel tank in the southwestern portion of the Brightwaters Yard Site exhibited elevated levels of BTEX and PAHs. Metals analysis indicated that the majority of RCRA metals in subsurface soil samples to be at or below typical background concentrations. Analytical results indicated total cyanide concentrations were below the Contract Required Detection Limit

(CRDL) of 1 mg/kg. Details concerning subsurface soil conditions are summarized later in this section as part of the descriptions of the Interim Remedial Measures (IRMs) associated with these areas.

Groundwater beneath the Brightwaters Yard Site, Brightwaters East Parcel and Bay Shore West Storage Lot Parcel did not exhibit elevated levels of BTEX and PAHs with the exception of groundwater in the vicinity and downgradient of the former H-fuel tank on the Brightwaters Yard Site and the former USTs on the Brightwaters East Parcel. Details concerning groundwater quality downgradient of the former H-fuel tank and former USTs are summarized later in this section as part of the descriptions of the IRMs associated with these areas.

Off-site Investigation – Bay Shore Site and Bay Shore West Parcel

Off-site subsurface soil samples collected at locations east of the Bay Shore Site along Fifth Avenue did not exhibit evidence of chemical constituents related to the former MGP.

The highest BTEX and PAH concentrations identified in off-site groundwater were observed in shallow monitoring wells located immediately downgradient of the Bay Shore Site. In general, BTEX and PAH concentrations decrease rapidly with increasing distance downgradient of the Bay Shore Site. The sources of BTEX and PAH compounds in off-site groundwater appear to be primarily located within the central and southern portions of the Bay Shore Site. The Bay Shore West Parcel appears to be a minor contributor of these compounds to off-site groundwater.

The BTEX/PAH plume associated with the Bay Shore Site appears to be migrating south to southeast from the site in the direction of natural groundwater flow. The width of plume is approximately 500 feet extending from the Bay Shore Site to the southeast corner of the Bay Shore West Parcel. The total length of the plume is estimated to be approximately 3,400 feet extending from the Bay Shore Site and Bay Shore West Parcel to the apparent discharge point at Lawrence Creek. Lawrence Creek is a tidally influenced surface water body located south of Montauk Highway. Although the plume discharges to Lawrence Creek, analysis of surface water and sediment samples collected from the suspected discharge area indicated BTEX and PAHs to be at relatively low concentrations in surface water.

Impact to the underlying Magothy aquifer is not expected. While the Bay Shore Site groundwater plume immediately downgradient of the site appears to extend throughout the vertical extent of the Upper Glacial aquifer, the low permeable fine sands, silt and clay underlying this aquifer restrict the vertical migration of the plume. Also, limiting the downward migration is the transition from a predominantly horizontal flow regime to an “upward” or discharging flow regime in the Upper Glacial aquifer downgradient of the site.

A review of historical and current data suggests that natural processes, including dispersion, dilution and biodegradation, are actively reducing the areal distribution of the plume, as well as BTEX and PAH groundwater concentrations. It is anticipated that these processes will likely continue to attenuate the plume in the future. However, additional geochemical data will be required to evaluate these processes and to demonstrate the extent to which natural attenuation of the plume is occurring.

While the Bay Shore Site groundwater plume appears to be well defined, groundwater data and NYSDEC records documenting petroleum releases downgradient of the site suggests that there are other sources contributing BTEX and PAHs to groundwater. Additional details concerning these other sources of BTEX and PAHs are provided in the April 2002 RI Report.

Metals analysis of groundwater samples collected from monitoring wells located downgradient of the Bay Shore Site indicated that the majority of RCRA listed metals were generally within concentration ranges that would be considered typical of ambient groundwater quality for the Upper Glacial aquifer given the commercial and industrial land use within the area.

Total cyanide concentrations in the majority of groundwater samples collected from wells located downgradient of the Bay Shore Site were found to be below instrument detection limits or the CRDL of 20 ug/l. The maximum observed concentrations did not exceed 70 ug/l. Free cyanide analysis was generally consistent with the total cyanide results with the majority of samples exhibiting free cyanide concentrations below the instrument detection limit or the CRDL of 20 ug/l. The maximum observed concentrations did not exceed 60 ug/l.

Watchogue Creek/Crum's Brook IRM/Investigation

The investigation activities associated with this IRM/Investigation were primarily conducted in two general areas, one being the former cesspool area and the other being the former pond area/headwaters of Watchogue Creek/Crum's Brook. The former Cesspool historically received storm water drainage and process wastewater from the former Bay Shore MGP site.

Former Cesspool Area

Surface soil samples collected in the vicinity of the former Cesspool did not exhibit chemical constituents at elevated levels. Subsurface soil samples collected from this area exhibited elevated levels of BTEX and PAHs. BTEX and PAH concentrations were observed in shallow subsurface soil within and immediately south of the cesspool area and PAH concentrations were observed in shallow subsurface soil at a location approximately 65 feet downgradient of the former Cesspool. RCRA metals analysis on subsurface soil samples indicated all targeted metals to be generally at or below typical background concentrations for soil in the eastern United States. Total cyanide analysis indicated the majority of soil samples to be free of detectable levels of total cyanide or exhibit cyanide at concentrations less than the CRDL of 1.0 mg/kg. Groundwater in the vicinity and downgradient of the former Cesspool exhibited detectable BTEX and PAHs.

Former Pond Area and Watchogue Creek/Crum's Brook Headwaters

Surface soil samples collected in the former pond area and headwaters of Watchogue Creek/Crum's Brook did not exhibit chemical constituents at elevated levels. Subsurface soil samples collected from this area exhibited elevated levels of BTEX and PAHs. Both BTEX and

PAH concentrations rapidly decrease with increasing depth. BTEX compounds and PAHs were detected at low concentrations in groundwater samples collected in the vicinity of the former pond area and headwaters of Watchogue Creek/Crum's Brook. Based on the results of the investigation, subsurface soil within the former pond area appears to be a minor contributor of BTEX and PAHs to groundwater. RCRA metals analysis indicated that the majority of targeted metals were within or below typical background concentrations for soil in the eastern United States. Total cyanide analysis indicated that the majority of soil samples did not exhibit detectable levels of total cyanide or exhibit total cyanide at concentrations below the CRDL.

Surface water samples collected from the former pond area and headwaters of Watchogue Creek/Crum's Brook between the LIRR and Union Boulevard and samples collected from within the main body of the creek between Union Boulevard and Mechanicsville Service Road did not exhibit detectable levels of BTEX compounds. Several PAHs were detected at trace levels in the surface water samples collected from the main body of the creek. Stream sediment samples collected from the main body of the creek exhibited detectable concentrations of BTEX, PAHs and metals. However, in general, the concentrations of the chemicals detected in surface water and sediment would be considered typical of surface water and sediment that receives storm water from suburban roadways and commercial and light industrial properties, such as those present in the areas surrounding the pond/headwaters areas of Watchogue Creek/Crum's Brook.

Brightwaters Yard UST Removal/Closure IRM/Investigation

This IRM/Investigation included the excavation, cleanout, removal and closure of four USTs at the Brightwaters Yard, as well as the investigation and delineation of chemical constituents in soil and groundwater. The investigation/delineation program identified BTEX and PAHs present in subsurface soil within and immediately adjacent to the UST excavation. BTEX and PAH concentrations, as well as physical evidence of hydrocarbons such as staining and odors, decreased significantly at depths greater than 10 feet bgs. The majority of subsurface soil samples within the study area exhibited metals within concentration ranges that would be considered typical for ambient soil. However, a number of samples characterized as fill material containing coal, ash and cinders, exhibited several metals at concentrations above typical background levels. Total cyanide was generally not detected or was present at concentrations less than the CRDL of 1.0 mg/kg with few exceptions. Total cyanide concentrations detected above the CRDL ranged from 2.0 mg/kg to a maximum of 81.7 mg/kg.

Groundwater samples collected downgradient of the UST excavation exhibited detectable levels of BTEX and PAHs. The highest concentrations of total BTEX and PAHs were detected in shallow groundwater approximately 30 feet downgradient of the UST excavation. Based on the results of the investigation, these constituents do not appear to be migrating off the Brightwaters East Parcel at any appreciable levels.

<u>Brightwaters Yard Groundwater Plume IRM/Investigation</u>

The results of this IRM/Investigation confirmed and clarified the findings of previous investigations. Compounds present in the groundwater plume included BTEX and "light-end" PAHs, primarily naphthalene. The plume is generally confined to shallow groundwater from the top of the water table to approximately 15 feet below grade at all off-site well locations. BTEX and PAH concentrations in groundwater appear to fluctuate over time within the downgradient limits of the plume. This may be due to the combination of a number of factors including: the naturally occurring increases and decreases in the elevations of the groundwater table and the associated "smearing" of chemicals within the clay/silt unit, the overall dilution of the plume through dispersion, and the reduction of chemical mass through naturally occurring biological processes.

Metals analysis of groundwater samples collected from monitoring wells indicated that the majority of metals were found at concentrations that would be considered typical of ambient groundwater quality. Total cyanide analysis identified several groundwater samples in which total cyanide was detected at concentrations that were greater than the CRDL of 20 ug/l with a maximum concentration of 125 ug/l. Free cyanide analysis indicated that the majority of the samples were free of detectable levels of free cyanide. Samples that indicated concentrations of free cyanide did not exceed 140 ug/l.

Surface water samples collected from O-Co-Nee Pond did not contain BTEX and PAH compounds while sediment samples exhibited trace levels of BTEX compounds, as well as certain PAHs. Cyanide was either not detected or found at concentrations less than the CRDL.

Private Property Air Sampling Program

As part of this investigation, 26 indoor air samples and ambient (outdoor) air samples were collected at eight private properties in the vicinity of the site. The analytical results of these samples indicated that, in general, the compounds detected were those that are typically found in homes due to the storage and use of consumer household products associated with cleaning, home care, refinishing, hobbies and automotive products, as well as from the storage of heating fuel. Various BTEX compounds were detected in a number of samples and are commonly associated with MGP-related residuals, as well as contemporary household products and applications as noted above. However, naphthalene, a signature compound associated with MGP-related residuals, was not detected in any of the samples.

Qualitative Human Exposure Assessment Findings

Under current and future site use conditions, the potentially exposed populations (i.e., potential receptors) are those that might come into contact with site chemicals of potential concern (COPCs). These receptor populations and the potential exposure pathways associated with each population are summarized in the July 2002 qualitative human exposure assessment.

Under current site use conditions, the on-site trespasser population is assumed to have the potential to receive exposure to surface soil via the ingestion (oral), dermal and inhalation routes. On-site KeySpan workers are assumed to spend time both outdoors and indoors and, consequently, are assumed to be exposed to chemicals in surface soil (via ingestion, dermal contact and inhalation during outdoor activities), and also to COPCs in indoor air (via inhalation during indoor activities).

Adult nearby off-site utility workers are assumed to be exposed to surface and subsurface soil via the ingestion, dermal and inhalation routes, and to groundwater via the dermal and inhalation routes as a consequence of their work.

Off-site residents living near former pond area of Watchogue Creek are assumed to contact surface soil (via ingestion, dermal contact and inhalation) during everyday activities such as playing, gardening, etc. Exposure to off-site sediment and surface water in Lawrence Creek, Lawrence Lake and O-Co-Nee Pond also is possible for these off-site residents. In addition, persons residing near the Bay Shore and Brightwaters groundwater plumes may be exposed to chemicals originating from groundwater via inhalation of vapors in indoor air.

Trespassers to Watchogue Creek are assumed to contact chemicals in sediment via ingestion and dermal contact in the area between Union Boulevard to the north and Mechanicsville Service Road to the south.

Under future site use conditions, on-site construction workers are assumed to be subject to exposure to surface and subsurface soil via the ingestion, dermal and inhalation routes, and to groundwater via the dermal and inhalation routes as a consequence of their work (i.e., trenching, excavation and installing deep piles). Off-site construction worker exposures to chemicals in these media also are assumed to occur in the former Cesspool and former pond area of Watchogue Creek. Given the potential for commercial redevelopment of the site, commercial workers and site visitors may be exposed to site-related chemicals via inhalation of chemicals in indoor air. A future residential land use scenario for the site was not included in the exposure assessment because it is expected that future residential development will be prevented by the use of deed restrictions.

<u>Fish and Wildlife Resources Impact Analysis Findings</u>

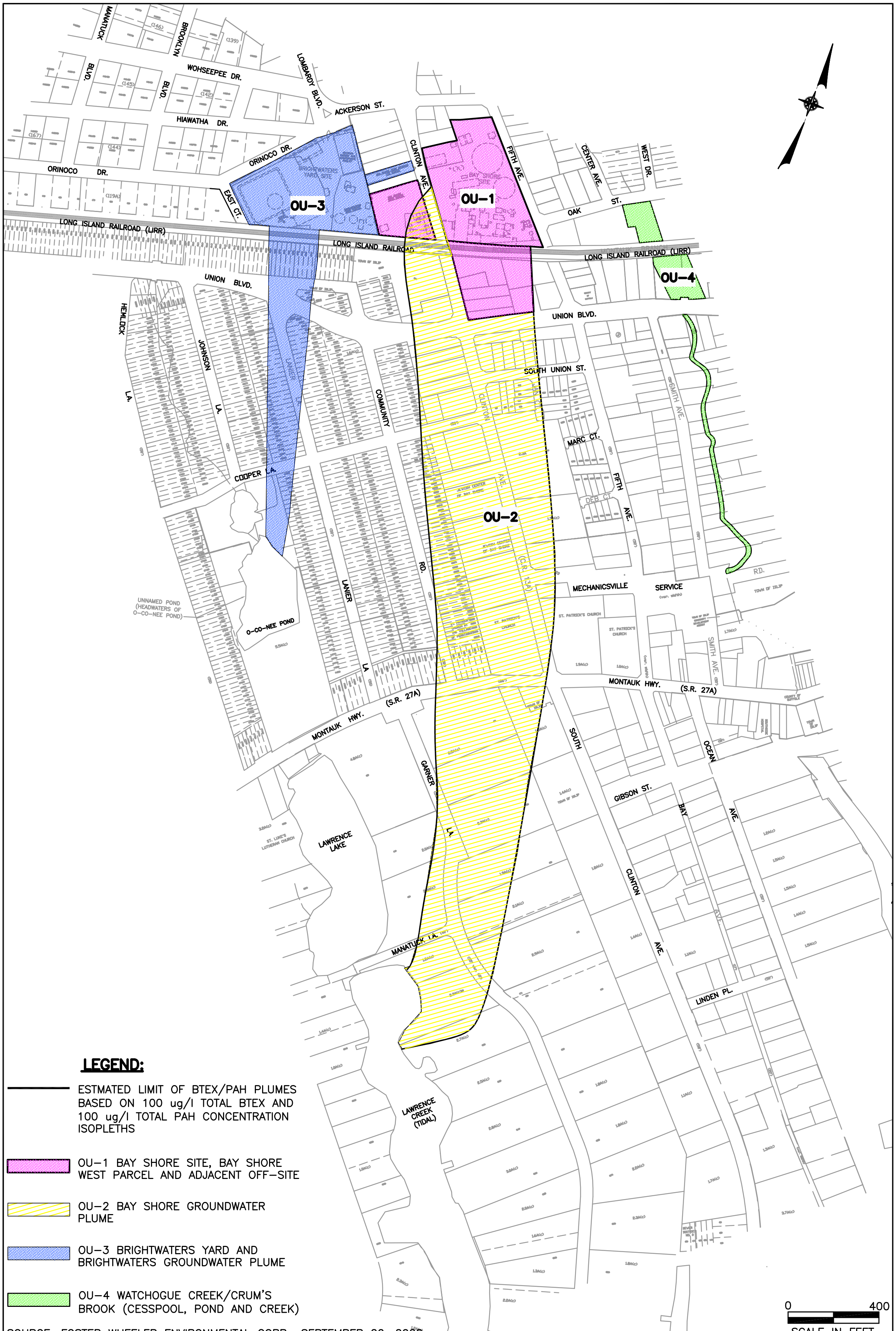
Following the Appendix 1C Decision Key in NYSDEC's Fish and Wildlife Resources Impact Analysis (FWRIA) guidance, a FWRIA was deemed required. The analysis focuses on risks associated with site-related chemicals detected in soil, surface water, sediment and groundwater. The site reconnaissance conducted as part of this analysis indicates that the site and surrounding area are poor quality environmental resources, due to the limited presence of vegetation. The site is partially covered with buildings, bluestone and asphalt. Wildlife species typically present are adapted to an urban setting. Due to the limited size of the vegetated areas, only a few individual animals will be present. In addition, virtually all wildlife species in the community are transient and present on the site or in the plume path areas for brief periods, reflecting the degree of urbanization. Thus, there is little opportunity for exposure to any of the chemicals of potential ecological concern.

1.5 Operable Unit Designations

In an effort to more effectively manage the remediation of the Bay Shore/Brightwaters former MGP site, the site has been divided into four operable units (OUs), including:

- *Operable Unit 1* - Bay Shore Site, Adjacent Off-site Areas north of Union Boulevard and Bay Shore West Parcel.
- *Operable Unit 2* - Bay Shore Site Groundwater Plume.
- *Operable Unit 3* - Brightwaters Yard and Groundwater Plume.
- *Operable Unit 4* - Watchogue Creek/Crum's Brook.

The geographic boundaries of each operable unit are provided on **Figure 1-3** and additional descriptive detail is provided below.



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OPERABLE UNIT DESIGNATIONS

FIGURE 1–3

Operable Unit 1 (OU-1 - Bay Shore MGP Site, Bay Shore West Parcel and Off-site Area South to Union Boulevard)

This operable unit addresses the Bay Shore Site, the Bay Shore West Parcel, and an off-site area south of the Bay Shore Site, extending to Union Boulevard. This area has been found to contain the source material associated with the Bay Shore Site groundwater plume.

Operable Unit 2 (OU-2 - Bay Shore MGP Groundwater Plume)

This operable unit addresses the dissolved phase groundwater plume emanating from Operable Unit 1 (OU-1) and the plume discharge area of Lawrence Creek.

Operable Unit 3 (OU-3 - Brightwaters Yard and Groundwater Plume)

This operable unit addresses the Bay Shore West Storage Lot Parcel, the Brightwaters Yard and its associated dissolved phase groundwater plume. This operable unit includes the plume discharge area of O-Co-Nee Pond.

Operable Unit 4 (OU-4 - Watchogue Creek/Crum's Brook)

This operable unit addresses off-site areas including a former Cesspool, former pond area, and the headwaters of Watchogue Creek (a.k.a. Crum's Brook), located approximately 400 feet east of the Bay Shore site. The former Cesspool historically received storm water drainage and process wastewater from the former Bay Shore MGP Site. The cesspool area is located immediately upgradient from a former pond that likely formed the headwaters of Watchogue Creek/Crum's Brook.

2.0 FIELD INVESTIGATION PROGRAM

This section provides an overview of the field activities associated with the supplemental field program. In addition, this section provides information on data management, and chemical data validation and usability.

2.1 Organization and Overview of Field Program Activities

Consistent with the initial field program completed in the Fall of 2000, environmental samples collected as part of the supplemental field program from on-site locations have been grouped into what is referred to as the On-site Field Investigation Program, and samples collected from off-site locations have been grouped into what is referred to as the Off-site Field Investigation Program. However, the on-site field investigation includes “off-site” samples collected adjacent to the Bay Shore Site as far south as Union Boulevard. The Off-site Field Investigation Program includes all other off-site locations.

Consistent with the Supplemental Field Investigation Work Plan and the operable unit designations discussed in **Section 1.5**, the On-site Field Investigation Program has been further divided into the following areas:

- Bay Shore Site and adjacent off-site locations (Operable Unit 1)
- The Bay Shore West Parcel (Operable Unit 1)
- The Bay Shore West Storage Lot Parcel (Operable Unit 3)

The Off-site Field Investigation Program has been divided into the following areas:

- The Bay Shore Plume IRM (Operable Units 1 and 2)
- O-Co-Nee Pond (Operable Unit 3)
- Watchogue Creek/Crum’s Brook (Operable Unit 4)

In addition, the supplemental field program included a private well and basement survey that was completed by KeySpan within populated areas downgradient of the Bay Shore/ Brightwaters Former MGP Site.

The field investigation was conducted in order to meet the objectives defined in **Section 1.1** and included:

- Test pit excavation and sampling;
- Surface soil sampling;
- Subsurface soil sampling;
- Groundwater probe installation and sampling;
- Groundwater monitoring well installation and sampling;
- Perimeter air monitoring;
- Surveying and mapping;
- Private well and basement survey;
- Ambient outdoor and indoor air sampling; and
- Private groundwater well sampling.

Environmental samples collected as part of the field investigation program were analyzed for various chemical constituents. The media sampled, chemical constituents analyzed and the laboratory methods associated with these analyses are summarized in **Table 2-1**. On-site and adjacent off-site sample locations are shown on **Drawing 2A**. Off-site sample locations are shown on **Drawing 2B**. The sample locations from the Watchogue Creek/Crum's Brook area are shown on **Figure 2-1**. Locations where private groundwater well and air samples were collected are shown on **Figure 2-2**. All drawings are provided in a map pocket at the end of this section.

TABLE 2-1

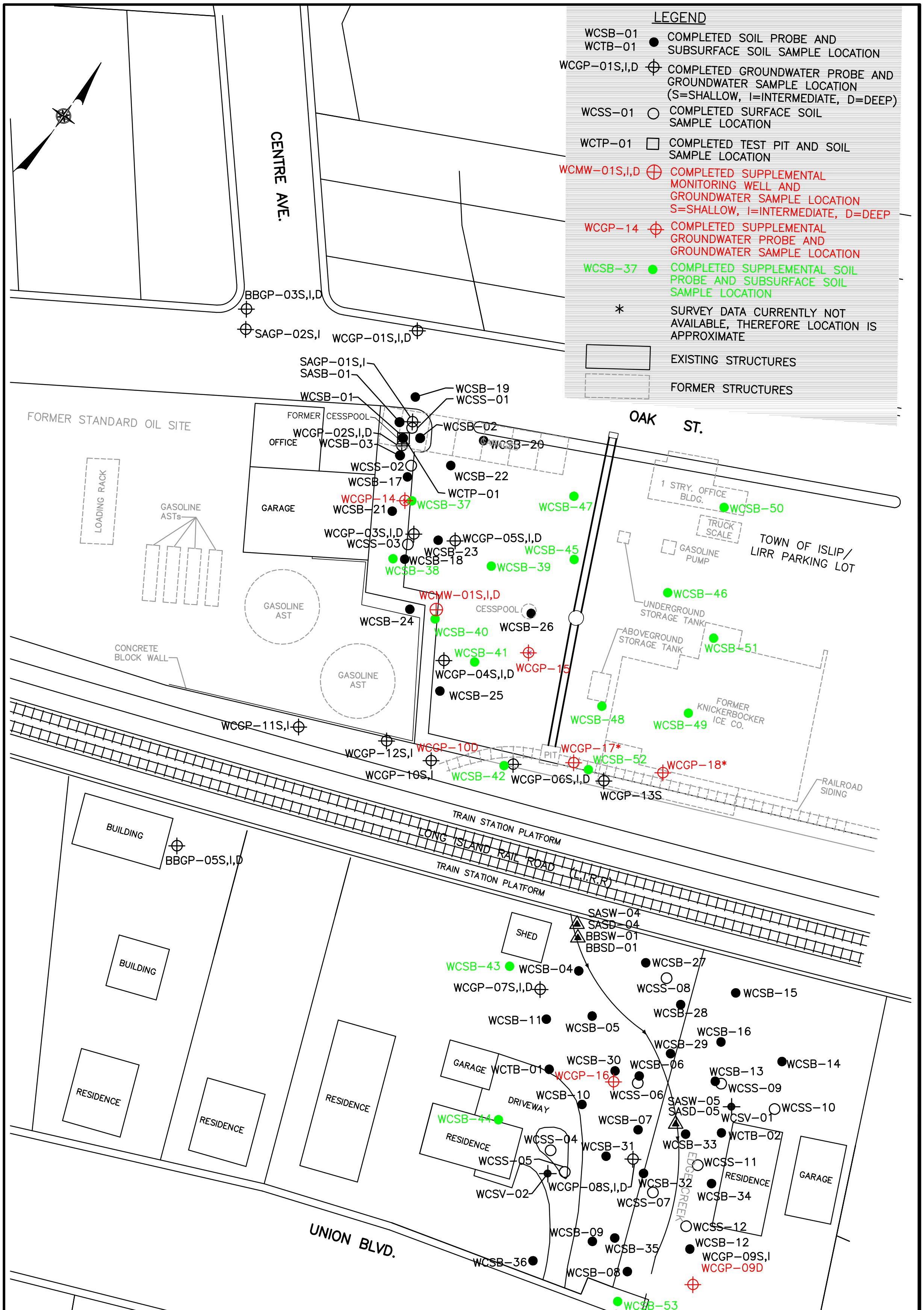
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SAMPLE MEDIA, CHEMICAL CONSTITUENTS AND ANALYTICAL METHODS

CHEMICAL CONSTITUENTS	SAMPLE MEDIA AND ANALYTICAL METHOD	
	Soil	**Groundwater**
BTEX	USEPA Method 8021	USEPA Method 8021
PAHs	USEPA Method 8270	USEPA Method 8270
RCRA Metals	USEPA Methods 6010/7471	--
PCBs	USEPA 8082	--
Total Organic Carbon	USEPA Method 9060	--
Petroleum Fingerprint and Total Petroleum Hydrocarbons (TPHCs)	Method 310.13	Method 310.13

Notes:

--: Not applicable.



SOURCES: TOWN OF ISLIP ENGINEERING DEPARTMENT, DATED MAY 1965
LONG ISLAND LIGHTING CO., DATED DECEMBER 1947
LONG ISLAND LIGHTING CO., REV. DATED APRIL 1973
INTERPRETATION OF AN APRIL 4, 1994 AERIAL PHOTOGRAPH

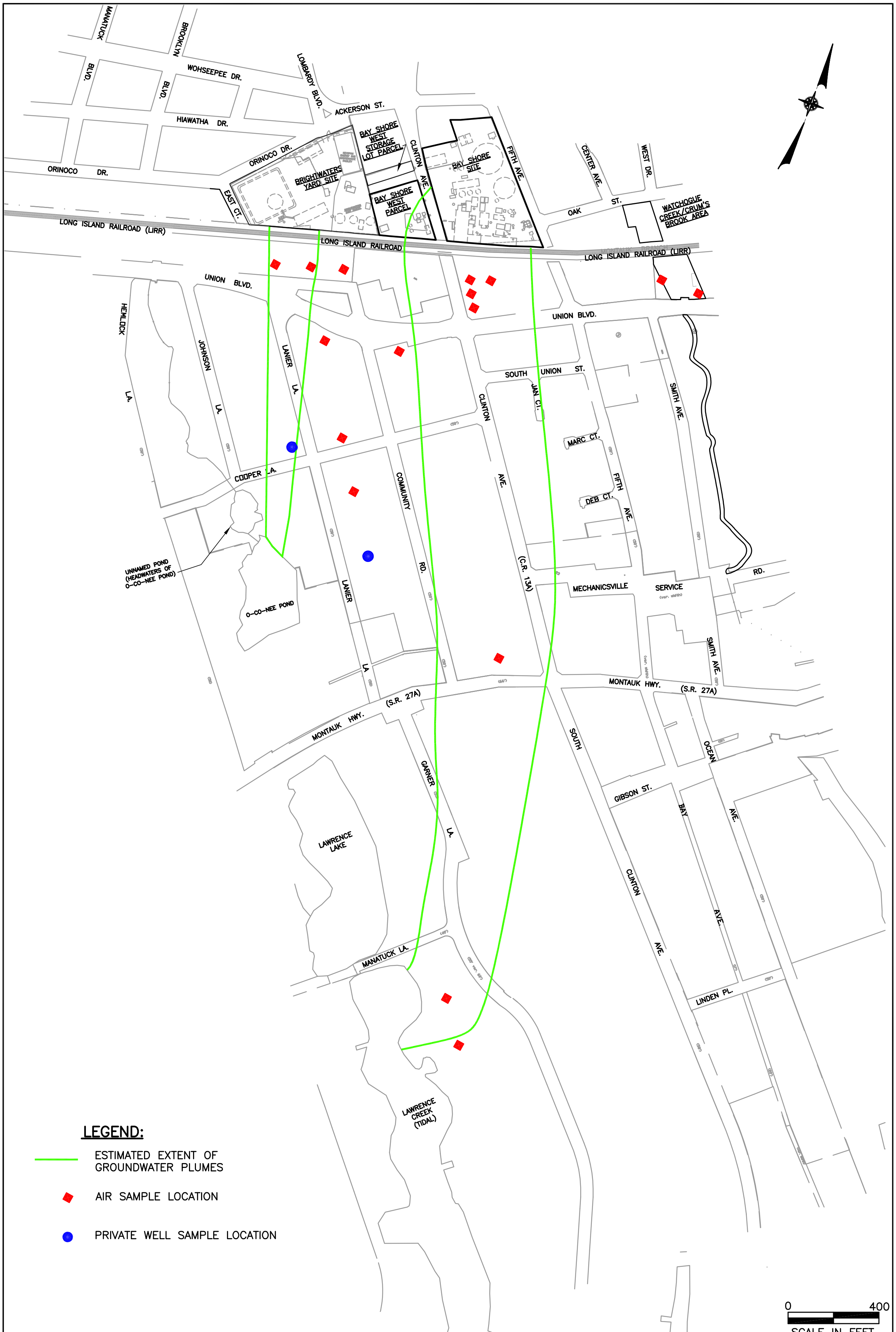
NOTE: SITE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS.

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

WATCHOGUE CREEK/CRUM'S BROOK AREA SAMPLE LOCATION MAP

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE 2-1



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PRIVATE GROUNDWATER WELL AND AIR SAMPLE LOCATION MAP

FIGURE 2-2

F:\1620B12C\LOCATION MAP.dwg, 01/06/03 09:32:33 AM, PMartorano

2.2 Field Methods/Procedures

Drilling and sampling methodologies and procedures are generally described in this section. Additional detailed descriptions of methodologies and procedures are provided in the Generic Work Plan for the project entitled, "Bay Shore/Brightwaters Former MGP Site, Investigation Work Plan," Volume II: Generic Work Plan, dated August 1999.

Surface Soil Sampling

Surface soil samples were either collected from a depth of 0 to 2, 6 or 8 inches below ground surface (bgs) utilizing a dedicated polyethylene scoop and placed into laboratory-supplied glass bottles. All samples were screened utilizing a photoionization detector (PID) for the presence of volatile organic compounds (VOCs).

Test Pits

Each test pit was completed using a tire-mounted or track-mounted backhoe starting with the removal of top soil or cover material. Each test pit proceeded with the excavated material being temporarily stockpiled adjacent to the excavation and with the shallow visibly clean material being segregated from any deeper soil, which may have exhibited visible signs of staining, elevated PID readings and/or odors. Excavated soil was characterized by a field geologist using the Unified Soil Classification System and screened for the presence of VOCs using a calibrated PID. Photographs were also taken of the excavation. All observations and PID measurements were recorded by the field geologist in a field book. In addition, test pit logs are included in **Appendix A**. After completing each test pit, all excavated material was placed back into the excavation, with the segregated visibly "clean" surficial material being placed into the excavation last. After compacting the excavation, 6 to 12 inches of crushed stone was placed over the excavation area.

Subsurface Soil Sampling

Subsurface soil samples were collected using either a direct push (Geoprobe) sampling technique with a decontaminated probe sampler or through continuous core retrieval in conjunction with a roto-sonic vibratory drill rig. The samples were screened for VOCs utilizing a photoionization detector (PID); inspected for staining, discoloration, nonaqueous phase liquid (NAPL), ash, tar and other MGP-residuals; checked for odors; and logged by a geologist using the Unified Soil Classification system. Boring logs are included in **Appendix A**.

Before commencement of soil probing and drilling activities and between boring locations, all "down-hole" probing equipment, including drill casing, core barrel samplers and probe rods, was decontaminated using a steam cleaner/pressure washer and/or alconox and water at the decontamination pad. Soil probe samplers were also decontaminated between each use by thoroughly washing with alconox and water, using a brush to remove particulate matter or surface film, followed by a thorough rinsing with tap water. All liquids generated from the decontamination process were pumped into an on-site storage tank for subsequent off-site disposal by KeySpan.

During soil probe/boring installation, a PID was used to monitor VOCs in the breathing zone and at the probe holes and boreholes. The PID was calibrated on at least a daily basis, using isobutylene gas at a concentration of 100 parts per million (ppm) in air. Equipment calibration was documented in the instrument calibration log.

Upon completion of soil probes, recovered sample material that was not retained for laboratory analysis was placed in an on-site roll-off for subsequent off-site disposal by KeySpan. Each probe hole was either allowed to naturally collapse into itself or, if located in a potential source area, pressure grouted. All probe holes were restored at grade to the original condition. For example, asphalt areas were replaced with asphalt, concrete areas were replaced with concrete and grass and soil areas were restored with grass and soil.

Soil cuttings generated during the completion of each soil boring were placed in lined and covered roll-off containers for subsequent off-site disposal by KeySpan.

Groundwater Probes

Groundwater probe samples were collected by driving probe rods to the designated sample depth and retracting 4 feet to expose a decontaminated stainless steel screen. Dedicated polyethylene tubing was inserted into the rod assembly and purged with a peristaltic pump until approximately three casing volumes of groundwater were discharged. The screen, check valve and rods were decontaminated and new tubing was used between each interval. Water quality parameters including pH, conductivity, turbidity, dissolved oxygen, temperature and salinity were monitored utilizing a calibrated Horiba U-22 multiple parameter instrument. Additionally, any evidence of odors, sheens or the presence of free product was noted. All observations and results were logged in project field books. Groundwater samples were then collected from the pump discharge tubing in laboratory-supplied glass bottles at a flow rate of less than one-quarter gallon per minute.

Upon completion, each bore hole was allowed to naturally collapse into itself. Bore holes in potential source areas were pressure grouted to grade. All bore holes were restored at grade with the same material that was originally in place, as described previously. Purge water generated during the sampling process was transported back to the site and placed in an on-site storage tank for off-site disposal by KeySpan at a later date.

Groundwater Monitoring Well Installation

The number of wells and the depth and location of each well was presented in the NYSDEC-approved work plans, and was based on the results of the groundwater probe sampling program, the soil probe sampling program and the direction of groundwater flow. Monitoring wells were installed at three general depth intervals as discussed below.

- Water Table/Shallow Groundwater - Monitoring well clusters installed as part of this investigation included one shallow monitoring well screened in the glacial sediments. The 10-foot screens generally lie approximately three quarters below the water table and one quarter above to account for natural fluctuation in the level of the water table. The objective of the shallow well was to collect and analyze representative samples in order to characterize the water quality of the shallow groundwater zone and, secondly, to obtain potentiometric head elevations needed to determine groundwater flow patterns. For the purpose of this investigation, shallow groundwater is considered to be groundwater encountered at the water table to a depth of 26 feet below ground surface (bgs).

- Intermediate Groundwater - Intermediate groundwater monitoring wells were installed within the glacial sediments with the majority of the 10-foot well screens set between 30 and 45 feet bgs. For the purpose of this investigation, the intermediate groundwater zone is defined at a depth of between 26 and 50 feet bgs. The objective of the intermediate wells was to collect and analyze representative samples in order to characterize the water quality of the intermediate groundwater zone and, secondly, to obtain potentiometric head elevations needed to determine groundwater flow patterns.

- Deep Groundwater - Deep groundwater monitoring wells were generally installed within the deep glacial sand and immediately above the top of the clay-rich Magothy sediments. For the purpose of this investigation, deep groundwater is considered groundwater between 50 and 80 feet bgs. The objective of the deep wells was to obtain and analyze a representative sample in order to characterize the water quality of the deep groundwater zone located immediately above the Magothy sediments and, secondly, to obtain potentiometric head elevations needed to determine the vertical gradient between the shallow, intermediate and deep groundwater zones. In addition, monitoring well BBMW-05D2 was installed below the clay-rich Magothy formation. The objective of this well was to collect and analyze a representative sample in order to characterize the water quality below the top of the Magothy formation but within the Magothy aquifer downgradient of the Bay Shore Site.

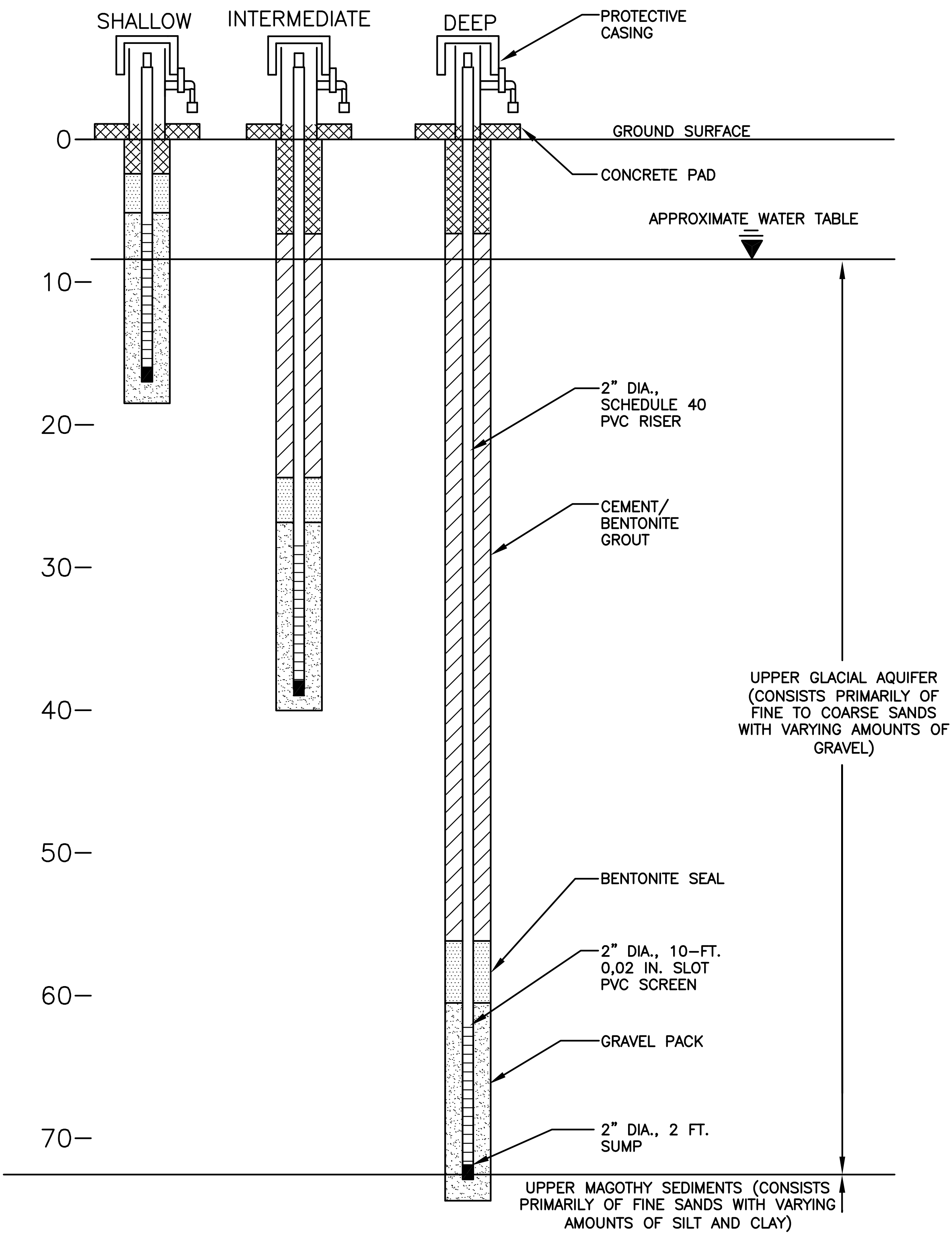
Before commencement of drilling activities and between well locations, all “down-hole” drilling equipment (i.e., drill casing, core barrel samplers, rods, etc.) was decontaminated using a steam cleaner/pressure washer at the decontamination pad. Core barrel samplers were also decontaminated between each use by thoroughly washing with alconox and water, using a brush to remove particulate matter or surface film, followed by a thorough rinsing with tap water.

All on-site monitoring wells (BBMW-17S,I, BBMW-18S,I,D and BBMW-19S,I,D) were installed using the roto-sonic vibratory drill method and constructed with 2-inch diameter Schedule 40 polyvinyl chloride (PVC) well screens and casings. The wells were fitted with a

10-foot long well screen having either 0.010-inch, where fine sand/silt was encountered, or 0.020-inch slotted openings. Below the monitoring well screen, a 2-foot sump was installed on all wells. A solid 2-inch diameter, PVC well casing or riser extended from the screen to grade. All the off-site wells installed during the supplemental field program were installed using either the direct push Geoprobe method, the roto-sonic vibratory drill method, or the hollow stem auger drill method. The monitoring wells were constructed with 1-inch diameter Schedule 40 PVC and fitted with a 10-foot long prepacked well screen having 0.010-inch slotted openings. A 2-foot sump was installed below each monitoring well except for BBMW-24D where a 1/2-foot end cap was installed at the bottom of the well.

All on-site wells were fitted with above grade ("stick-up") locking steel casings. All off-site wells were fitted with flush-mounted locking steel protective casings. **Figure 2-3** shows the typical construction of a monitoring well cluster with above grade ("stick-up") locking steel casings installed as part of this field investigation program. **Table 2-2** summarizes the completed well construction details. In addition, the boring logs for these monitoring wells are included in **Appendix A**. Monitoring well BBMW-05D2 was installed using the roto-sonic vibratory drilling method. Monitoring well BBMW-05D2 was installed as a double-case well with the outer casing grouted into the low permeable unit to avoid vertical migration of chemical constituents from the upper glacial aquifer into the underlying Magothy aquifer. The 2-inch diameter well was constructed of Schedule 40 PVC well screen and casing within the 6-inch outer casing effectively sealing off the Upper Glacial aquifer from the underlying Magothy aquifer. The well was fitted with a 10-foot long well screen having 0.020-inch slotted openings.

A Number 2 graded gravel was set from about 1 foot below the bottom of the monitoring well sump to a point approximately 3 feet above the top of the well screen. A slurry composed of bentonite clay and water was pumped into the annulus via tremie pipe above the gravel pack. Typically this seal was at least 2 feet thick. A cement and bentonite mix was pumped into the annulus via tremie pipe, from the top of the bentonite seal to the surface.



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

TYPICAL CONSTRUCTION OF NEW MONITORING WELL CLUSTERS

FIGURE 2-3

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TABLE 2-2
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION (feet)$^{(1)}$	CASING DIAMETER (inches)	SCREEN DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
						INTERVAL	DESCRIPTION	INTERVAL	TYPE	MATERIALS
BBMW-05D2	136.50	226.00	23.06	25.35	2.00	126.50-136.50	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement/Bentonite
								1.00-120.00	Backfill	Bentonite Grout
								120.00-123.90	Seal	Bentonite
								123.90-126.5	Filter	On Morie Sand #1
BBMW-06ST	15.00	17.00	25.24	28.34	1.00	5.00-15.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-2.00	Backfill	Cement/Bentonite
								2.00-3.00	Seal	Bentonite
								3.00-4.00	Filter	On Morie Sand #1
								4.00-17.00	Filter	Pre-packed Sand #00
BBMW-17S	15.50	18.00	23.70	25.99	2.00	5.50-15.50	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-3.83	Seal	Bentonite
								3.83-18.00	Filter	On Morie Sand #00
BBMW-17I	40.50	42.00	23.46	25.87	2.00	30.50-40.50	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-24.75	Backfill	Bentonite Grout
								24.75-28	Seal	Bentonite
								28.00-42.00	Filter	On Morie Sand #1
BBMW-18S	16.00	18.00	22.56	24.96	2.00	6.00-16.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-4.00	Seal	Bentonite Chips
								4.00-18.00	Filter	On Morie Sand #1
BBMW-18I	40.00	42.00	22.51	24.95	2.00	30.00-40.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-24.00	Backfill	Cement/Bentonite Grout
								24.00-27.00	Seal	Bentonite
								27.00-42.00	Filter	On Morie Sand #1
BBMW-18D	70.00	88.00	22.45	25.03	2.00	60.00-70.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-53.00	Backfill	Cement/Bentonite Grout
								53.00-57.00	Seal	Bentonite
								57.00-88.00	Filter	On Morie Sand #1
BBMW-19S	16.00	18.00	22.91	25.28	2.00	6.00-16.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-2.00	Backfill	Cement/Bentonite Grout
								2.00-4.00	Seal	Bentonite Chips
								4.00-18.00	Filter	On Morie Sand #1
BBMW-19I	39.60	42.00	22.90	25.44	2.00	29.60-39.60	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-23.00	Backfill	Cement/Bentonite Grout
								23.00-26.60	Seal	Bentonite Chips
								26.60-42.00	Filter	On Morie Sand #1
BBMW-19D	74.75	88.00	22.81	25.33	2.00	64.75-74.75	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-59.50	Backfill	Bentonite Grout
								59.50-61.83	Seal	Bentonite Chips
								61.83-88.00	Filter	On Morie Sand #1
BBMW-20S	14.00	16.00	20.29	20.18	1.00	4.00-14.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-2.00	Seal	Bentonite
								2.00-3.00	Filter	On Morie Sand #1
								3.00-16.00	Filter	Pre-packed Sand #00

TABLE 2-2 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION (feet)(1)	CASING DIAMETER (inches)	SCREEN DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
						INTERVAL	DESCRIPTION	INTERVAL	TYPE	MATERIALS
BBMW-20I	45.00	47.00	20.33	20.21	1.00	35.00-45.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-31.00	Backfill	Bentonite Grout
								31.00-33.00	Seal	Bentonite
								33.00-34.00	Filter	On Morie Sand #1
								34.00-47.00	Filter	Pre-packed Sand #00
BBMW-20D	72.00	74.00	20.30	20.16	1.00	62.00-72.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-59.00	Backfill	Bentonite Grout
								59.00-60.00	Seal	Bentonite Pellets
								60.00-61.00	Filter	On Morie Sand #1
								61.00-74.00	Filter	Pre-packed Sand #00
BBMW-21S	17.50	19.00	23.94	26.41	2.00	7.50-17.50	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-3.00	Backfill	Cement/Bentonite Grout
								3.00-4.00	Seal	Bentonite
								4.00-19.00	Filter	On Morie Sand #1
BBMW-21I	40.00	43.00	23.94	26.47	2.00	30.00-40.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-25.00	Backfill	Cement/Bentonite Grout
								25.00-28.00	Seal	Bentonite
								28.00-43.00	Filter	On Morie Sand #1
BBMW-21D	76.33	78.33	23.90	26.41	2.00	66.33-76.33	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-60.00	Backfill	Bentonite Grout
								60.00-63.25	Seal	Bentonite Chips
								63.25-78.33	Filter	On Morie Sand #1
BBMW-22S	10.00	17.00	22.31	24.71	2.00	5.00-10.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-3.00	Seal	Bentonite Chips
								3.00-17.00	Filter	On Morie Sand #1
BBMW-22I	40.00	42.00	22.24	24.65	2.00	30.00-40.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-23.00	Backfill	Cement/Bentonite Grout
								23.00-26.50	Seal	Bentonite
								26.50-42.00	Filter	On Morie Sand #1
BBMW-22D	74.00	76.00	22.27	24.73	2.00	64.00-74.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-55.40	Backfill	Bentonite Grout
								55.40-58.00	Seal	Bentonite
								58.00-76.00	Filter	On Morie Sand #1
BBMW-23S	15.00	17.00	20.47	20.21	1.00	5.00-15.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-3.00	Seal	Bentonite
								3.00-4.00	Filter	Wellgravel #2
								4.00-17.00	Filter	Pre-packed Sand #00
BBMW-23I	43.00	45.00	20.52	20.29	1.00	33.00-43.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-28.00	Backfill	Bentonite Grout
								28.00-30.00	Seal	Bentonite
								30.00-32.00	Filter	Wellgravel #2
								32.00-45.00	Filter	Pre-packed Sand #00
BBMW-23D	59.50	60.50	20.52	20.27	1.00	49.50-59.50	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-44.50	Backfill	Bentonite Grout
								44.50-46.50	Seal	Bentonite
								46.50-48.50	Filter	Wellgravel #2
								48.50-60.50	Filter	Pre-packed Sand #00

TABLE 2-2 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION (feet)[1]	CASING DIAMETER (inches)	SCREEN DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
						INTERVAL	DESCRIPTION	INTERVAL	TYPE	MATERIALS
BBMW-23D2	73.00	76.20	20.48	19.68	2.00	63.00-73.00	Slotted Schedule 40 PVC	0.00-1.00	Seal	Cement
								1.00-59.00	Backfill	Cement/Bentonite Grout
								59.00-61.00	Seal	Bentonite
								61.00-76.20	Filter	Wellgravel #1
BBMW-24S	14.00	16.00	19.35	19.15	1.00	4.00-14.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-2.00	Seal	Bentonite
								2.00-3.00	Filter	On Morie Sand #1
								3.00-16.00	Filter	Pre-packed Sand #00
BBMW-24I	42.00	44.00	19.25	19.00	1.00	32.00-42.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-28.00	Backfill	Bentonite Grout
								28.00-30.00	Seal	Bentonite Chips
								30.00-31.00	Filter	On Morie Sand #1
								31.00-44.00	Filter	Pre-packed Sand #00
BBMW-24D	69.50	70.00	19.00	18.77	1.00	59.50-69.50	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-55.00	Backfill	Bentonite Grout
								55.00-57.00	Seal	Bentonite Chips
								57.00-58.50	Filter	On Morie Sand #1
								58.50-70.00	Filter	Pre-packed Sand #00
BBMW-25S	14.00	16.00	14.53	14.25	1.00	4.00-14.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-2.00	Seal	Bentonite
								2.00-3.00	Filter	On Morie Sand #1
								3.00-16.00	Filter	Pre-packed Sand #00
BBMW-25I	35.00	37.00	14.49	14.22	1.00	25.00-35.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-21.00	Backfill	Bentonite Grout
								21.00-23.00	Seal	Bentonite
								23.00-24.00	Filter	On Morie Sand #1
								24.00-37.00	Filter	Pre-packed Sand #00
BBMW-25D	72.00	74.00	14.43	14.21	1.00	62.00-72.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-58.00	Backfill	Bentonite Grout
								58.00-60.00	Seal	Bentonite Pellets
								60.00-61.00	Filter	On Morie Sand #1
								61.00-74.00	Filter	Pre-packed Sand #00
WCMW-01S	12.00	14.00	19.55	19.31	1.00	2.00-12.00	Pre-packed, 20/40 mesh	0.00-0.50	Seal	Cement
								0.50-1.00	Seal	Bentonite
								1.00-2.00	Filter	Well Gravel #2
								2.00-14.00	Filter	Pre-packed Sand #00
WCMW-01I	45.00	47.00	19.37	19.07	1.00	35.00-45.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-19.00	Backfill	Bentonite Grout
								19.00-21.00	Seal	Bentonite
								21.00-34.00	Filter	Well Gravel #2
								34.00-47.00	Filter	Pre-packed Sand #00
WCMW-01D	74.00	75.00	19.05	18.78	1.00	64.00-74.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-62.00	Backfill	Bentonite Grout
								62.00-64.00	Filter	Gravel Pack
WCMW-02S	13.00	15.00	16.54	16.20	1.00	3.00-13.00	Pre-packed, 20/40 mesh	0.00-0.50	Seal	Cement
								0.50-1.00	Seal	Bentonite
								1.00-2.00	Filter	Well Gravel #2
								2.00-15.00	Filter	Pre-packed Sand #00

TABLE 2-2 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION (feet)[1]	CASING DIAMETER (inches)	SCREEN DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
						INTERVAL	DESCRIPTION	INTERVAL	TYPE	MATERIALS
WCMW-02I	44.50	46.50	16.47	16.23	1.00	34.50-44.50	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-29.50	Backfill	Bentonite Grout
								29.50-31.50	Seal	Bentonite
								31.50-33.50	Filter	Well Gravel #2
								33.50-46.50	Filter	Pre-packed Sand #00
WCMW-02D	72.00	74.00	16.39	16.11	1.00	62.00-72.00	Pre-packed, 20/40 mesh	0.00-1.00	Seal	Cement
								1.00-57.00	Backfill	Bentonite Grout
								57.00-59.00	Seal	Bentonite
								59.00-61.00	Filter	Well Gravel #2
								61.00-74.00	Filter	Pre-packed Sand #00

NOTES:
(1) Top of casing elevation.
bgs: Below ground surface

The gravel pack, bentonite seal and cement grout were placed into the annulus in a manner that ensured complete placement, free of any voids or drill cuttings that might jeopardize the integrity of the groundwater monitoring well.

Soil generated during the installation of each well was placed into covered roll-off containers for proper off-site transportation and disposal by KeySpan.

The new groundwater monitoring wells were developed after installation. The well development protocol for the 2-inch diameter wells on-site and off-site was the airlift method followed by pumping with a submersible pump. For the 1-inch diameter wells installed off-site, a peristaltic pump was used for development. Well BBMW-23D2 was developed by using a submersible pump. During development activities, the purge water was monitored for flow rate, pH, conductivity, turbidity, dissolved oxygen, temperature, salinity and depth to water. The development process continued until the turbidity readings were 50 Nephelometric Turbidity Units (NTUs) or less and stabilization of the measured field parameters was achieved. All development water was temporarily containerized on-site in an aboveground storage tank. After waste characterization, all containerized liquids were removed from the site for proper off-site transportation and disposal by KeySpan.

Groundwater Sampling

In order to meet the objectives outlined in the Supplemental Field Investigation Work Plan, a number of groundwater samples were collected from selected wells located on-site, adjacent, upgradient and downgradient to the Bay Shore site. The groundwater samples were collected using a peristaltic pump following the procedures outlined in the generic work plan.

In addition, the existing monitoring wells were also sampled at this time. Prior to sampling, the total depth and depth to water at each well was measured and recorded in order to estimate purge volumes. An oil/water interface probe was used to determine if any nonaqueous phase liquid (NAPL) was present within each well.

Monitoring wells were sampled using disposable weighted plastic bailers after purging the equivalent of three to five well volumes of groundwater from each well. Each well was purged using a peristaltic pump. During purging, groundwater was pumped through a 3-inch diameter flow cell. The groundwater entered through the bottom of the flow cell and exited through a tube near the top. The probes from the Horiba-U22 were placed into the flow cell so that the parameters for pH, specific conductance, temperature, turbidity, dissolved oxygen, ORP and salinity could be monitored and recorded using field instrumentation. Groundwater was carefully poured from the bailers into laboratory-supplied glass bottles. While the vast majority of groundwater samples exhibited a turbidity of well below 50 NTUs, some of the existing monitoring wells yielded highly turbid samples even after extensive purging. Therefore, groundwater from these wells was filtered in the field prior to filling the sample bottles intended for inorganic analysis.

After completing sampling activities, the weighted bailer used in sampling the monitoring well was slowly lowered to the bottom of the well in an effort to determine if dense nonaqueous phase liquid (DNAPL) had accumulated within the well sump. All purge water was transferred into the on-site storage tank for subsequent off-site disposal by KeySpan.

Air Sampling

Air samples were collected in Summa canisters as 1-hour composites under low atmospheric pressure conditions. Summa canisters are stainless steel vessels that have been cleaned and certified contaminant-free by the contract laboratory. Each Summa canister was shipped to the sampling site under a high vacuum (-30 inches Hg) to ensure that the canister remained free of contaminants prior to use. The following atmospheric conditions/parameters were generally recorded/measured during sample collection: barometric pressure, temperature, relative humidity and wind direction and speed.

2.3 On-site Field Investigation Program

The investigation activities completed as part of the On-site Field Investigation Program are summarized in **Table 2-3**. The on-site (and adjacent off-site) sample locations are shown on **Drawing 2A**.

2.3.1 Bay Shore Site and Adjacent Off-site Locations

Surface Soil

A total of seven surface soil samples were collected at the site and immediately adjacent to the site for PCB analysis. The analytical results of these surface soil samples are presented and discussed in **Section 4.2.1.1**.

Subsurface Soil

A total of 39 soil probes and borings were advanced within the site and adjacent off-site locations. Boring logs are included in **Appendix A**. Soil probes were advanced to at least 76 feet below grade. Samples were collected continuously from ground surface to the top of the Magothy formation in order to characterize subsurface soil conditions and to determine the vertical and horizontal extent of chemical constituents. However, in cases where tar staining and strong hydrocarbon-like odors were observed at the planned termination depth, the soil probes were advanced until at least 10 feet of visibly "clean" soil had been sampled. In addition, additional soil samples were selected for chemical analysis when these conditions were encountered in order to define soil conditions vertically. The analytical results of the subsurface soil samples collected from on-site and adjacent off-site soil probes are presented and discussed in **Section 4.2.1.2**.

TABLE 2-3
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY PROPOSED	QUANTITY ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis [1]
Surface Soil Sampling	Soil	4	7	BBSS-30	6"	BBSS-30(0-6")							■					
				BBSS-31	6"	BBSS-31(0-6")							■					
				BBSS-32	6"	BBSS-32(0-6")							■					
				BBSS-33	6"	BBSS-33(0-6")							■					
				BBSS-36	6"	BBSS-36(0-6")							■					
				BBSS-37	6"	BBSS-37(0-6")							■					
				BBSS-38	6"	BBSS-38(0-6")							■					
Subsurface Soil Borings	--	31	39	BBSB-37	50'	BBSB-37(4-6)	■	■										
Subsurface Soil Boring Samples	Soil	111	171			BBSB-37(8-10)	■	■										
						BBSB-37(12-14)	■	■										
						BBSB-37(48-50)	■	■										
				BBSB-38	28'	BBSB-38(6-8)	■	■										
						BBSB-38(10-12)	■	■										
						BBSB-38(24-26)	■	■										
				BBSB-39	40'	BBSB-39(4-6)	■	■										
						BBSB-39(10-12)	■	■										
						BBSB-39(12-14)	■	■										
						BBSB-39(38-40)	■	■										
				BBSB-40	44'	BBSB-40(4-6)	■	■										
						BBSB-40(8-10)	■	■										
						BBSB-40(21-23)	■	■										
						BBSB-40(42-44)	■	■										
				BBSB-41	52'	BBSB-41(2-4)	■	■										
						BBSB-41(9-11)	■	■										
						BBSB-41(49-51)	■	■										
				BBSB-42	106'	BBSB-42(8-10)	■	■										
						BBSB-42(11-13)	■	■										
						BBSB-42(16-18)												■
						BBSB-42(21-23)	■	■										
						BBSB-42(63-65)												■
						BBSB-42(67-69)	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Subsurface Soil Boring Samples (cont.)				BBSB-43	25'	BBSB-43(0-2)	■	■										
						BBSB-43(9-11)	■	■										
						BBSB-43(23-25)	■	■										
				BBSB-44	25'	BBSB-44(4-6)	■	■										
						BBSB-44(10-12)	■	■										
						BBSB-44(24-25)	■	■										
				BBSB-45	26'	BBSB-45(10-12)	■	■										
						BBSB-45(14-16)	■	■										
						BBSB-45(22-24)	■	■										
				BBSB-46	52'	BBSB-46(8-10)	■	■										
						BBSB-46(24-25)	■	■										
						BBSB-46(48-50)	■	■										
				BBSB-47	40'	BBSB-47(0-2)	■	■										
						BBSB-47(6-8)	■	■										
						BBSB-47(10-12)	■	■							■			
						BBSB-47(16-18)	■	■							■			
						BBSB-47(36-38)	■	■										
				BBSB-48	86'	BBSB-48(7-9)	■	■										
						BBSB-48(12-14)	■	■										
						BBSB-48(39-41)	■	■										
						BBSB-48(83-85)	■	■										
				BBSB-49	86'	BBSB-49(4-6)	■	■										
						BBSB-49(9-11)	■	■										
						BBSB-49(24-26)												■
						BBSB-49(26-28)	■	■										
						BBSB-49(64-66)												■
						BBSB-49(68-70)	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis [1]
Subsurface Soil Boring Samples (cont.)				BBSB-50	86'	BBSB-50(7-9)	■	■										
						BBSB-50(12-14)	■	■										
						BBSB-50(21-23)												■
						BBSB-50(26-28)	■	■										
						BBSB-50(64-66)												■
						BBSB-50(68-70)	■	■										
				BBSB-51	106'	BBSB-51(7-9)	■	■										
						BBSB-51(18-20)	■	■										
						BBSB-51(36-38)	■	■										
						BBSB-51(96-98)	■	■										
				BBSB-52	86'	BBSB-52(1-3)	■	■										
						BBSB-52(6-8)	■	■										
						BBSB-52(13-14)	■	■										
						BBSB-52(33-35)	■	■										
						BBSB-52(84-86)	■	■										
				BBSB-53	86'	BBSB-53(6-8)	■	■										
						BBSB-53(19-21)	■	■										
						BBSB-53(26-28)	■	■										
						BBSB-53 (66-68)	■	■										
				BBSB-54	106'	BBSB-54(7-9)	■	■							■			
						BBSB-54(13-15)	■	■										
						BBSB-54(22-24)	■	■										
						BBSB-54(53-55)	■	■										
				BBSB-55	76'	BBSB-55(12-14)	■	■										
						BSB-55 (16-18)	■	■										
						BSB-55 (20-22)	■	■										
						BBSB-55 (70-72)	■	■										

TABLE 2-3 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis [1]
Subsurface Soil Boring Samples (cont.)				BBSB-56	86'	BBSB-56(9-11)	■	■										
						BBSB-56(12-14)	■	■										
						BBSB-56(21-23)												■
						BBSB-56(43-44)	■	■										
						BBSB-56(68-70)												■
						BBSB-56(71-73)	■	■										
				BBSB-57	76'	BBSB-57(10-12)	■	■										
						BBSB-57(20-22)	■	■										
						BBSB-57(54-56)	■	■										
						BBSB-57(64-66)	■	■										
				BBSB-58	76'	BBSB-58(6-8)	■	■							■			
						BBSB-58(13-15)	■	■							■			
						BBSB-58(22-24)	■	■										
						BBSB-58(46-48)	■	■										
						BBSB-58(73-75)	■	■										
				BBSB-59	28'	BBSB-59(9-11)	■	■										
						BBSB-59(16-18)	■	■										
						BBSB-59(24-26)	■	■										
				BBSB-60	32'	BBSB-60(8-10)	■	■										
						BBSB-60(20-22)	■	■										
						BBSB-60(28-30)	■	■										
				BBSB-61	76'	BBSB-61(6-8)	■	■										
						BBSB-61(12-14)	■	■										
						BBSB-61(40-42)	■	■										
						BBSB-61(70-72)	■	■										
						BBSB-61(74-75.5)	■	■										
				BBSB-62	76'	BBSB-62(0-2)	■	■										
						BBSB-62(12-14)	■	■										
						BBSB-62(40-42)	■	■										
						BBSB-62(74-76)	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Subsurface Soil Boring Samples (cont.)				BBSB-63	76'	BBSB-63(6-8)	■	■							■			
						BBSB-63(8-10)	■	■										
						BBSB-63(12-14)	■	■										
						BBSB-63(34-36)	■	■							■			
						BBSB-63(64-65)	■	■										
						BBSB-63(74-75)	■	■										
				BBSB-64	76'	BBSB-64(5-7)	■	■										
						BBSB-64(9-11)	■	■										
						BBSB-64(16-18)	■	■										
						BBSB-64(44-46)	■	■										
						BBSB-64(74-75.5)	■	■										
				BBSB-65	86'	BBSB-65(9-11)	■	■										
						BBSB-65(11-13)	■	■										
						BBSB-65(16-18)												■
						BBSB-65(21-23)	■	■										
						BBSB-65(62-64)												■
						BBSB-65(71-72)	■	■										
				BBSB-66	83'	BBSB-66(9-11)	■	■										
						BBSB-66(12-14)	■	■										
						BBSB-66(24-26)	■	■							■			
						BBSB-66(36-37)	■	■										
						BBSB-66(53-54)	■	■										
						BBSB-66(64-66)	■	■										
						BBSB-66(79-81)	■	■										
				BBSB-67	76'	BBSB-67(12-14)	■	■										
						BBSB-67(28-30)	■	■										
						BBSB-67(66-68)	■	■										
						BBSB-67(72-74)	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Subsurface Soil Boring Samples (cont.)				BBSB-81	106'	BBSB-81(7-9)	■	■										
						BBSB-81(16-18)	■	■										
						BBSB-81(36-38)	■	■										
						BBSB-81(63-65)												■
						BBSB-81(69-71)	■	■										
						BBSB-81(81-83)	■	■										
				BBSB-82	86'	BBSB-82(10-12)	■	■										
						BBSB-82(30-32)	■	■										
						BBSB-82(50-52)	■	■										
						BBSB-82(69-71)	■	■										
				BBSB-86	78'	BBSB-86(8-10)	■	■										
						BBSB-86(15-17)	■	■										
						BBSB-86(48-50)	■	■										
						BBSB-86(76-78)	■	■										
				BBSB-87	70'	BBSB-87(7-9)	■	■										
						BBSB-87(19-21)	■	■										
						BBSB-87(48-50)	■	■										
						BBSB-87(68-70)	■	■										
				BBSB-88	72'	BBSB-88(10-12)	■	■										
						BBSB-88(20-22)	■	■										
						BBSB-88(50-52)	■	■										
						BBSB-88(70-72)	■	■										
				BBSB-89	76'	BBSB-89(10-12)	■	■										
						BBSB-89(12-14)	■	■										
						BBSB-89(25-27)	■	■										
						BBSB-89(46-48)	■	■										
						BBSB-89(70-72)	■	■										

TABLE 2-3 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Subsurface Soil Boring Samples (cont.)				BBSB-90	74'	BBSB-90(8-10)	■	■										
						BBSB-90(12-14)	■	■							■			
						BBSB-90(48-50)	■	■										
						BBSB-90(72-74)	■	■										
				BBSB-105	76'	BBSB-105(8-10)	■	■										
						BBSB-105(16-18)	■	■										
						BBSB-105(68-70)	■	■										
						BBSB-105(72-74)	■	■										
Groundwater Probes	--	18	20	BBGP-57	35'	BBGP-57(9-13)	■	■										
Groundwater Probe Samples	Groundwater	78	105			BBGP-57(31-35)	■	■										
				BBGP-58	35'	BBGP-58(9-13)	■	■										
						BBGP-58(31-35)	■	■										
				BBGP-59	35'	BBGP-59(8-12)	■	■										
						BBGP-59(31-35)	■	■										
				BBGP-60	35'	BBGP-60(8-12)	■	■										
						BBGP-60(20-24)	■	■										
						BBGP-60(31-35)	■	■										
				BBGP-61	75'	BBGP-61(8-12)	■	■										
						BBGP-61(26-30)	■	■										
						BBGP-61(40-44)	■	■										
						BBGP-61(56-60)	■	■										
						BBGP-61(71-75)	■	■										
				BBGP-62	75'	BBGP-62(8-12)	■	■										
						BBGP-62(26-30)	■	■										
						BBGP-62(40-44)	■	■										
						BBGP-62(56-60)	■	■										
						BBGP-62(71-75)	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Groundwater Probe Samples (cont.)				BBGP-63	75'	BBGP-63(8-12)	■	■										
						BBGP-63(26-30)	■	■										
						BBGP-63(40-44)	■	■										
						BBGP-63(56-60)	■	■										
						BBGP-63(71-75)	■	■										
				BBGP-64	75'	BBGP-64(8-12)	■	■										
						BBGP-64(26-30)	■	■										
						BBGP-64(40-44)	■	■										
						BBGP-64(56-60)	■	■										
						BBGP-64(71-75)	■	■										
				BBGP-65	75'	BBGP-65(8-12)	■	■										
						BBGP-65(26-30)	■	■										
						BBGP-65(40-44)	■	■										
						BBGP-65(56-60)	■	■										
						BBGP-65(71-75)	■	■										
				BBGP-66	78'	BBGP-66(6-10)	■	■										
						BBGP-66(14-18)	■	■										
						BBGP-66(24-28)	■	■										
						BBGP-66(36-40)	■	■										
						BBGP-66(48-52)	■	■										
						BBGP-66(66-70)	■	■										
						BBGP-66(74-78)	■	■										
				BBGP-67	72'	BBGP-67(9-13)	■	■										
						BBGP-67(16-20)	■	■										
						BBGP-67(28-32)	■	■										
						BBGP-67(48-52)	■	■										
						BBGP-67(68-72)	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Groundwater Probe Samples (cont.)				BBGP-68	70'	BBGP-68(9-13)	■	■										
						BBGP-68(20-24)	■	■										
						BBGP-68(32-36)	■	■										
						BBGP-68(48-52)	■	■										
						BBGP-68(60-64)	■	■										
						BBGP-68(66-70)	■	■										
				BBGP-69	75'	BBGP-69(9-13)	■	■										
						BBGP-69(20-24)	■	■										
						BBGP-69(34-38)	■	■										
						BBGP-69(40-44)	■	■										
						BBGP-69(56-60)	■	■										
						BBGP-69(71-75)	■	■										
				BBGP-70	75'	BBGP-70(9-13)	■	■										
						BBGP-70(20-24)	■	■										
						BBGP-70(34-38)	■	■										
						BBGP-70(48-52)	■	■										
						BBGP-70(63-67)	■	■										
						BBGP-70(71-75)	■	■										
				BBGP-71	74'	BBGP-71(6-10)	■	■										
						BBGP-71(20-24)	■	■										
						BBGP-71(38-42)	■	■										
						BBGP-71(56-60)	■	■										
						BBGP-71(70-74)	■	■										
				BBGP-72	75'	BBGP-72(8-12)	■	■										
						BBGP-72(16-20)	■	■										
						BBGP-72(24-28)	■	■										
						BBGP-72(32-36)	■	■										
						BBGP-72(40-44)	■	■										
						BBGP-72(48-52)	■	■										
						BBGP-72(56-60)	■	■										
						BBGP-72(64-68)	■	■										
						BBGP-72(71-75)	■	■										

TABLE 2-3 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Groundwater Probe Samples (cont.)				BBGP-73	76'	BBGP-73(8-12)	■	■										
						BBGP-73(16-20)	■	■										
						BBGP-73(24-28)	■	■										
						BBGP-73(32-36)	■	■										
						BBGP-73(40-44)	■	■										
						BBGP-73(48-52)	■	■										
						BBGP-73(56-60)	■	■										
						BBGP-73(64-68)	■	■										
						BBGP-73(72-76)	■	■										
				BBGP-74	76'	BBGP-74(8-12)	■	■										
						BBGP-74(16-20)	■	■										
						BBGP-74(24-28)	■	■										
						BBGP-74(32-36)	■	■										
						BBGP-74(40-44)	■	■										
						BBGP-74(48-52)	■	■										
						BBGP-74(56-60)	■	■										
						BBGP-74(64-68)	■	■										
						BBGP-74(72-76)	■	■										
				BBGP-89	44'	BBGP-89(7.5-11.5)	■	■										
						BBGP-89(16-20)	■	■										
						BBGP-89(24-28)	■	■										
						BBGP-89(32-36)	■	■										
						BBGP-89(40-44)	■	■										
				BBGP-90	36'	BBGP-90(8-12)	■	■										
						BBGP-90(16-20)	■	■										
						BBGP-90(24-28)	■	■										
						BBGP-90(32-36)	■	■										
Groundwater Monitoring Well Sampling	Groundwater	21	55	BBMW-04D	73'	BBMW-04D	■	■										
				BBMW-05D	74'	BBMW-05D	■	■										
				BBMW-05D2	136.5'	BBMW-05D2	■	■										
				BBMW-06ST	15'	BBMW-06ST	■											
						BBMW-06ST	■	■							■			

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis [1]
Groundwater Monitoring Well Sampling (cont.)				BBMW-06S	15'	BBMW-06S	■											
						BBMW-06S	■	■										
				BBMW-06I	40'	BBMW-06I	■	■										
				BBMW-06D	76'	BBMW-06D	■	■										
				BBMW-08D	75'	BBMW-08D	■	■										
				BBMW-10S	15.50'	BBMW-10S	■	■										
				BBMW-10I	35'	BBMW-10I	■	■										
				BBMW-10D	73'	BBMW-10D	■	■										
				BBMW-11D	71'	BBMW-11D	■	■										
				BBMW-12S	15'	BBMW-12S	■	■										
						BBMW-12S	■	■										
				BBMW-12I	40'	BBMW-12I	■	■										
						BBMW-12I	■	■										
				BBMW-12D	72.5'	BBMW-12D	■	■										
						BBMW-12D	■	■										
				BBMW-14S	15'	BBMW-14S	■	■										
				BBMW-14I2	25'	BBMW-14I2	■	■										
				BBMW-14I	40'	BBMW-14I	■	■										
				BBMW-14D	75'	BBMW-14D	■	■										
				BBMW-17S	15.5'	BBMW-17S	■	■										
				BBMW-17I	40.5'	BBMW-17I	■	■										
				BBMW-18S	16'	BBMW-18S	■	■										
				BBMW-18I	40'	BBMW-18I	■	■										
				BBMW-18D	70'	BBMW-18D	■	■										
				BBMW-19S	16'	BBMW-19S	■	■										
				BBMW-19I	39.60'	BBMW-19I	■	■										
				BBMW-19D	74.75'	BBMW-19D	■	■										
				BBMW-20S	14'	BBMW-20S	■	■										
				BBMW-20I	45'	BBMW-20I	■	■										
				BBMW-20D	72'	BBMW-20D	■	■										
				BBMW-21S	17.5'	BBMW-21S	■	■										
				BBMW-21I	40'	BBMW-21I	■	■										

TABLE 2-3 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis (1)
Groundwater Monitoring Well Sampling (cont.)				BBMW-21D	76.33'	BBMW-21D	■	■							■			
				BBMW-22S	10'	BBMW-22S	■	■										
				BBMW-22I	40'	BBMW-22I	■	■										
				BBMW-22D	74'	BBMW-22D	■	■							■			
						BBMW-22D									■			
				BBMW-23S	15'	BBMW-23S	■	■										
				BBMW-23I	43'	BBMW-23I	■	■										
				BBMW-23D	59.5'	BBMW-23D	■	■										
				BBMW-23D2	73'	BBMW-23D2	■	■										
				MW-04S	14'	MW-04S	■	■										
				MW-04D	45'	MW-04D	■	■										
				MW-05S	14'	MW-05S	■	■										
				MW-05D	45.50'	MW-05D	■	■										
				MW-07S	12'	MW-07S	■	■										
				MW-07D	45'	MW-07D	■	■										
				MW-08S	12'	MW-08S	■	■										
				MW-08D	45'	MW-08D	■	■										
				MW-09S	14'	MW-09S	■	■										
Groundwater Monitoring Well Sampling	Soil	0	3	BBMW-18D	70'	BBMW18D									■			
				BBMW-21	76.33'	BBMW-21(33-35)												■
						BBMW-21(73-75)												■
Test Pit Soil Sampling	Soil	11	16	BBTP-03	6'	BBTP-03 (5-6)	■	■							■			
				BBTP-04	6'	BBTP-04 (5-6)	■	■										
				BBTP-05	10'	BBTP-05(6-8)	■	■										
				BBTP-06A	10'	BBTP-06A(9-10)	■	■										
				BBTP-06B	10'	BBTP-06B(9-10)	■	■										
				BBTP-07	10'	BBTP-07(7-8)	■	■										
				BBTP-08	6'	BBTP-08(6)	■	■										
				BBTP-09	8'	BBTP-09(7-8)	■	■										
				BBTP-10	8'	BBTP-10(5-7)	■	■										
						BBTP-10(4"PIPE)									■			

TABLE 2-3 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE SITE AND ADJACENT OFF-SITE AREAS FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis [1]
Test Pit Soil Sampling (cont.)				BBTP-11	10'	BBTP-11(6-7)	■	■										
						BBTP-11(9-10)	■	■							■			
				BBTP-12	8'	BBTP-12(6-8)	■	■										
				BBTP-13	8'	BBTP-13(3-5)	■	■							■			
				BBTP-14	9'	BBTP-14(7-9)	■	■										
						BBTP-14(7-9) (2)	■	■										

Notes:

[1] Includes grain size and specific gravity only

-- : Not applicable.

TPH: Total petroleum hydrocarbons

TOC : Total organic carbon.

Groundwater Probes

Twenty groundwater probes were completed within the Bay Shore site and adjacent off-site locations. The purpose of the groundwater probes that were completed during the supplemental field program was to identify zones of elevated BTEX and PAHs and to characterize and define the vertical and areal extent of NAPL in suspected source areas. The groundwater probes were also completed at the Bay Shore site and within adjacent off-site locations to provide additional data to identify zones of NAPL. Two to seven groundwater samples were collected at each on-site probe location. In addition, up to nine groundwater samples were collected from several adjacent off-site groundwater probe locations. The selection of the sample intervals was based on the current understanding of BTEX/PAHs and NAPL distribution and field observations (i.e., presence of sheen, visible tar/oil blebs or odor).

Groundwater Monitoring Wells

A total of 23 new groundwater monitoring wells were installed at the Bay Shore site and adjacent off-site locations.

Three monitoring well clusters were installed on-site. Monitoring well clusters BBMW-18 and BBMW-19 each consist of a shallow (S), intermediate (I) and deep (D) monitoring well. Monitoring well cluster BBMW-17 consists of a shallow and intermediate monitoring well. Well clusters BBMW-18S,I,D and BBMW-19S,I,D were installed along the southwestern boundaries of the property, and BBMW-17S,I was installed on the central section of the Bay Shore site downgradient of the former Drip Oil Tanks.

Four monitoring well clusters were installed at adjacent off-site locations downgradient of the Bay Shore site. Monitoring well clusters BBMW-20S,I,D, BBMW-21S,I,D, BBMW-22S,I,D and BBMW-23S,I,D1,D2, were installed in the area immediately downgradient of the Bay Shore site, south of the Long Island Rail Road. A deep monitoring well, BBMW-05D2, and a test groundwater monitoring well, BBMW-06ST, were installed in the area immediately downgradient and adjacent to the Bay Shore site, south of the Long Island Rail Road (**Section 2.2**).

The new monitoring wells and all of the existing monitoring wells located in the Bay Shore site and adjacent off-site locations were sampled for BTEX/PAHs. In addition, all of the wells were checked for DNAPL using a bailer.

The analytical results of groundwater samples collected from on-site and adjacent off-site monitoring wells and groundwater probes are presented and discussed in **Section 4.2.1.3**.

Test Pits

Fourteen test pits were excavated on-site. The test pits were excavated to the water table and ranged from a depth of 6 to 10 feet bgs. The objectives of the test pits included:

- Observe shallow soil conditions
- Determine if NAPL is present at the water table
- Locate and identify former MGP structure foundations

Four test pits were excavated toward the southeastern vicinity of the site with test pits BBTP-06A and BBTP-06B located at the Tar Tank area; and BBTP-07, BBTP-08 and BBTP-09 located at the Tar Settling Tank/Tar Separator area.

Two test pits were excavated toward the southwestern area of the site with test pit BBTP-12 located in the vicinity of the transformer/accumulator and BBTP-14 in the cesspool area.

The central portion of the site had four test pits that were excavated with test pit BBTP-13 located in the vicinity of the Naphthalene Scrubber/Scrubber Pump Room. Test pit BBTP-11 was advanced adjacent to the Tar and Drip Oil Collection Pit/Exhauster House, while BBTP-04 and BBTP-05 were excavated adjacent to the former Relief Gas Holder pad.

BBTP-10 was located by the Boiler House/Gas Holder at the southern end of the site, and BBTP-03 and BBTP-03A were excavated in the northern-central area of the site in the vicinity of the Main Storage Gas Holder.

One to two soil samples were collected per test pit for laboratory analysis depending on size and contamination observed at the test pit. The analytical results of the on-site test pit soil samples are presented and discussed in **Section 4.2.1.2**.

Perimeter Air Monitoring

During the completion of on-site field activities, perimeter air monitoring was conducted at the site boundary. A PID and a dust monitoring instrument were used to detect any potential off-site migration of VOCs or dust emanating from the on-site field operations. Readings were taken at established air monitoring stations located at approximately 200-foot intervals around the site perimeter and recorded in a project field book.

During the excavation of test pits, calibrated air monitoring instruments were also employed to monitor for potential releases of VOCs and/or dust related to these operations. Upwind and downwind air monitoring stations were established at each test pit location. Each monitoring station contained a data logging PID and a data logging dust meter. In addition, a PID was used to monitor the air quality within the worker's breathing zone and to quantitatively measure any VOCs being emitted from the borehole or drill cuttings.

All air monitoring instruments were calibrated on a daily basis prior to the start of field work. The calibration records have been retained in the project files. All data from the stationary air monitoring stations were electronically downloaded to the on-site computer at the conclusion of the day's work. This information is also available in the project files.

2.3.2 Bay Shore West Parcel

The investigation activities completed at the Bay Shore West Parcel and the Brightwaters Yard during the supplemental field program are summarized in **Table 2-4**. The sample locations are shown in **Drawing 2A**.

Subsurface Soil

Using the direct push (Geoprobe) method, a total of 25 soil borings were completed within the Bay Shore West Parcel. The purpose of the subsurface soil borings at the Bay Shore West parcel was to delineate the vertical and areal extent of BTEX/PAHs in subsurface soil in the vicinity of the soil boring BBSB-25 completed during the initial field program. The soil borings were completed to a depth of between 20 and 26 feet bgs. Two samples were collected at each probe location in the majority of the soil borings. The selection of the sample intervals was based on field observations. Specifically, one sample was collected in the zone exhibiting the highest PID reading and most visible contamination, and another in the visibly "clean" soil to delineate the vertical extent of the BTEX/PAHs. Additional borings were required on and off the Bay Shore West Parcel to delineate the areal extent of the BTEX/PAHs adjacent and downgradient of BBSB-25. The results of the soil borings are discussed in **Section 4.2.2.1**.

Groundwater Probes

Four groundwater probes were completed along the southern edge of the Bay Shore West Parcel. The groundwater probes, BBGP-85, BBGP-86, BBGP-87 and BBGP-88, were added to the supplemental field program to further delineate the vertical and areal extent of the BTEX/PAHs downgradient of the Bay Shore West Parcel. In addition, groundwater monitoring wells in the Bay Shore West Parcel and Brightwaters Yard were sampled as part of the supplemental field program. This included BBMW-09S,I,D, BBMW-13D and MW-03S,D.

The results of the groundwater sampling program are discussed in **Section 4.2.2.2**.

TABLE 2-4
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE WEST PARCEL/BRIGHTWATERS YARD FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Subsurface Soil Borings	--	7	25	BBSB-68	26'	BBSB-68(8-10)	■	■										
Subsurface Soil Boring Samples	Soil	22	58			BBSB-68(12-14)	■	■										
						BBSB-68(24-26)	■	■										
				BBSB-69	26'	BBSB-69(6-8)	■	■										
						BBSB-69(10-12)	■	■										
						BBSB-69(24-26)	■	■										
				BBSB-70	30'	BBSB-70(8-10)	■	■										
						BBSB-70(16-18)	■	■										
						BBSB-70(22-24)	■	■										
						BBSB-70(27-29)	■	■										
				BBSB-71	26'	BBSB-71(5-7)	■	■										
						BBSB-71(9-11)	■	■							■			
						BBSB-71(16-18)	■	■										
				BBSB-72	26'	BBSB-72(4-6)	■	■										
						BBSB-72(8-10)	■	■										
						BBSB-72(24-25.5)	■	■										
				BBSB-73	26'	BBSB-73(4-6)	■	■										
						BBSB-73(10-12)	■	■										
						BBSB-73(24-26)	■	■										
				BBSB-78	26'	BBSB-78(0-2)	■	■										
						BBSB-78(9-11)	■	■										
						BBSB-78(24-25)	■	■										
				BBSB-79	20'	BBSB-79(6-7)	■	■										
						BBSB-79(16-18)	■	■										
				BBSB-80	20'	BBSB-80(6-7)	■	■										
						BBSB-80(8.5-9.5)	■	■										
						BBSB-80(16-18)	■	■										
				BBSB-83	20'	BBSB-83(8-10)	■	■										
						BBSB-83(18-20)	■	■										
				BBSB-84	20'	BBSB-84(8-10)	■	■										
						BBSB-84(18-20)	■	■										
				BBSB-91	24'	BBSB-91(10-12)	■	■										
						BBSB-91(22-24)	■	■										

TABLE 2-4 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE WEST PARCEL/BRIGHTWATERS YARD FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				BBSB-92	24'	BBSB-92(8-10)	■	■										
						BBSB-92(20-22)	■	■										
				BBSB-93	24'	BBSB-93(6-8)	■	■										
						BBSB-93(18-20)	■	■										
				BBSB-94	24'	BBSB-94(10-12)	■	■										
						BBSB-94(18-20)	■	■										
				BBSB-95	24'	BBSB-95(8-10)	■	■										
						BBSB-95(18-20)	■	■										
				BBSB-96	24'	BBSB-96(8-10)	■	■										
						BBSB-96(18-20)	■	■										
				BBSB-97	24'	BBSB-97(8-10)	■	■										
						BBSB-97(22-24)	■	■										
				BBSB-98	24'	BBSB-98(8-10)	■	■										
						BBSB-98(22-24)	■	■										
				BBSB-99	24'	BBSB-99(8-10)	■	■										
						BBSB-99(22-24)	■	■										
				BBSB-100	10'	BBSB-100(8-10)	■	■										
				BBSB-101	24'	BBSB-101(10-12)	■	■										
						BBSB-101(22-24)	■	■										
				BBSB-102	24'	BBSB-102(9-11)	■	■										
						BBSB-102(22-24)	■	■										
				BBSB-103	24'	BBSB-103(8-10)	■	■										
						BBSB-103(22-24)	■	■										
				BBSB-104	20'	BBSB-104(4-6)	■	■										
						BBSB-104(16-18)	■	■										
Groundwater Probes	--	0	4	BBGP-85	10'	BBGP-85(6-10)	■	■										
Groundwater Probe Samples	Groundwater	0	6	BBGP-86	10'	BBGP-86(6-10)	■	■										
				BBGP-87	24'	BBGP-87(8-12)	■	■										
						BBGP-87(20-24)	■	■										
				BBGP-88	24'	BBGP-88(8-12)	■	■										
						BBGP-88(20-24)	■	■										

TABLE 2-4 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE WEST PARCEL/BRIGHTWATERS YARD FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Groundwater Monitoring Well Sampling	Groundwater	0	6	BBMW-09S	15'	BBMW-09S	■	■										
				BBMW-09I	40'	BBMW-091	■	■										
				BBMW-09D	72'	BBMW-09D	■	■										
				BBMW-13D	72'	BBMW-13D	■	■										
				MW-03S	13'	MW-03S	■	■										
				MW-03D	45'	MW-03D	■	■										

Notes:
-- : Not applicable.
TPH: Total petroleum hydrocarbons
TOC : Total organic carbon.

2.3.3 Bay Shore West Storage Lot

The investigation activities completed at the Bay Shore West Storage Lot during the supplemental field program are summarized in **Table 2-5**. The sample locations are shown in **Drawing 2A**.

Surface Soil

Two surface soil samples were collected in the vicinity of previous surface soil sample BBSS-13 at the Bay Shore West Storage Lot Parcel. The purpose of the soil sampling was to determine the areal extent of PAHs identified in surface soil in this area during the initial site characterization.

The analytical results of the surface soil samples collected at the Bay Shore West Storage Parcel are presented and discussed in **Section 4.2.3.1**.

2.4 Off-site Field Investigation Program

The Off-site Field Investigation Program completed during the supplemental field program has been grouped as:

- Bay Shore Plume IRM Investigation
- O-Co-Nee Pond Supplemental Investigation
- Watchogue Creek/Crum's Brook Supplemental Investigation
- Private Well and Basement Survey
- Air Sampling
- Private Groundwater Well Sampling

The adjacent off-site sample locations (as well as the on-site) are shown on **Drawing 2A**. Off-site sample locations are shown on **Drawing 2B**. Both are provided in a map pocket at the

TABLE 2-5
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE WEST STORAGE LOT PARCEL FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Surface Soil Sampling	Soil	2	2	BBSS-34	6"	BBSS-34(0-6")		■										
				BBSS-35	6"	BBSS-35(0-6")		■										

Notes:
TPH: Total petroleum hydrocarbons
TOC : Total organic carbon.

end of this section of the report. Locations where private groundwater well and air samples were collected are shown on **Figure 2-2**, presented earlier.

2.4.1 Bay Shore Plume IRM Investigation

The Bay Shore groundwater plume IRM investigation was completed to obtain additional stratigraphic and geotechnical data needed to further characterize the plume and obtain additional data needed to design and implement an IRM. The investigation activities completed as part of the Bay Shore Plume IRM Investigation are summarized in **Table 2-6**.

Subsurface Soil

Four soil probes were installed within the Bay Shore Plume. All the probes were completed to depths ranging from 72 to 76-feet bgs, the top of the confining Magothy formation. Continuous soil samples were collected at each probe location from grade to termination depth. The samples were characterized for stratigraphy, presence of any NAPL and related MGP material and any hydrocarbon-like odors. Based on field observations, three to four samples per bore hole were submitted to the laboratory for geotechnical analysis. One sample (BBSB-76 [17 to 19 feet]) was submitted for analysis of BTEX/PAHs. The boring logs are included in **Appendix A** and the results are discussed in **Section 4.3.1.1**.

Groundwater Probes

A total of 10 groundwater probes were completed within the vicinity of the Bay Shore site groundwater plume to determine groundwater quality immediately downgradient of the Bay Shore site and to further delineate off-site migration of BTEX/PAHs and NAPL.

Where possible, all the groundwater probes were extended to the top of the Magothy formation. After reaching the targeted depth, samples were collected at each probe location starting with the deepest sample first and then "pulling back" the sampler to the next depth until reaching the shallowest sample, typically at the groundwater table. The selection of the sample

TABLE 2-6
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE PLUME IRM FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	TOC	Field Parameters(1)	Geochemical Parameters(2)	Geotechnical Parameters(3)
Subsurface Soil Borings	--	4	4	BBSB-74	76'	BBSB-74(8-10)												■
Subsurface Soil Boring Samples	Soil	12	13			BBSB-74(16-18)												■
						BBSB-74(52-54)												■
				BBSB-75	72'	BBSB-75(8-10)												■
						BBSB-75(52-54)												■
						BBSB-75(68-70)												■
				BBSB-76	72'	BBSB-76(8-10)												■
						BBSB-76(17-19)	■	■										
						BBSB-76(40-44)												■
						BBSB-76(60-64)												■
				BBSB-77	74'	BBSB-77(8-10)												■
						BBSB-77(32-36)												■
						BBSB-77(56-58)												■
Groundwater Probes	--	10	10	BBGP-75	76'	BBGP-75(8-12)	■	■								■	■	
Groundwater Probe Samples	Groundwater	60	71			BBGP-75(16-20)	■	■								■	■	
						BBGP-75(24-28)	■	■								■	■	
						BBGP-75(32-36)	■	■								■	■	
						BBGP-75(40-44)	■	■										
						BBGP-75(48-52)	■	■								■	■	
						BBGP-75(56-60)	■	■										
						BBGP-75(64-68)	■	■								■	■	
						BBGP-75(72-76)	■	■										
				BBGP-76	73'	BBGP-76(8-12)	■	■								■	■	
						BBGP-76(16-20)	■	■								■	■	
						BBGP-76(24-28)	■	■								■	■	
						BBGP-76(32-36)	■	■								■	■	
						BBGP-76(40-44)	■	■										
						BBGP-76(48-52)	■	■								■	■	
						BBGP-76(56-60)	■	■										
						BBGP-76(64-68)	■	■								■	■	
						BBGP-76(69-73)	■	■										
				BBGP-77	70'	BBGP-77(8-12)	■	■								■	■	
						BBGP-77(16-20)	■	■								■	■	
						BBGP-77(24-28)	■	■								■	■	
						BBGP-77(32-36)	■	■								■	■	
						BBGP-77(40-44)	■	■										
						BBGP-77(48-52)	■	■								■	■	

TABLE 2-6 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE PLUME IRM FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	TOC	Field Parameters(1)	Geochemical Parameters(2)	Geotechnical Parameters(3)
Groundwater Probe Samples (cont.)						BBGP-77(54-58)	■	■										
						BBGP-77(60-64)	■	■								■	■	
						BBGP-77(66-70)	■	■										
				BBGP-78	70'	BBGP-78(6-10)	■	■								■	■	
						BBGP-78(14-18)	■	■								■	■	
						BBGP-78(22-26)	■	■								■	■	
						BBGP-78(32-36)	■	■								■	■	
						BBGP-78(48-52)	■	■								■	■	
						BBGP-78(66-70)	■	■								■	■	
				BBGP-79	70'	BBGP-79(6-10)	■	■								■	■	
						BBGP-79(14-18)	■	■								■	■	
						BBGP-79(22-26)	■	■								■	■	
						BBGP-79(32-36)	■	■								■	■	
						BBGP-79(48-52)	■	■								■	■	
						BBGP-79(66-70)	■	■								■	■	
				BBGP-80	64'	BBGP-80(6-10)	■	■								■	■	
						BBGP-80(16-20)	■	■								■	■	
						BBGP-80(26-30)	■	■								■	■	
						BBGP-80(36-40)	■	■								■	■	
						BBGP-80(48-52)	■	■								■	■	
						BBGP-80(60-64)	■	■								■	■	
				BBGP-81	80'	BBGP-81(6-10)	■	■								■	■	
						BBGP-81(16-20)	■	■								■	■	
						BBGP-81(26-30)	■	■								■	■	
						BBGP-81(36-40)	■	■								■	■	
						BBGP-81(48-52)	■	■								■	■	
						BBGP-81(60-64)	■	■								■	■	
						BBGP-81(76-80)	■	■										
				BBGP-82	80'	BBGP-82(6-10)	■	■								■	■	
						BBGP-82(16-20)	■	■								■	■	
						BBGP-82(26-30)	■	■								■	■	
						BBGP-82(36-40)	■	■								■	■	
						BBGP-82(48-52)	■	■								■	■	
						BBGP-82(56-60)	■	■								■	■	
						BBGP-82(76-80)	■	■										
				BBGP-83	60'	BBGP-83(6-10)	■	■								■	■	
						BBGP-83(16-20)	■	■								■	■	

TABLE 2-6 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE PLUME IRM FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	TOC	Field Parameters(1)	Geochemical Parameters(2)	Geotechnical Parameters(3)
Groundwater Probe Samples (cont.)						BBGP-83(26-30)	■	■								■	■	
						BBGP-83(36-40)	■	■								■	■	
						BBGP-83(46-50)	■	■								■	■	
						BBGP-83(56-60)	■	■								■	■	
				BBGP-84	60'	BBGP-84(6-10)	■	■								■	■	
						BBGP-84(16-20)	■	■								■	■	
						BBGP-84(26-30)	■	■								■	■	
						BBGP-84(36-40)	■	■								■	■	
						BBGP-84(46-50)	■	■								■	■	
						BBGP-84(56-60)	■	■								■	■	
Groundwater Monitoring Well Sampling	Groundwater	18	45	BBMW-01S	15'	BBMW-01S	■	■										
				BBMW-01I	42'	BBMW-01I	■	■										
				BBMW-01D	78.5	BBMW-01D	■	■										
				BBMW-02S	15'	BBMW-02S	■	■										
				BBMW-02I	40'	BBMW-02I	■	■										
				BBMW-02D	83'	BBMW-02D	■	■										
				BBMW-03S	13'	BBMW-03S	■	■								■	■	
						BBMW-03S	■	■										
				BBMW-03I	40'	BBMW-03I	■	■								■	■	
						BBMW-03I	■	■										
				BBMW-03D	62'	BBMW-03D	■	■								■	■	
						BBMW-03D	■	■										
				BBMW-07S	15'	BBMW-07S	■	■										
				BBMW-07I	40'	BBMW-07I	■	■										
				BBMW-07D	65'	BBMW-07D	■	■										
				BBMW-15S	15'	BBMW-15S	■	■										
				BBMW-15I2	28'	BBMW-15I2	■	■										
				BBMW-15I	45'	BBMW-15I	■	■										
				BBMW-15D	80'	BBMW-15D	■	■										
				BBMW-24S	14'	BBMW-24S	■	■										
				BBMW-24I	42'	BBMW-24I	■	■										
				BBMW-24D	69.5'	BBMW-24D	■	■										
				BBMW-25S	14'	BBMW-25S	■	■										
				BBMW-25I	35'	BBMW-25I	■	■										
				BBMW-25D	72'	BBMW-25D	■	■										
				BS-01S	15'	BS-01S	■	■										
				GM-03S	21.78'	GM-03S	■	■								■	■	
						GM-03S	■	■										
				GM-03I	45.03'	GM-03I	■	■								■	■	

TABLE 2-6 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF BAY SHORE PLUME IRM FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	TOC	Field Parameters(1)	Geochemical Parameters(2)	Geotechnical Parameters(3)
Groundwater Monitoring Well Sampling (cont.)						GM-03I	■	■										
				GM-03D	68.18'	GM-03D	■	■								■	■	
						GM-03D	■	■										
				GM-05S	20.10'	GM-05S	■	■								■	■	
						GM-05S	■	■										
				GM-05I	48.05'	GM-05I	■	■								■	■	
						GM-05I	■	■										
				GM-05D	75.95'	GM-05D	■	■								■	■	
						GM-05D	■	■										
				GMP-01	30'	GMP-01	■	■								■	■	
						GMP-01	■	■										
				GMP-02	23'	GMP-02	■	■								■	■	
						GMP-02	■	■										
				GMP-04	20.50'	GMP-04	■	■								■	■	
						GMP-04	■	■										
				MW-16AS	13'	MW-16AS	■	■										

Notes:
(1) Includes pH, specific conductance, temperature, turbidity, dissolved oxygen, and redox potential
(2) Includes ammonia, BOD, CO_2, chloride, COD, plate count, iron, dissolved iron, ferrous iron, manganese, dissolved manganese, and orthophosphate
(3) Includes grain size and specific gravity only
-- : Not applicable.
TOC : Total organic carbon.

intervals was based on the current understanding of the stratigraphic and geochemical characteristics of the plume. Additionally, existing groundwater monitoring wells BBMW-03S, BBMW-03I, BBMW-03D, GM-03S, GM-03I, GM-03D, GM-05S, GM-05I, GM-05D, GMP-01, GMP-02 and GMP-04, were sampled for both BTEX/PAHs and geochemical parameters.

Groundwater Monitoring Wells

Two new monitoring well clusters, BBMW-24S,I,D and BBMW-25S,I,D, were installed at off-site locations in order to characterize off-site groundwater. The new monitoring wells and all the existing monitoring wells were sampled as part of the off-site groundwater monitoring well sampling program. The results are discussed in **Section 4.3.1.2**.

2.4.2 O-Co-Nee Pond Investigation

In order to determine whether the Brightwaters Yard Plume is entering O-Co-Nee Pond and its headwaters, pore water, surface water and surface water sediment samples were collected as part of the supplemental field investigation. The investigation activities completed as part of the O-Co-Nee Pond Supplemental Investigation are summarized in **Table 2-7**.

Pore Water Sampling

Six pore water samples were collected at O-Co-Nee Pond to meet the objectives of the supplemental field program. The pore water samples were collected by advancing the 6-inch stainless steel well screen attached to 1-inch threaded steel pipe into the sand deposits immediately underlying the pond sediment. A dedicated polyethylene tubing was then connected to the well screen. Using a peristaltic pump with a flow rate of 70 millimeters per minute, pore water was purged from the screen zone and sampled directly from the tubing. After field measurements of pH, temperature and conductivity had stabilized, pore water samples were collected directly from the discharge tubing. The well screen and associated steel pipe was decontaminated before the collection of each sample. The results of the sampling are discussed in **Section 4.3.2.2**.

TABLE 2-7
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF O-CO-NEE POND FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Pore Water Sampling	Water	6	6	BWPW-01	1.67'	BWPW-01	■	■										
				BWPW-02	1.67'	BWPW-02	■	■										
				BWPW-03	1.67'	BWPW-03	■	■										
				BWPW-04	1.67'	BWPW-04	■	■										
				BWPW-05	1.67'	BWPW-05	■	■										
				BWPW-06	1.67'	BWPW-06	■	■										
Surface Water Sampling	Water	12	11	BWSW-01	bottom+12"	BWSW-01(B+12)	■	■										
					bottom	BWSW-01(B)	■	■										
				BWSW-02	bottom+12"	BWSW-02(B+12)	■	■										
					bottom	BWSW-02(B)	■	■										
				BWSW-03	bottom+12"	BWSW-03(B+12)	■	■										
					bottom	BWSW-03(B)	■	■										
				BWSW-04	bottom+12"	BWSW-04(B+12)	■	■										
					bottom	BWSW-04(B)	■	■										
				BWSW-05	bottom+12"	BWSW-05(B+12)	■	■										
					bottom	BWSW-05(B)	■	■										
				BWSW-06	bottom	BWSW-06(B)	■	■										
Surface Water Sediment Sampling	Soil	12	12	BWSD-01	0-6"	BWSD-01(0-6)	■	■									■	
					6-12"	BWSD-01(6-12)	■	■									■	
				BWSD-02	0-6"	BWSD-02(0-6)	■	■									■	
					6-12"	BWSD-02(6-12)	■	■									■	
				BWSD-03	0-6"	BWSD-03(0-6)	■	■									■	
					6-12"	BWSD-03(6-12)	■	■									■	
				BWSD-04	0-6"	BWSD-04(0-6)	■	■									■	
					6-12"	BWSD-04(6-12)	■	■									■	
				BWSD-05	0-6"	BWSD-05(0-6)	■	■									■	
					6-12"	BWSD-05(6-12)	■	■									■	
				BWSD-06	0-6"	BWSD-06(0-6)	■	■									■	
					6-12"	BWSD-06(6-12)	■	■									■	

Notes:
TPH: Total petroleum hydrocarbons
TOC : Total organic carbon.

Surface Water and Sediment Sampling

Eleven surface water samples and twelve sediment samples were collected at the pore water locations at O-Co-Nee Pond. At each location, two surface water samples were collected; one at a depth of 12 inches above the pond bottom and one at the sediment/water interface immediately above the pond bottom. Similarly, two sediment samples were collected at each pore water sample location; one at a depth of 0 to 6 inches below the pond bottom and one at 6 to 12 inches below the pond bottom. Surface water samples were collected by slowly immersing the laboratory supplied sample containers into the surface water body being careful not to disturb the surface water sediment. Water quality parameters including pH, specific conductance, turbidity, dissolved oxygen, temperature and salinity were measured in the field utilizing a calibrated Horiba U-10 multiple parameter instrument. All samples were collected during dry conditions (i.e., no precipitation within the prior 3 days) in order to sample surface water at or near base flow conditions and to minimize any possible influence of storm water runoff on the chemical quality of the surface water. The results are discussed in **Sections 4.3.2.3** and **4.3.2.4**.

2.4.3 Watchogue Creek/Crum's Brook Investigation

Table 2-8 summarizes all the investigation activities completed during the Watchogue Creek Supplemental Investigation. All sample locations are shown on **Figure 2-1**.

Subsurface Soil

Seventeen soil borings were installed within the former cesspool area and adjacent locations. Originally, six soil borings in the former Cesspool and two soil borings in the former pond area were proposed for the supplemental field program. However, additional borings were required to delineate the vertical and areal extent of the BTEX/PAHs and any MGP-related impacts based on field observations. Using the direct push (Geoprobe) method, continuous soil samples were collected from ground surface to the top of the Magothy unit. The soil samples were characterized noting any presence of staining, visible tar or NAPL and hydrocarbon-like odors. Samples exhibiting any visible staining and/or NAPL and hydrocarbon-like odors were

TABLE 2-8
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF WATCHOGUE CREEK/CRUM'S BROOK FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Surface Soil Sampling	Soil	0	1	WC-SOP*	6"	WC-SOP	■	■	■						■			
Subsurface Soil Borings	--	8	17	WCSB-37	75'	WCSB-37(8-10)	■	■										
Subsurface Soil Boring Samples	Soil	32	66			WCSB-37(21-23)	■	■										
						WCSB-37(45-47)	■	■										
						WCSB-37(73-75)	■	■										
				WCSB-38	76'	WCSB-38(4-6)	■	■										
						WCSB-38(13-15)	■	■										
						WCSB-38(48-50)	■	■										
						WCSB-38(72-74)	■	■										
				WCSB-39	76'	WCSB-39(8-10)	■	■										
						WCSB-39(26-28)	■	■										
						WCSB-39(54-56)	■	■										
						WCSB-39(72-74)	■	■										
				WCSB-40	76'	WCSB-40(8-10)	■	■										
						WCSB-40(12-14)	■	■										
						WCSB-40(50-52)	■	■										
						WCSB-40(74-76)	■	■										
				WCSB-41	76'	WCSB-41(6-8)	■	■										
						WCSB-41(12-14)	■	■										
						WCSB-41(24-26)	■	■										
						WCSB-41(70-72)	■	■										
				WCSB-42	74'	WCSB-42(8-10)	■	■										
						WCSB-42(25-27)	■	■										
						WCSB-42(56-58)	■	■										
						WCSB-42(72-74)	■	■										
				WCSB-43	66'	WCSB-43(0-2)	■	■										
						WCSB-43(16-18)	■	■										
						WCSB-43(50-52)	■	■										
						WCSB-43(64-66)	■	■										

TABLE 2-8 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF WATCHOGUE CREEK/CRUM'S BROOK FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				WCSB-44	76'	WCSB-44(0-2)	■	■										
						WCSB-44(13-15)	■	■										
						WCSB-44(48-50)	■	■										
						WCSB-44(68-70)	■	■										
				WCSB-45	74'	WCSB-45(6-8)	■	■										
						WCSB-45(20-22)	■	■										
						WCSB-45(44-45.5)	■	■										
						WCSB-45(70-72)	■	■										
				WCSB-46	52'	WCSB-46(6-8)	■	■										
						WCSB-46(20-22)	■	■										
						WCSB-46(48-50)	■	■										
				WCSB-47	74'	WCSB-47(10-12)	■	■										
						WCSB-47(22-24)	■	■										
						WCSB-47(50-52)	■	■										
						WCSB-47(68-70)	■	■										
				WCSB-48	76'	WCSB-48(6-8)	■	■										
						WCSB-48(20-22)	■	■							■			
						WCSB-48(26-28)	■	■							■			
						WCSB-48(62-64)	■	■										
						WCSB-48(70-72)	■	■										
				WCSB-49	56'	WCSB-49(4-6)	■	■										
						WCSB-49(8-10)	■	■							■			
						WCSB-49(48-50)	■	■										
				WCSB-50	52'	WCSB-50(8-10)	■	■										
						WCSB-50(20-22)	■	■										
						WCSB-50(50-52)	■	■										
				WCSB-51	52'	WCSB-51(10-12)	■	■										
						WCSB-51(30-32)	■	■										
						WCSB-51(48-50)	■	■										

TABLE 2-8 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF WATCHOGUE CREEK/CRUM'S BROOK FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				WCSB-52	72'	WCSB-52(8-10)	■	■										
						WCSB-52(10-12)	■	■										
						WCSB-52(28-30)	■	■										
						WCSB-52(48-50)	■	■										
						WCSB-52(70-72)	■	■										
				WCSB-53	75'	WCSB-53(5-7)	■	■										
						WCSB-53(25-27)	■	■										
						WCSB-53(45-47)	■	■										
						WCSB-53(70-72)	■	■										
Groundwater Probes	--	5	7	WCGP-09D	69'	WCGP-09D(2-6)	■	■										
Groundwater Probe Samples	Groundwater	21	37			WCGP-09D(12-16)	■	■										
						WCGP-09D(26-30)	■	■										
						WCGP-09D(36-40)	■	■										
						WCGP-09D(48-52)	■	■										
						WCGP-09D(65-69)	■	■										
				WCGP-10D	75'	WCGP-10D(5-9)	■	■										
						WCGP-10D(36-40)	■	■										
						WCGP-10D(52-56)	■	■										
						WCGP-10D(71-75)	■	■										
				WCGP-14	76'	WCGP-14(4.5-8.5)	■	■										
						WCGP-14(18-22)	■	■										
						WCGP-14(30-34)	■	■										
						WCGP-14(56-60)	■	■										
						WCGP-14(72-76)	■	■										
				WCGP-15	74'	WCGP-15(4-8)	■	■										
						WCGP-15(18-22)	■	■										
						WCGP-15(30-34)	■	■										
						WCGP-15(56-60)	■	■										
						WCGP-15(70-74)	■	■										

TABLE 2-8 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF WATCHOGUE CREEK/CRUM'S BROOK FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint/ TPH	Full TCL/TAL	TOC	Geotechnical Analysis
Groundwater Probe Samples (cont.)				WCGP-16	69'	WCGP-16(2-6)	■	■										
						WCGP-16(12-16)	■	■										
						WCGP-16(26-30)	■	■										
						WCGP-16(36-40)	■	■										
						WCGP-16(48-52)	■	■										
						WCGP-16(65-69)	■	■										
				WCGP-17	71'	WCGP-17(4-8)	■	■										
						WCGP-17(8-12)	■	■										
						WCGP-17(18-22)	■	■										
						WCGP-17(28-32)	■	■										
						WCGP-17(42-46)	■	■										
						WCGP-17(67-71)	■	■										
				WCGP-18	71'	WCGP-18(4-8)	■	■										
						WCGP-18(8-12)	■	■										
						WCGP-18(18-22)	■	■										
						WCGP-18(28-32)	■	■										
						WCGP-18(67-71)	■	■										
Groundwater Monitoring Well Sampling	Groundwater	6	6	WCMW-01S	12'	WCMW-01S	■	■										
				WCMW-01I	45'	WCMW-01I	■	■										
				WCMW-01D	74'	WCMW-01D	■	■										
				WCMW-02S	13'	WCMW-02S	■	■										
				WCMW-02I	44.5'	WCMW-02I	■	■										
				WCMW-02D	72'	WCMW-02D	■	■										

Notes:
*: Former Standard Oil Property
-- : Not applicable.
TPH: Total petroleum hydrocarbons
TOC : Total organic carbon.

submitted to the laboratory for analysis. The soil boring logs are included in **Appendix A** and results are discussed in **Section 4.3.3.2**.

Groundwater Probes

A total of seven groundwater probes were completed within the Watchogue Creek/Crum's Brook area as part of the supplemental field program. The groundwater probes were advanced to a depth ranging from 69 to 76 feet below ground surface, representing the top of the low permeability unit referred to as the Magothy formation. After reaching the targeted depth, between four and seven samples were collected at each probe location starting with the deepest sample first and then "pulling back" the sampler to the next depth until reaching the shallowest sample, typically at the groundwater table. The sample intervals were based on both field observations in soil borings and the current understanding of BTEX/PAHs trends at the Watchogue Creek/Crum's Brook area.

Monitoring Wells

Two monitoring well clusters, WCMW-01S,I,D and WCMW-02S,I,D, were installed in the Watchogue Creek/Crum's Brook area to monitor groundwater at and downgradient of the former pond area as part of the supplemental field program. The monitoring wells were sampled for BTEX/PAHs and the results are discussed in **Section 4.3.3.3**.

2.4.4 Private Well and Basement Survey

As part of the supplemental field program, a private well and basement survey was conducted. The purpose of the survey was to identify any residences and/or businesses in the study area that might be utilizing private wells, the extent to which groundwater may be infiltrating the basements of these structures along with a request for other pertinent information necessary to meet the objectives of the survey. As part of initiating the program, a total of 289 questionnaires were mailed out to property owners/occupants within the survey area. The survey area was defined to include all residents and businesses located within downgradient areas associated with the Bay Shore site. The findings of the Private Well and Basement Survey are discussed in the Final Qualitative Exposure Assessment presented in **Appendix F**.

2.4.5 Air Sampling

Forty-one indoor and ambient (outdoor) air samples were collected from nine private properties. One-hour composite samples were typically collected inside with at least one outdoor composite ambient air sample collected during each day that indoor air sampling was conducted. All samples were analyzed for volatile organic compounds (VOCs) and naphthalene. **Table 2-9** summarizes the air sampling activities conducted during the supplemental field program. Note that an additional 26 samples were collected during the initial field program. The analytical results associated with all air samples collected during both field programs are presented and discussed in **Section 4.3.4.1**.

2.4.6 Private Groundwater Well Sampling

The completed private well and basement survey (**Section 2.4.4**) identified two private wells located downgradient of the former MGP site. One well was identified as being actively used for irrigation purposes. A sample was collected from this well at the pump discharge line after letting the pump run for approximately 10 minutes. The second well was identified as being inactive without an operable pump. As a result, an attempt was made to collect a representative groundwater sample from this well using a peristaltic pump. However, due to the poor recharge of the well, a sufficient volume of sample could not be collected. On a second attempt, a sample was successfully collected from this well using a disposable hand bailer. All samples were analyzed for VOCs/SVOCs. **Table 2-10** summarizes the private groundwater well sampling activities. The analytical results are presented and discussed in **Section 4.3.4.2**.

2.5 Water Level Measurements

Groundwater level measurements were recorded at available monitoring wells on four different occasions. Measurements were taken from either a notch on the inner casing or from a

TABLE 2-9
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF AMBIENT OUTDOOR AND INDOOR AIR SAMPLING ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	VOCs	Naphthalene	TOC	Geotechnical Analysis
Air Sampling	Air	--	41	Private Property #4 (2nd Round)	--	BB83A01									■	■		
						BB83A02									■	■		
				Private Property #4 (3rd Round)	--	BB83A01									■	■		
						BB83A02									■	■		
						BB83A03									■	■		
				Private Property #9	--	BB09A01									■	■		
						BB09A02									■	■		
						BB09A03									■	■		
						BB09A04									■	■		
						BB09A05									■	■		
						BB09A06									■	■		
						BB09A07									■	■		
						BB09A08									■	■		
						BB09A09									■	■		
						BB09A10									■	■		
						BB09A11									■	■		
						BB09A12									■	■		
						BB09A13									■	■		
				Private Property #10	--	BB87A01									■	■		
						BB87A02									■	■		
						BB87A03									■	■		
				Private Property #10 (2nd Round)	--	BB87A01									■	■		
						BB87A02									■	■		
						BB87A03									■	■		
				Private Property #11	--	BB79A01									■	■		
						BB79A02									■	■		
						BB79A03									■	■		
				Private Property #12	--	BB63A01									■	■		
						BB63A02									■	■		
						BB63A03									■	■		
				Private Property #13	--	BB13A01									■	■		
						BB13A02									■	■		
						BB13A03									■	■		

TABLE 2-9 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF AMBIENT OUTDOOR AND INDOOR AIR SAMPLING ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS											
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	VOCs	Naphthalene	TOC	Geotechnical Analysis
Air Sampling (cont.)				Private Property #14	--	BB14A01									■	■		
						BB14A02									■	■		
						BB14A03									■	■		
				Private Property #15	--	BB15A02									■	■		
						BB15A02 (duplicate)									■	■		
				Private Property #16	--	BB59A01									■	■		
						BB59A02									■	■		
						BB59A03									■	■		

Notes:
-- : Not applicable
TOC : Total organic carbon

TABLE 2-10
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF PRIVATE GROUNDWATER WELL SAMPLING ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS											
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	VOCs	SVOCs	TOC	Geotechnical Analysis
Private Well Sampling	Groundwater	--	2	Private Well 1	--	PW-1									■	■		
				Private Well 2	--	PW-2									■	■		

Notes:
-- : Not applicable.
TOC : Total organic carbon.

point on the northernmost side of the inner casing of each monitoring well. Groundwater level measurements were recorded utilizing a Solinist water level indicator to an accuracy of 0.01-foot. In addition, a Solinist interface meter was utilized to determine whether free-product was present in any of the wells and, if present, measure its thickness. Groundwater level data is summarized in **Table 2-11**.

2.6 Surveying and Mapping

All existing and new monitoring well locations, casing elevations, soil probes/borings, groundwater probes, surface soil sampling locations, test pit locations, air sample locations and soil vapor probe locations were surveyed by a licensed surveyor and located on a base map. Top of casing measurements for monitoring wells were utilized in determining groundwater elevations. Surveyed locations for completed sample points are shown on **Drawings 2A** and **2B** and on **Figure 2-1** provided in this section of the report.

2.7 Laboratory Analysis and Data Management

The data collected as part of and in support of the field investigations for the site and surrounding areas was managed using the GIS/Key Data Management System.

GIS/Key was utilized for the management of both geological and chemical data. Boring logs and monitoring well construction logs were entered into GIS/Key in order to establish a geological database and produce geologic cross sections across the site.

The analytical data was transmitted by the laboratory, Mitkem Corporation, in both hard copy and electronic disk deliverable (EDD) format. The EDD was submitted in a database file (dbf) format for direct import into GIS/Key. Once the data was imported into GIS/Key, reports were generated and checked against the hard copy data packages to ensure data integrity and completeness.

TABLE 2-11

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
BBMW-01S	4/29/02	20.64	7.00	13.64
	6/7/02		7.16	13.48
BBMW-01I	4/29/02	20.15	6.60	13.55
	6/7/02		6.76	13.39
BBMW-01D	4/29/02	20.17	7.00	13.17
	6/7/02		6.73	13.44
BBMW-02S	3/26/02	17.95	5.54	12.41
	6/6/02		5.49	12.46
BBMW-02I	3/26/02	18.10	5.7	12.40
	6/6/02		5.64	12.46
BBMW-02D	3/26/02	18.31	5.89	12.42
	6/6/02		5.83	12.48
BBMW-03S	3/26/02	12.39	3.82	8.57
	6/6/02		3.79	8.60
BBMW-03I	3/26/02	12.68	4.08	8.60
	6/6/02		4.07	8.61
BBMW-03D	3/26/02	12.27	3.7	8.57
	6/6/02		3.64	8.63
BBMW-04D	3/25/02	20.92	6.47	14.45
	6/7/02		5.77	15.15
	8/28/02		7.72	13.20
BBMW-05D	3/25/02	26.46	11.95	14.51
	6/6/02		11.86	14.60
	8/28/02		13.22	13.24
BBMW-05D2	3/25/02	25.35	10.27	15.08
	6/6/02		10.45	14.90
	8/28/02		11.97	13.38
BBMW-06S	3/25/02	28.34	14.04	14.30
	6/7/02		13.62	14.72
	8/28/02		15.29	13.05
BBMW-06ST	3/25/02	28.34	14.25	14.09
	6/7/02		13.70	14.64
	8/28/02		15.39	12.95
BBMW-06I	3/25/02	28.76	14.52	14.24
	6/7/02		14.08	14.68
	8/28/02		15.77	12.99
BBMW-06D	3/25/02	28.29	14.09	14.20
	6/7/02		13.65	14.64
	8/28/02		15.35	12.94
BBMW-07S	3/26/02	13.75	7.64	6.11
	6/7/02		7.22	6.53
BBMW-07I	3/26/02	13.57	7.47	6.10
	6/7/02		7.00	6.57
BBMW-07D	3/26/02	13.52	7.44	6.08
	6/7/02		6.99	6.53
BBMW-08D	3/25/02	26.52	11.28	15.24
	6/6/02		11.15	15.37
	8/28/02		12.59	13.93
BBMW-09S	6/7/02	23.15	7.09	16.06
	8/28/02		9.32	13.83

TABLE 2-11 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
BBMW-09I	6/7/02	23.19	7.19	16.00
	8/28/02		9.41	13.78
BBMW-09D	6/7/02	23.62	7.65	15.97
	8/28/02		9.82	13.80
BBMW-10S	3/25/02	26.62	11.71	14.91
	6/6/02		11.42	15.20
	8/28/02		12.99	13.63
BBMW-10I	3/25/02	26.41	11.54	14.87
	6/6/02		11.59	14.82
	8/28/02		12.81	13.60
BBMW-10D	3/25/02	26.37	11.46	14.91
	6/6/02		11.33	15.04
	8/28/02		12.74	13.63
BBMW-11D	3/25/02	25.72	10.9	14.82
	6/6/02		10.81	14.91
	8/28/02		12.17	13.55
BBMW-12S	3/25/02	25.03	10.25	14.78
	6/6/02		10.17	14.86
	8/28/02		11.51	13.52
BBMW-12I	3/25/02	25.04	10.3	14.74
	6/6/02		10.2	14.84
	8/28/02		11.55	13.49
BBMW-12D	3/25/02	25.56	10.78	14.78
	6/6/02		10.71	14.85
	8/28/02		12.04	13.52
BBMW-13D	3/25/02	24.95	10.15	14.8
	6/7/02		9.35	15.60
	8/28/02		11.42	13.53
BBMW-14S	3/25/02	26.53	11.27	15.26
	6/6/02		11.23	15.30
	8/28/02		12.58	13.95
BBMW-14I	3/25/02	27.06	11.81	15.25
	6/6/02		11.72	15.34
	8/28/02		13.11	13.95
BBMW-14I2	3/25/02	26.41	11.18	15.23
	6/6/02		11.08	15.33
	8/28/02		12.49	13.92
BBMW-14D	3/25/02	27.32	12.08	15.24
	6/6/02		11.98	15.34
	8/28/02		13.39	13.93
BBMW-15S	3/26/02	17.09	5.86	11.23
	6/6/02		5.82	11.27
BBMW-15I	3/26/02	17.12	5.8	11.32
	6/6/02		5.75	11.37
BBMW-15I2	3/26/02	16.99	5.9	11.09
	6/6/02		5.86	11.13
BBMW-15D	3/26/02	16.79	5.62	11.17
	6/6/02		5.57	11.22

TABLE 2-11 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
BBMW-17S	3/25/02	25.99	10.55	15.44
	6/6/02		10.41	15.58
	8/28/02		11.89	14.10
BBMW-17I	3/25/02	25.87	10.39	15.48
	6/6/02		10.26	15.61
	8/28/02		11.72	14.15
BBMW-18S	3/25/02	24.96	9.91	15.05
	6/6/02		9.77	15.19
	8/28/02		11.20	13.76
BBMW-18I	3/25/02	24.95	9.93	15.02
	6/6/02		9.78	15.17
	8/28/02		11.22	13.73
BBMW-18D	3/25/02	25.03	9.96	15.07
	6/6/02		9.81	15.22
	8/28/02		11.26	13.77
BBMW-19S	3/25/02	25.28	10.45	14.83
	6/6/02		10.32	14.96
	8/28/02		11.72	13.56
BBMW-19I	3/25/02	25.44	10.58	14.86
	6/6/02		10.43	15.01
	8/28/02		11.86	13.58
BBMW-19D	3/25/02	25.33	10.48	14.85
	6/6/02		10.34	14.99
	8/28/02		11.77	13.56
BBMW-20S	6/6/02	20.18	6.07	14.11
	8/28/02		7.38	12.80
BBMW-20I	6/6/02	20.21	6.11	14.10
	8/28/02		7.41	12.80
BBMW-20D	6/6/02	20.16	6.07	14.09
	8/28/02		7.37	12.79
BBMW-21S	3/25/02	26.41	12.01	14.40
	6/7/02		11.52	14.89
	8/28/02		13.28	13.13
BBMW-21I	3/25/02	26.47	12.07	14.40
	6/7/02		11.55	14.92
	8/28/02		13.33	13.14
BBMW-21D	3/25/02	26.41	12.01	14.40
	6/7/02		11.52	14.89
	8/28/02		13.27	13.14
BBMW-22S	3/25/02	24.71	10.39	14.32
	6/6/02		10.31	14.40
	8/28/02		11.64	13.07
BBMW-22I	3/25/02	24.65	10.35	14.30
	6/6/02		10.27	14.38
	8/28/02		11.59	13.06
BBMW-22D	3/25/02	24.73	10.41	14.32
	6/6/02		10.33	14.40
	8/28/02		11.66	13.07
BBMW-23S	6/6/02	20.21	6.55	13.66

TABLE 2-11 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
BBMW-23I	6/6/02	20.29	6.58	13.71
BBMW-23D	6/6/02	20.27	6.63	13.64
BBMW-23D2	6/18/02	19.68	5.81	13.87
BBMW-24S	4/26/02	19.15	7.26	11.89
	6/6/02		7.78	11.37
BBMW-24I	4/26/02	19.00	7.53	11.47
	6/6/02		7.66	11.34
BBMW-24D	4/26/02	18.77	7.35	11.42
	6/6/02		7.40	11.37
BBMW-25S	4/26/02	14.25	5.52	8.73
	6/6/02		5.47	8.78
BBMW-25I	4/26/02	14.22	5.51	8.71
	6/6/02		5.43	8.79
BBMW-25D	4/26/02	14.21	5.50	8.71
	6/6/02		5.35	8.86
BBSW-06	6/7/02	3.19	1.91	1.28
BBSW-07	6/7/02	7.93	1.75	6.18
BBSW-13	6/6/02	14.12	3.28	10.84
BBSW-14	6/7/02	16.05	3.23	12.82
WCMW-01S	6/7/02	19.31	4.29	15.02
WCMW-01I	5/17/02	19.07	4.26	14.81
	6/7/02		3.98	15.09
WCMW-01D	5/29/02	18.78	4.25	14.53
	6/7/02		3.69	15.09
WCMW-02S	6/7/02	16.20	2.38	13.82
WCMW-02I	6/7/02	16.23	2.37	13.86
WCMW-02D	6/7/02	16.11	2.23	13.88
BS-01S	4/29/02	17.08	4.05	13.03
	6/6/02		4.55	12.53
BS-02S	6/10/02	14.81	2.25	12.56
BS-02I	6/10/02	14.86	2.34	12.52
BS-02D	6/10/02	14.82	2.24	12.58
GM-02AS	6/6/02	22.18	10.46	11.72
GM-02AI	6/6/02	22.25	10.40	11.85
GM-02AD	6/6/02	22.15	10.30	11.85
GM-03S	4/26/02	16.54	6.31	10.23
	6/7/02		6.17	10.37
GM-03I	4/26/02	16.64	6.50	10.14
	6/7/02		6.26	10.38
GM-03D	4/26/02	16.72	6.45	10.27
	6/7/02		6.33	10.39
GM-05S	3/26/02	6.95	3.21	3.74
	6/7/02		2.52	4.43
GM-05I	3/26/02	7.14	3.30	3.84
	6/7/02		2.55	4.59
GM-05D[1]	3/26/02	9.35	< 0.00	9.35
	6/7/02		0.84	8.51

TABLE 2-11 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
GM-06S	3/26/02	10.72	6.63	4.09
	6/7/02		6.06	4.66
GM-06I	3/26/02	10.72	6.63	4.09
	6/7/02		5.99	4.73
GM-06D	3/26/02	10.85	6.74	4.11
	6/7/02		6.17	4.68
GM-07S	3/26/02	11.72	8.60	3.12
	6/7/02		8.12	3.60
GM-07I	3/26/02	11.69	8.53	3.16
	6/7/02		8.01	3.68
GM-07D	3/26/02	11.92	8.75	3.17
	6/7/02		8.21	3.71
GM-08S	3/26/02	4.91	3.26	1.65
	6/7/02		2.56	2.35
GM-08I	3/26/02	5.05	3.41	1.64
	6/7/02		2.71	2.34
GM-08D	3/26/02	4.91	3.29	1.62
	6/7/02		2.53	2.38
GM-09S	3/26/02	4.21	2.85	1.36
	6/7/02		1.99	2.22
GM-09I	3/26/02	4.36	3.03	1.33
	6/7/02		2.18	2.18
GM-09D	3/26/02	4.03	2.68	1.35
	6/7/02		1.85	2.18
GM-10AD	3/26/02	9.12	6.95	2.17
	6/7/02		6.21	2.91
MW-01S	8/28/02	20.72	5.70	15.02
MW-01D	8/28/02	20.53	5.82	14.71
MW-02S	6/7/02	22.62	6.38	16.24
	8/28/02		8.83	13.79
MW-02D	6/7/02	22.69	6.51	16.18
	8/28/02		8.68	14.01
MW-02DD	6/7/02	22.70	7.23	15.47
	8/28/02		9.38	13.32
MW-03	6/7/02	20.53	5.77	14.76
	8/28/02		6.12	14.41
MW-03S	3/25/02	23.88	8.87	15.01
	6/7/02		8.08	15.80
	8/28/02		10.14	13.74
MW-03D	3/25/02	23.81	8.76	15.05
	6/7/02		8.00	15.81
	8/28/02		10.04	13.77
MW-04	6/10/02	20.36	4.31	16.05
	8/28/02		6.18	14.18
MW-04S	3/25/02	20.40	5.59	14.81
	6/7/02		5.32	15.08
	8/28/02		7.23	13.17
MW-04D	3/25/02	21.14	6.66	14.48
	6/7/02		6.01	15.13
	8/28/02		7.90	13.24

TABLE 2-11 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
MW-05S[2]	3/25/02	21.03	6.50	14.53
	6/6/02	25.13	10.55	14.58
	8/28/02		11.89	13.24
MW-05D[2]	3/25/02	21.41	6.92	14.49
	6/6/02	25.45	10.86	14.59
	8/28/02		12.21	13.24
MW-07S	3/25/02	25.37	9.92	15.45
	6/6/02		9.83	15.54
	8/28/02		11.70	13.67
MW-07D	3/25/02	25.33	10.41	14.92
	6/6/02		10.31	15.02
	8/28/02		11.68	13.65
MW-08S	3/25/02	25.83	10.55	15.28
	6/6/02		10.41	15.42
	8/28/02		11.88	13.95
MW-08D	3/25/02	26.20	10.93	15.27
	6/6/02		10.78	15.42
	8/28/02		12.23	13.97
MW-09S	6/7/02	26.44	10.07	16.37
	8/28/02		11.60	14.84
MW-16S	6/7/02	23.37	6.82	16.55
	8/28/02		9.45	13.92
MW-16I	6/7/02	23.10	6.92	16.18
	8/28/02		9.14	13.96
MW-16D	6/7/02	23.10	6.88	16.22
	8/28/02		9.09	14.01
MW-16AS	3/26/02	17.36	5.86	11.50
	6/6/02		5.80	11.56
MW-29S	8/28/02	19.39	4.79	14.60
MW-29D	8/28/02	19.49	4.91	14.58
MW-34S	4/23/02	16.70	2.66	14.04
	6/6/02		2.58	14.12
MW-34I	4/23/02	16.69	2.77	13.92
	6/6/02		2.68	14.01
MW-34D	4/23/02	16.53	2.61	13.92
	6/6/02		2.51	14.02
GMP-01	3/26/02	7.22	3.61	3.61
	6/7/02		2.93	4.29
GMP-02	3/26/02	7.44	4.03	3.41
	6/7/02		3.33	4.11
GMP-04	3/26/02	4.90	2.78	2.12
	6/7/02		2.28	2.62

Notes:

[1]: Artesian well

[2]: Monitoring well converted to stick up after round of samples in late March

2.8 Data Validation/Data Usability

Analytical data packages submitted by Mitkem Corporation Inc. were validated in accordance with New York State Environmental Conservation (NYSDEC) 10/95 Analytical Services Protocol (ASP) Quality Assurance/Quality Control (QA/QC) requirements. Data validation was performed by D&B's QA/QC officer, who meets the qualifications required by NYSDEC to perform data validation.

The data packages were reviewed for transcription errors, as well as compliance with analytical methods and QA/QC requirements.

2.8.1 Sample Collection and Analysis

The field program consisted of collecting samples from various environmental media including surface soil, subsurface soil, Geoprobe groundwater and monitoring well groundwater. Sample collection was performed in accordance with the procedures set forth in the Work Plan for the Bay Shore/Brightwaters Former MGP site, dated August 1999. The water and soil samples were analyzed by Mitkem, a subcontractor to D&B, in accordance with the USEPA SW-846 methods stipulated in the work plan, as well as NYSDEC ASP QA/QC requirements. Mitkem participates in the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) for all analyses performed as part of this project. Mitkem also complies with the NYSDOH Contract Laboratory Program (CLP).

A summary of the analytical sampling program was previously presented in **Table 2-1**. The environmental samples were primarily analyzed for the following parameters:

Sample Type	Analytical Parameters
Groundwater Probes	BTEX, PAHs, geochemical parameters
Monitoring Well Groundwater	BTEX, PAHs, geochemical parameters
Soil Probe/Borings (Subsurface Soil)	BTEX, PAHs
Surface Soil	PCBs and/or PAHs, BTEX, RCRA Metals

In addition to the above analyses, some of the soil probe samples were also analyzed for petroleum fingerprints. Analytical methods and detection limits are presented in **Appendix B**.

2.8.2 Data Quality Objectives

The primary objective of this investigation was to obtain valid defensible data to be used to determine the nature, extent and sources of chemical constituents at the site, as well as the preparation of a human exposure assessment and identify, evaluate and recommend a cost effective, environmentally sound long-term remedial action plan. The data was also utilized during the remedial investigation to monitor for the health and safety of workers at the site and potential receptors off-site. This objective was achieved by designing a sampling program to encompass the entire site and surrounding area.

To ensure data quality, several types of quality control (QC) measures were implemented. QC samples were collected (field blanks, spikes and duplicates) at a rate of 1 per 20 environmental samples. Trip blanks accompanied all shipments of water samples that required volatile organic or BTEX analysis. All samples for organic analyses were spiked with surrogate and/or internal standard compounds in order to determine the integrity/reliability of the sample results.

To determine the comparability of the sample results, matrix spikes and matrix spike duplicates were analyzed for the organic parameters and spikes and duplicates were run for inorganic parameters. In addition, the analytical methods also require that specific laboratory QA/QC measures be taken during analysis (i.e., calibrations, blanks, control samples, spiked blanks, etc.).

2.8.3 Data Quality and Usability

In order to determine the quality and usability of the sample results, the data packages, submitted by the laboratories, were validated. Data validation was performed in accordance with

NYSDEC 10/95 ASP QA/QC requirements. A validation report/summary sheet was prepared for each sample delivery group (SDG) or data package. Copies of the reports are maintained in the project files.

Twenty percent of the environmental samples results, as well as all QA/QC results, were reviewed to yield a "20% validation" as required by the work plan.

Overall, the quality of the data was good and the results were determined to be usable for environmental assessment purposes. The findings of the validation process are summarized below.

General Findings

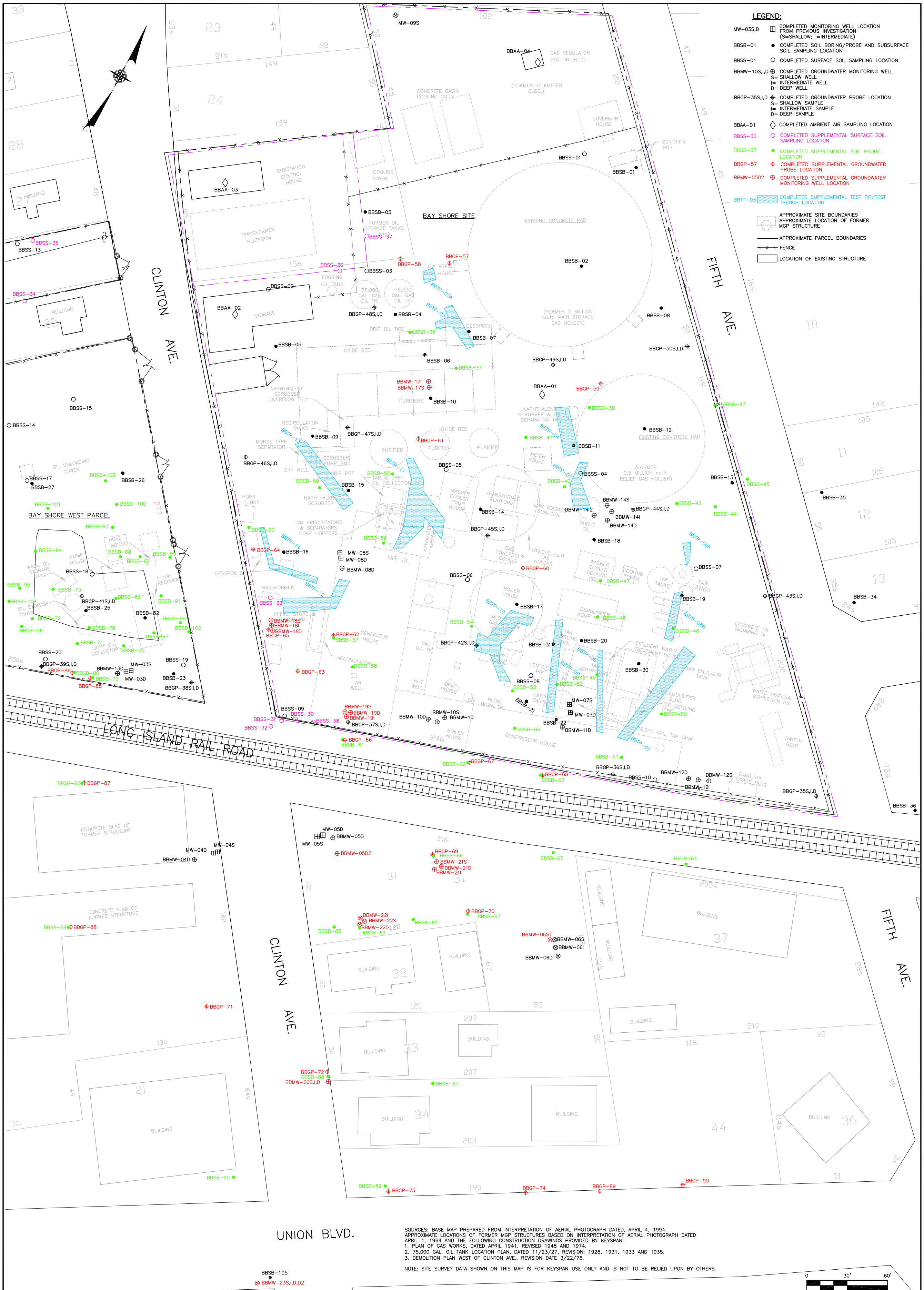
Sample analyses were performed within the NYSDEC 10/95 ASP specified holding times. All calibrations were run in accordance with the specified methods.

Several samples had surrogate recoveries outside QC limits. The samples were reanalyzed, as required by the NYSDEC ASP. The data summary tables contain the "best set" of data that were deemed to be most contractually compliant.

BTEX and PAH compound concentrations were calculated using the response factors from the initial calibrations which is acceptable with USEPA SW-846 methodologies.

Several samples required analysis and/or reanalysis due to compound concentrations exceeding the instrument calibration range. The best set of results have been included in the data summary table.

No other problems were identified. All results have been deemed valid and usable for environmental assessment, as qualified above.

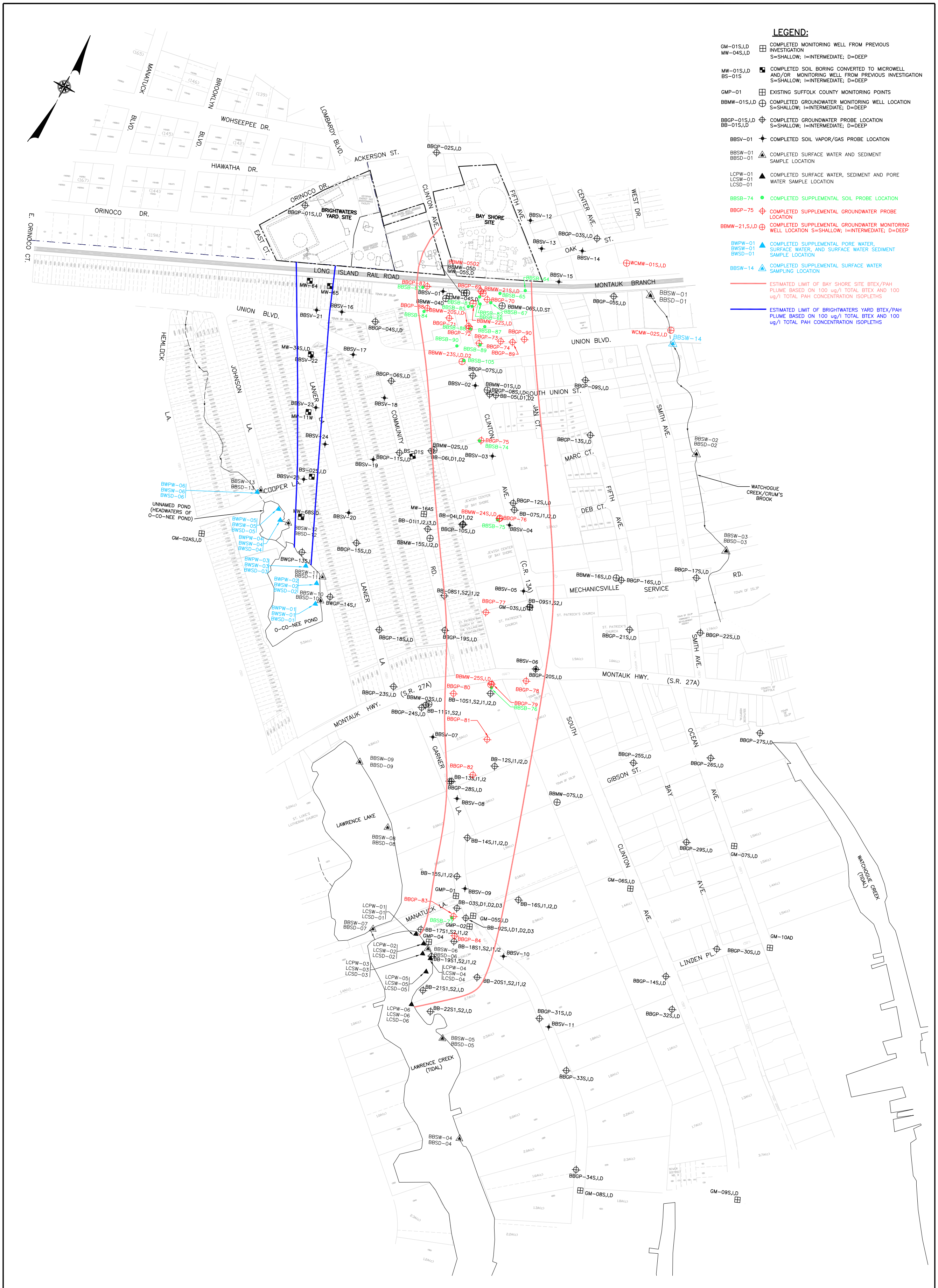


SOURCES: BASE MAP PREPARED FROM INTERPRETATION OF AERIAL PHOTOGRAPH DATED, APRIL 4, 1994. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON INTERPRETATION OF AERIAL PHOTOGRAPH DATED APRIL 1, 1964 AND THE FOLLOWING CONSTRUCTION DRAWINGS PROVIDED BY KEYSPAN:

1. PLAN OF GAS WORKS, DATED APRIL 1941, REVISED 1948 AND 1974.
2. 75,000 GAL. OIL TANK LOCATION PLAN, DATED 11/23/27, REVISION: 1928, 1931, 1933 AND 1935.
3. DEMOLITION PLAN WEST OF CLINTON AVE., REVISION DATE 3/22/76.

NOTE: SITE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS.

DVIRKA AND BARTILUCCI CONSULTING ENGINEERS A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.	BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION BAY SHORE, NEW YORK	BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS SAMPLE LOCATION MAP	PROJECT NO. 1620-B; DATE: JANUARY 2003; SCALE: AS SHOWN; DRAWING NO. 2A



SOURCE: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.
NOTE: SITE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS

DVIRKA AND BARTILUCCI CONSULTING ENGINEERS A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.	BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION BAY SHORE, NEW YORK	OFF-SITE SAMPLE LOCATION MAP	1620-B DATE: JANUARY 2003 SCALE: AS SHOWN	DRAWING NO. 2B

3.0 SITE GEOLOGY AND HYDROGEOLOGY

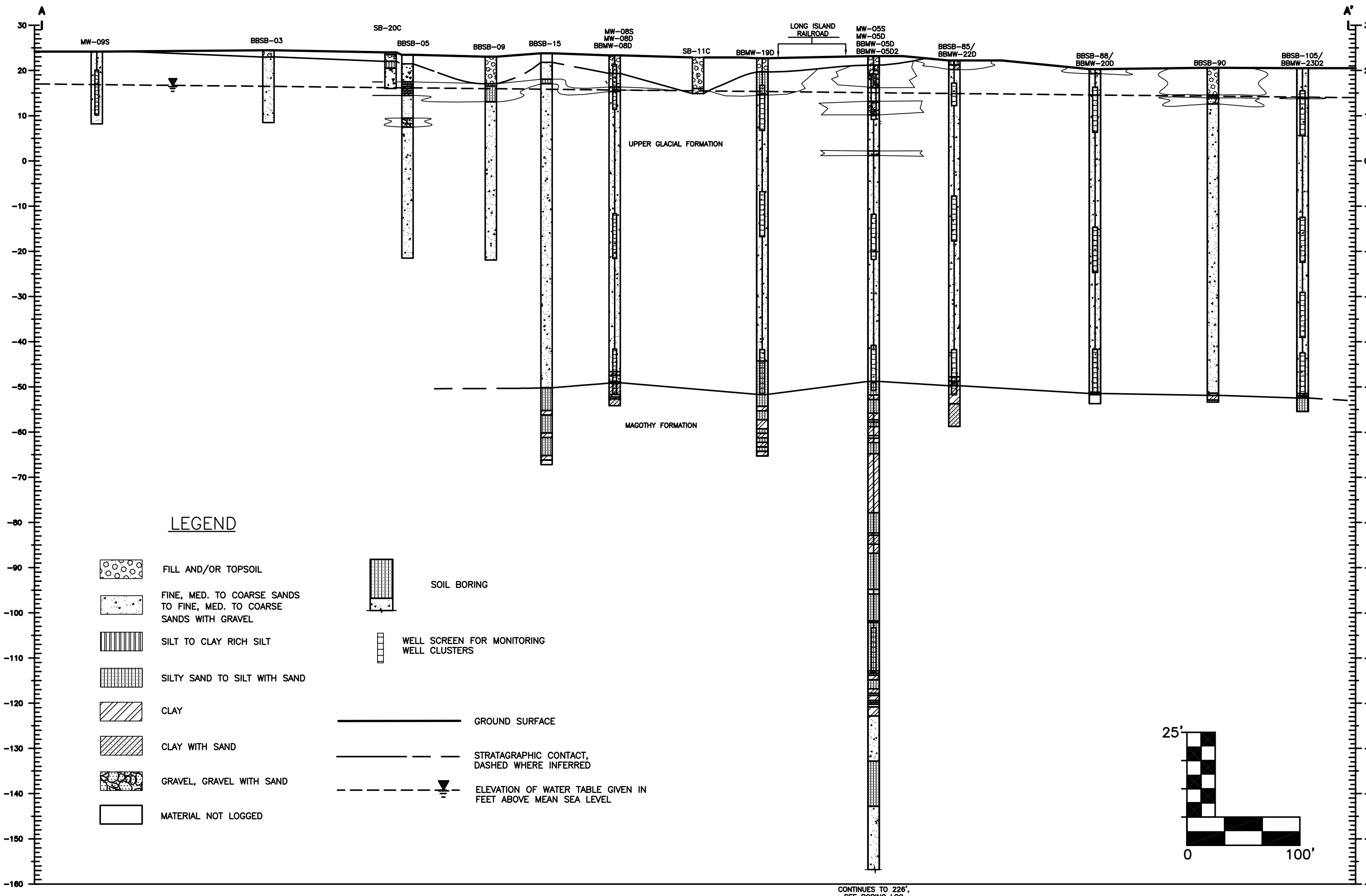
3.1 Introduction

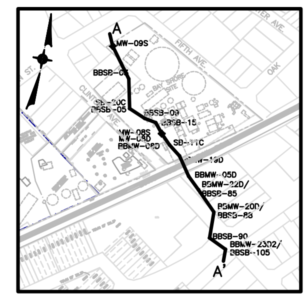
The following section presents the findings as well as a discussion and interpretation of the hydrogeologic data collected as part of the initial field program completed in the Fall of 2000 and the supplemental field program completed in the Summer of 2002. However, the discussion presented in this section focuses particularly on those aspects of site hydrogeology that have been clarified based on the supplemental field program. Data generated as part of the initial and supplemental field programs and utilized in this evaluation include the following:

- Logs from completed borings and monitoring wells;
- Geotechnical analysis of selected soil samples;
- Available boring logs from private and public wells located within or near the study area;
- Hydraulic head measurements from existing and newly installed monitoring wells; and
- Surface water level measurements from stream gauging stations installed at surface water bodies within the study area.

This data was evaluated and interpreted in conjunction with the characterization of the hydrogeology of the study area, as presented in the April 2002 RI Report.

Based on the information described above, five geologic cross sections of the Bay Shore site, including immediately adjacent and downgradient areas, were generated. The cross sections are provided as **Figures 3-1** through **3-5**. In addition three geologic cross sections of the Watchogue Creek/Crum's Brook area were generated and are provided as **Figures 3-6** and **3-7**. **Figures 3-1** through **3-3** are north-south trending geologic cross sections through the Bay Shore site and the adjacent off-site area to the south extending no further than soil boring BBSB-105/BBMW-23 located on the south-west corner of the intersection of Union Boulevard and Clinton Avenue. **Figure 3-4** is a west-east trending geologic cross section that runs along





KEY MAP SHOWING CROSS-SECTION LINE

SCALE:1"=500'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
GEOLOGIC CROSS-SECTION A-A'

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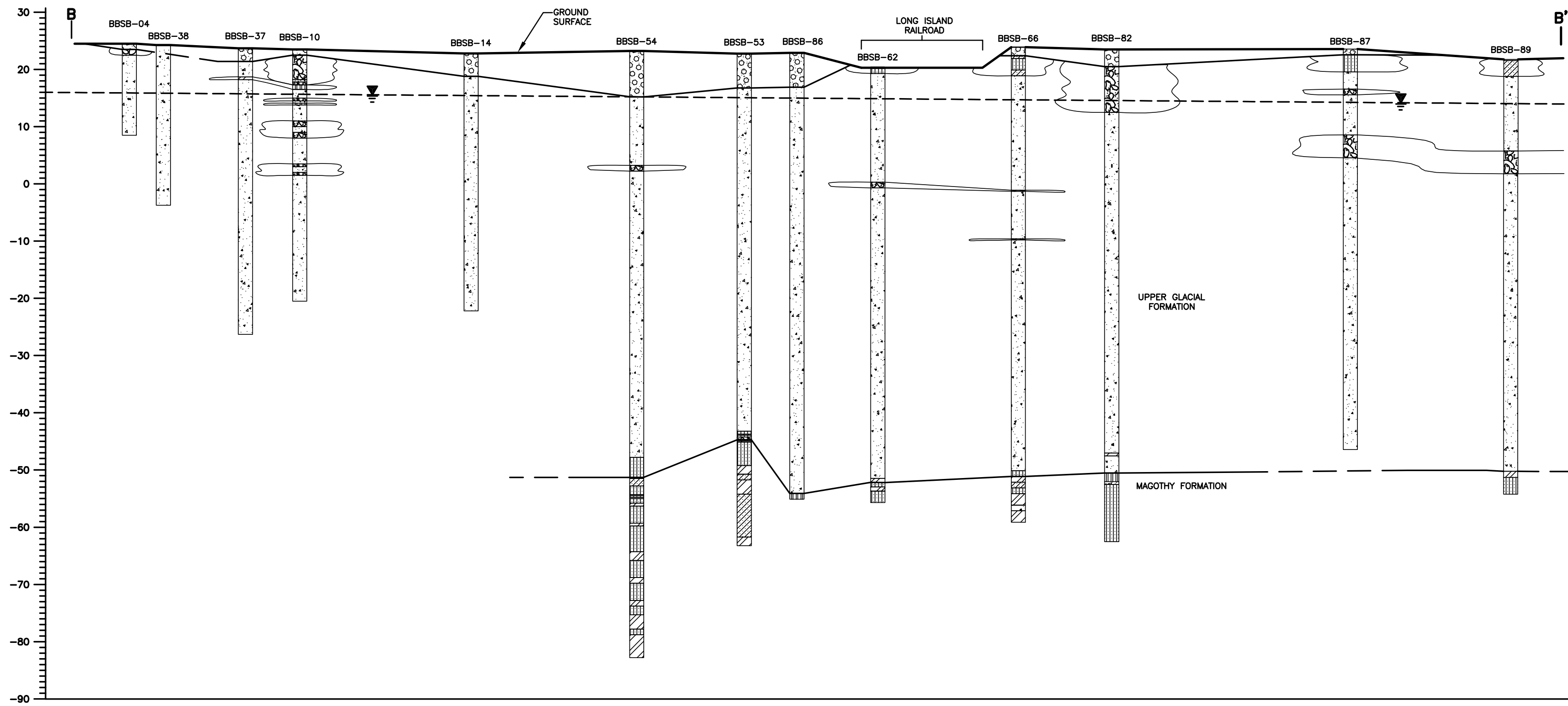
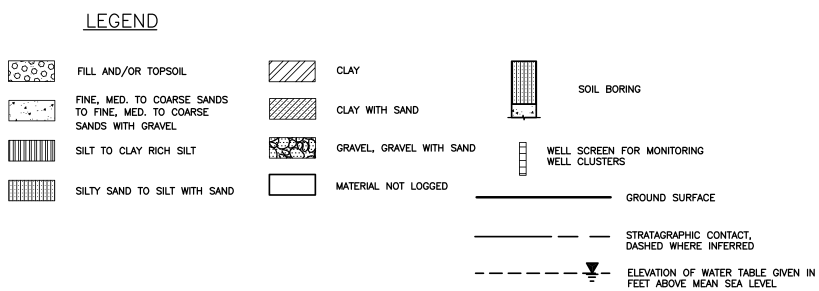
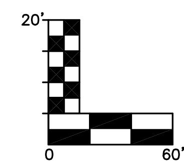
FIGURE 3-1

\\N4\CADwork\1620B12C\11X17\FIG-3A.dwg, 10/29/02 08:55:22 AM, APostyn

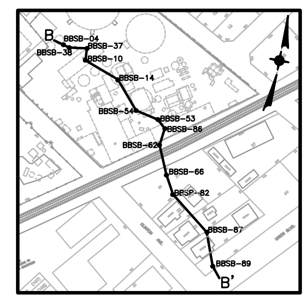






KEY MAP SHOWING CROSS-SECTION LINE

SCALE:1"=300'



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
GEOLOGIC CROSS-SECTION B-B'

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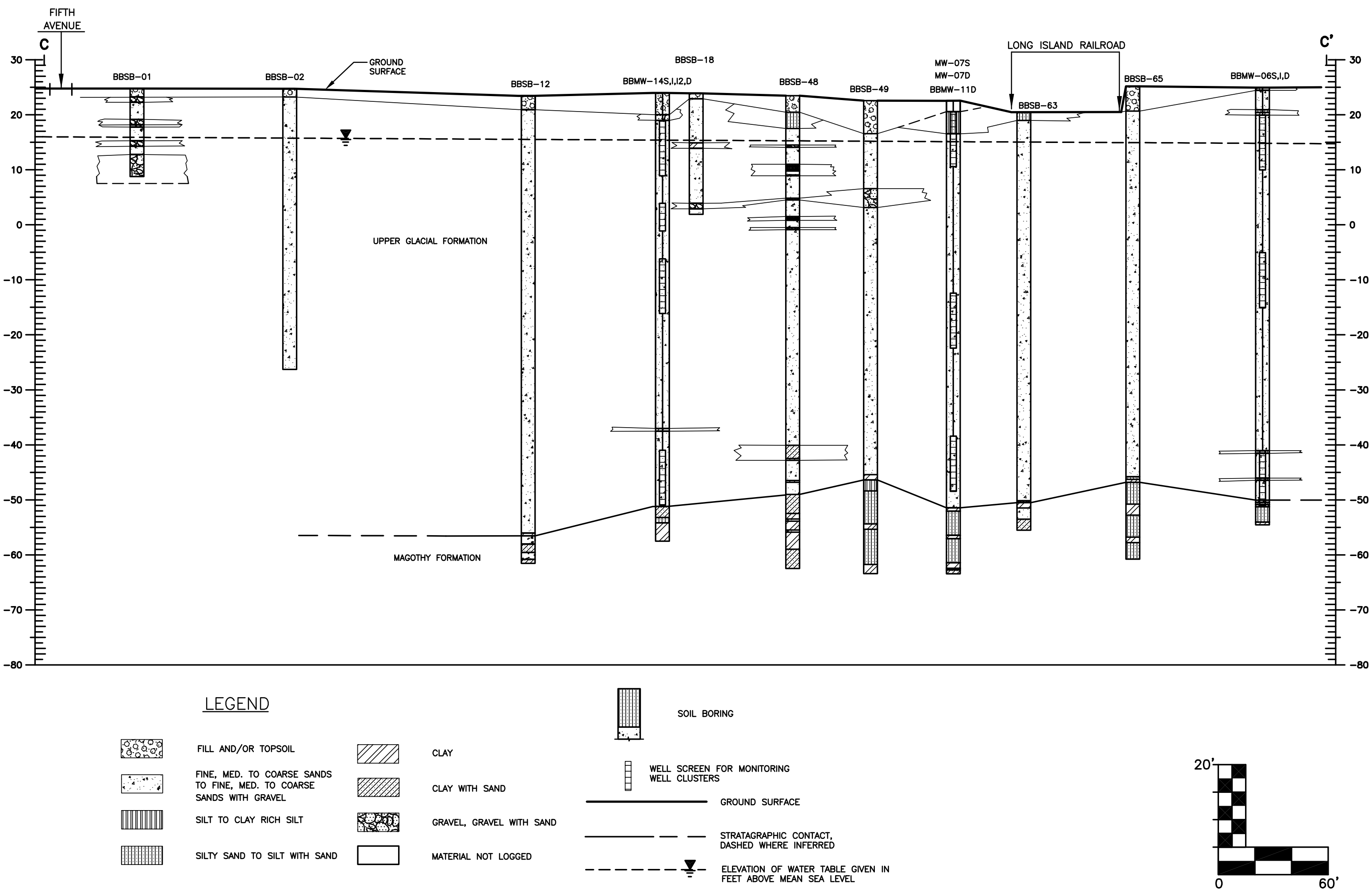
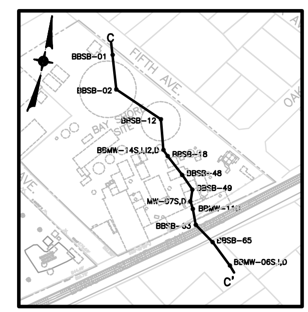
FIGURE 3-2

\\N4\CADwork\1620B12C\11X17\FIG-3B.dwg, 10/29/02 08:52:57 AM, APostyn





KEY MAP
SHOWING
CROSS-SECTION LINE
SCALE: 1"=300'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
GEOLOGIC CROSS-SECTION C-C'

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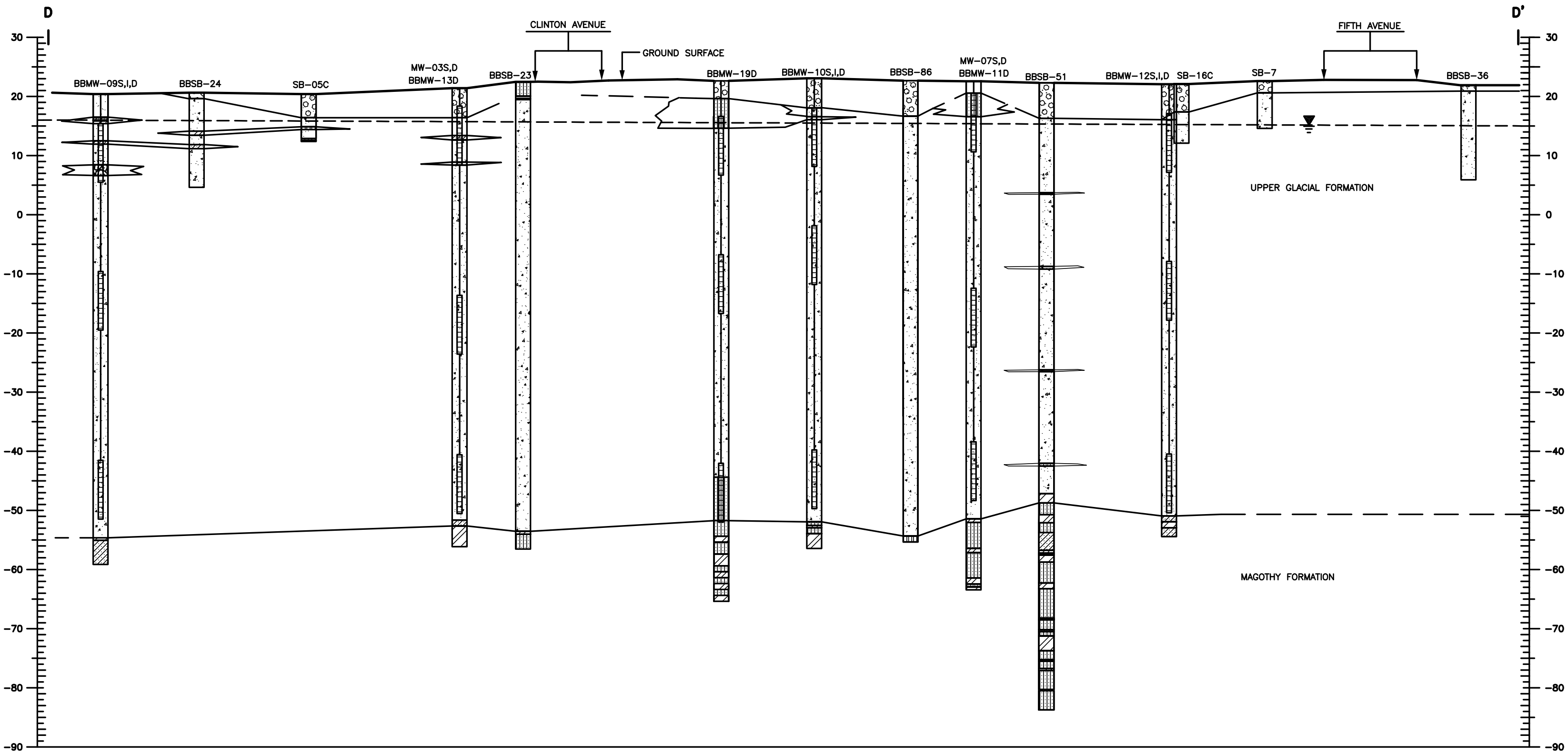
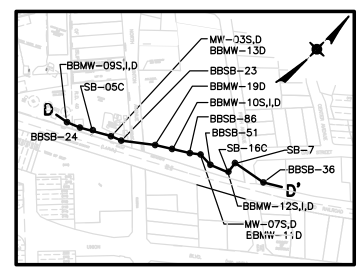
FIGURE 3-3

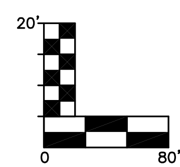
\\N4\CADwork\1620B12C\11X17\FIG-3C.dwg, 10/29/02 08:56:10 AM, APostyn



KEY MAP SHOWING CROSS-SECTION LINE

SCALE: 1"=500'





LEGEND

FILL AND/OR TOPSOIL

FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL

SILT TO CLAY RICH SILT

SILTY SAND TO SILT WITH SAND

CLAY

CLAY WITH SAND

GRAVEL, GRAVEL WITH SAND

MATERIAL NOT LOGGED

SOIL BORING

WELL SCREEN FOR MONITORING WELL CLUSTERS

GROUND SURFACE

STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED

ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

BAY SHORE SITE AND BAY SHORE WEST PARCEL
GEOLOGIC CROSS-SECTION D-D'

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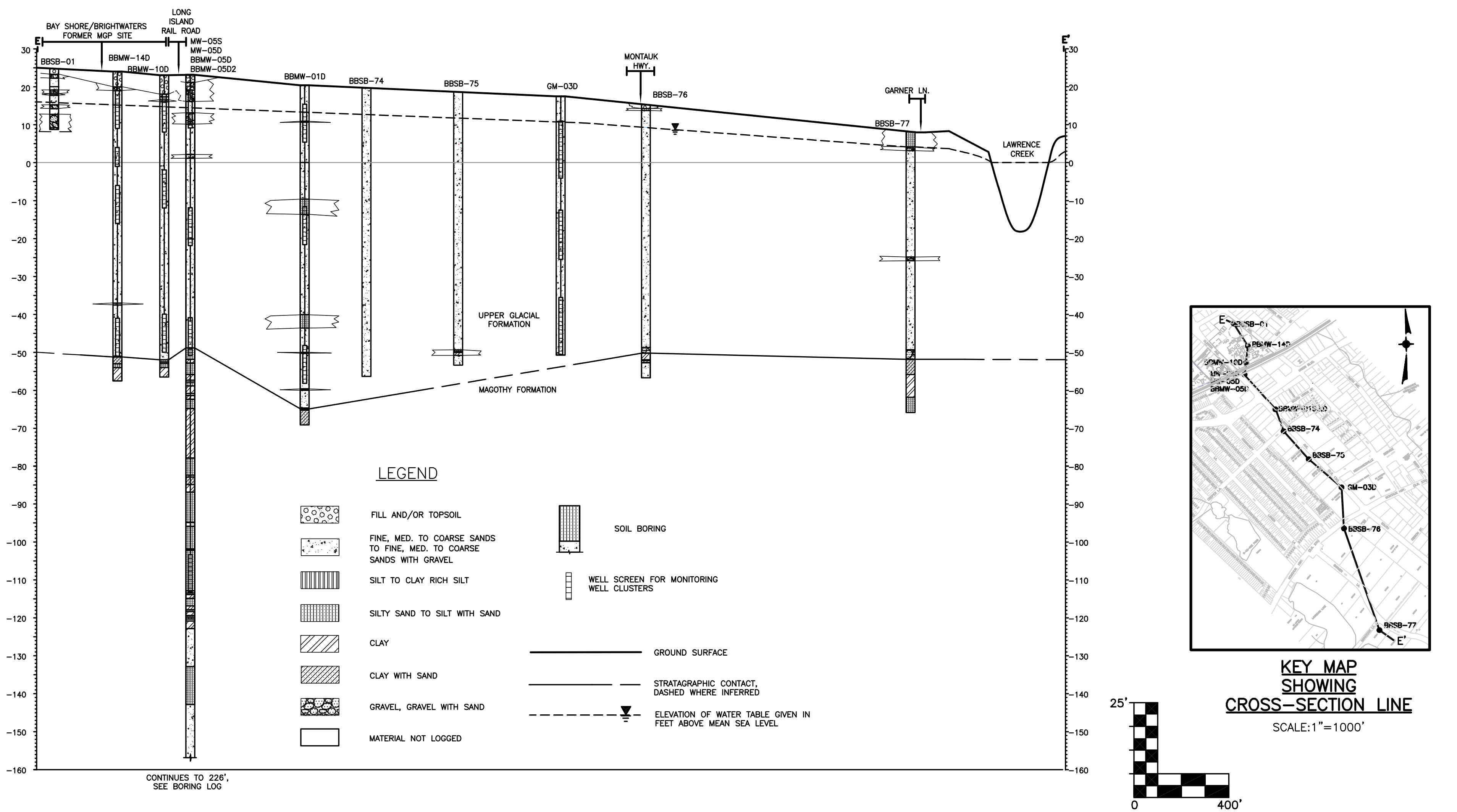
FIGURE 3-4

F:\1620B12C11X17\FIG-3D.dwg, 01/03/03 11:22:59 AM, PMartorano



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

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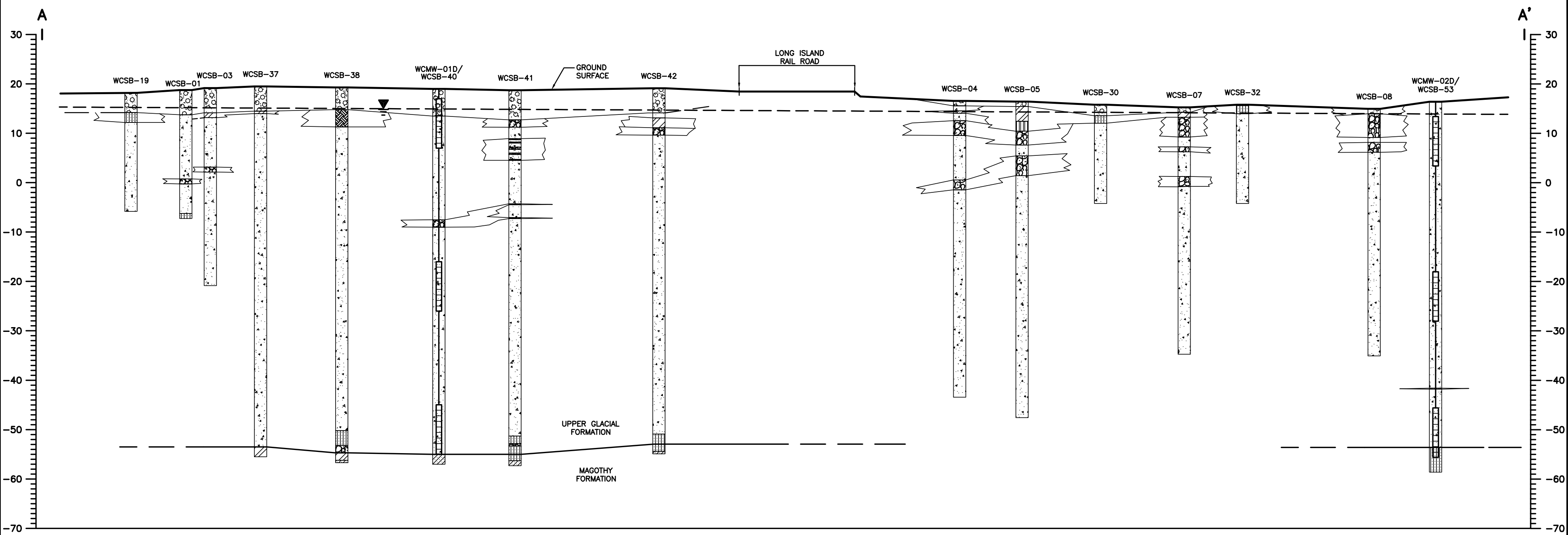
NORTH-SOUTH GEOLOGIC CROSS-SECTION E-E' FROM BAY SHORE SITE THROUGH BAY SHORE PLUME

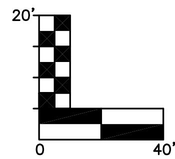
FIGURE 3-5

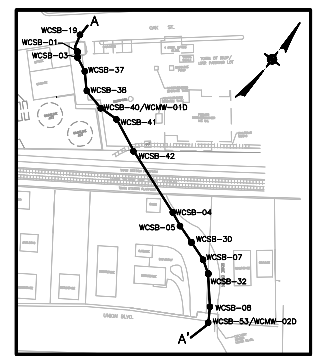
F:\1620B12C11X17\FIG-3E.dwg, 01/03/03 11:21:32 AM, PMartorano



LEGEND

	FILL AND/OR TOPSOIL
	FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
	SILT TO CLAY RICH SILT
	SILTY SAND TO SILT WITH SAND
	CLAY
	CLAY WITH SAND
	GRAVEL, GRAVEL WITH SAND
	PEAT
	MATERIAL NOT LOGGED
	SOIL BORING
	WELL SCREEN FOR MONITORING WELL CLUSTERS
	GROUND SURFACE
	STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
	ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL





KEY MAP
SHOWING CROSS-SECTION LINE
SCALE:1"=200'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

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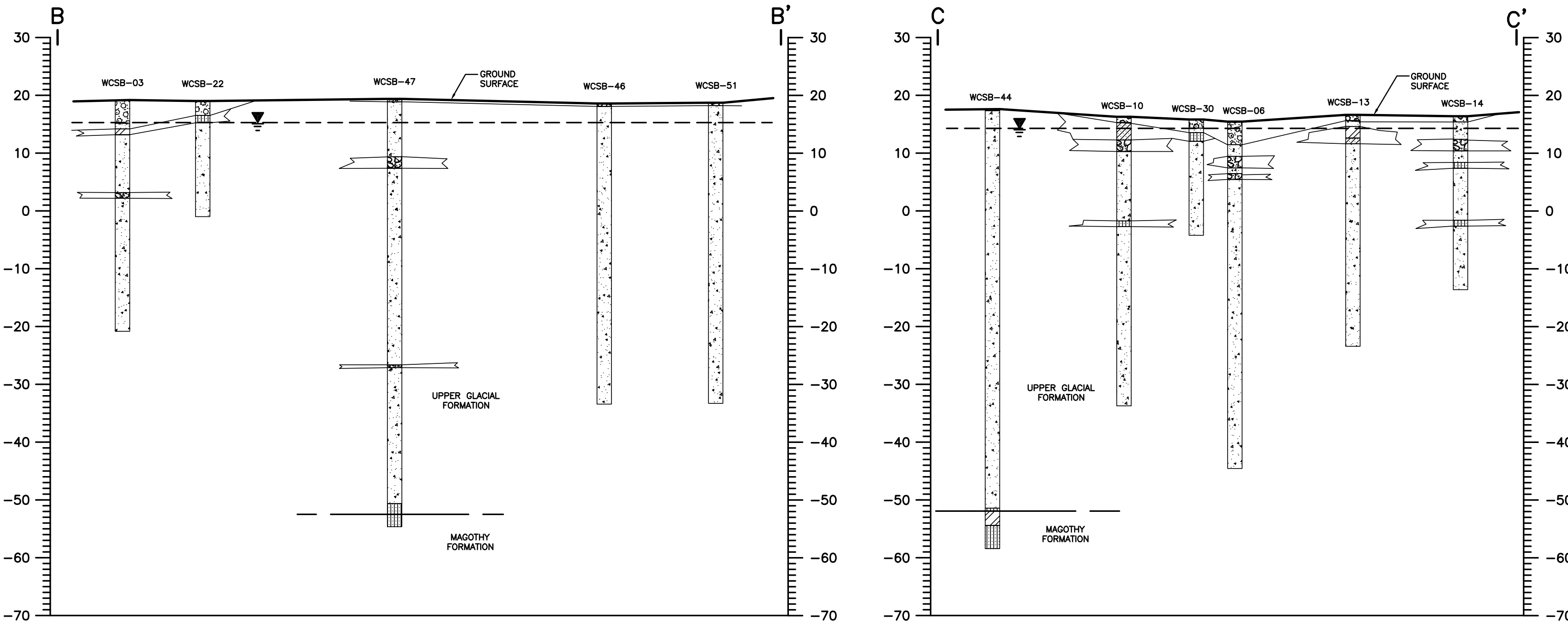
WATCHOGUE CREEK
GEOLOGIC CROSS-SECTION A-A'

FIGURE 3-6

\\NI4\CADwork\1620B12C\11X17\FIG-3F.dwg, 10/29/02 09:01:28 AM, APostyn



LEGEND

FILL AND/OR TOPSOIL

FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL

SILT TO CLAY RICH SILT

SILTY SAND TO SILT WITH SAND

CLAY

CLAY WITH SAND

GRAVEL, GRAVEL WITH SAND

MATERIAL NOT LOGGED

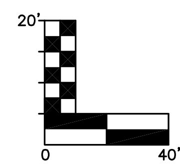
SOIL BORING

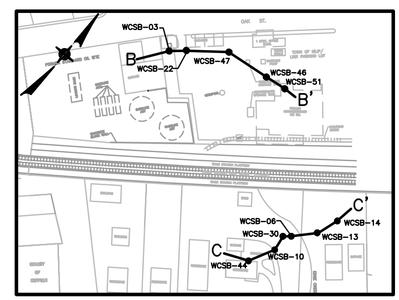
WELL SCREEN FOR MONITORING WELL CLUSTERS

GROUND SURFACE

STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED

ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL





KEY MAP
SHOWING CROSS-SECTION LINE

SCALE:1"=200'

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

WATCHOGUE CREEK
GEOLOGIC CROSS-SECTIONS B-B' AND C-C'

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FIGURE 3-7

\\N4\CADwork\1620B12C\11X17\FIG-3G.dwg, 10/29/02 09:02:43 AM, APostyn the north side of the Long Island Rail Road from monitoring well cluster BBMW-09 in the Brightwaters Yard to soil boring BBSB-36 located across Fifth Avenue from the south-east corner of the Bay Shore site. **Figure 3-5** is a north-south trending geologic cross section extending from soil boring BBSB-01 at the north end of the Bay Shore site through the length of the dissolved BTEX/PAH plume to soil boring BBSB-77, a distance of approximately 3600 feet.

Figure 3-6 is a north-south trending geologic cross section in the Watchogue Creek/Crum's Brook area, which extends south from soil boring WCSB-19 on Oak Street to soil boring WCSB-53/WCMW-02, located along Union Boulevard. **Figure 3-7** includes west-east trending geologic cross sections B-B' and C-C', which are located on the north and south sides of the Long Island Rail Road, respectively.

The locations of probes, borings and monitoring wells referenced in this section are shown on **Drawings 2A** and **2B** and on **Figure 2-1**. Boring and test pit logs from the supplemental field program are included in **Appendix A** of this report. Boring and test pit logs from the initial field program are provided in **Appendix C** of the April 2002 RI Report.

3.2 Site Stratigraphy

Consistent with the findings of the initial field program, there are four general stratigraphic units within the study area that are of importance with respect to this investigation: a fill unit, a recent silt/clay unit, glacial outwash deposits and the Magothy formation. The following is a brief description of each unit along with a presentation and discussion of any new findings from the supplemental field program. Please refer to the April 2002 RI Report for a full description of each unit and a discussion of the original findings.

Fill Material

The fill material encountered throughout the site is highly variable in character and thickness. However, it generally consists of brown to black sands and gravels with varying amounts of glass, brick, coal, ash, clinker and wood. The fill material extends throughout the southern two-thirds of the Bay Shore Site with the thickest component located along the southern most portion of the parcel as indicated by cross sections A-A', B-B' and D-D' provided on **Figures 3-1**, **3-2** and **3-4**, respectively. Fill material was encountered immediately south of the site at soil borings BBSB-65, BBSB-67 and BBSB-82, consisting of a mixture of brown sand, silt, clay and gravel with glass and coal fragments.

The fill material within the southern portion of the site contained extensive amounts of construction/demolition (C&D) material, such as brick, metal piping, concrete block and wood. Based on the nature of the C&D material, it is likely that it originated as a result of the demolition of the MGP facility which occurred in 1973. On-site test pit excavations completed during the supplemental field program determined that the locations of foundations and other subsurface structures remaining on-site are consistent with historic drawings for the MGP site.

Recent Clay/Silt Unit

The initial field program found that underlying the fill unit exists a recent-aged (post-glacial) clay-silt unit that was gray to brown to black in color and ranged from stiff to slightly plastic with varying amounts of fine sand. The unit was found primarily beneath the Brightwaters Yard where the headwaters of Lawrence Creek likely flowed prior to the site being developed. Within the Bay Shore site and Bay Shore West Parcel, the recent clay-silt unit was sporadically detected and hence, discontinuous within these portions of the study area. Therefore, the recent clay-silt unit was not considered an effective confining unit within these areas. Soil borings and test pits completed during the supplemental field program confirm the discontinuous nature of the recent clay-silt unit within the Bay Shore site and Bay Shore West Parcel. However, the unit was most commonly encountered in the southwestern portion of the Bay Shore site, such as in soil boring BBMW-18D (5' thick). In addition, evidence of the clay-silt unit was noted in test pit BBTP-12, which is also located in the southwestern portion of the site.

Glacial Outwash Deposits

Consistent with regional geology, a continuous sequence of glacial outwash sand and gravel exists throughout the site and surrounding areas. The glacial outwash deposits comprise the entire Upper Glacial aquifer. Within the site, the upper surface of the outwash deposits is located immediately below the surficial topsoil layer in areas where the fill and recent clay-silt units are absent. Where these units are present, outwash deposits are generally within 8 feet of ground surface. Within and adjacent to the site, the outwash deposits vary slightly in thickness, averaging approximately 65-70 feet. The thickness ranges from approximately 76 feet at BBSB-12 located within the east-central portion of the Bay Shore site to a minimum of 61.5 feet observed at BBSB-53 located within the south-central portion of the Bay Shore site. The glacial outwash deposits are thickest in the off-site portion of the study area with a maximum thickness of approximately 85-90 feet observed at soil boring BBMW-16D. The glacial outwash deposits rest on top of the low permeable Magothy formation, which is discussed below.

The glacial outwash deposits consist of a yellow-brown to orange colored medium to coarse quartzose sand with minor amounts of silt and gravel. The upper portions of the outwash deposits are generally well sorted and appear to have good to excellent primary porosity. The medium to coarse sands encountered throughout the site, as well as areas to the south, are typical of glacial outwash deposits which comprise the Upper Glacial aquifer within southern Suffolk County. Glacial outwash deposits within this area of Long Island exhibit excellent water transmitting properties with horizontal hydraulic conductivities ranging from 147 feet per day to 270 feet per day (USGS Water Supply Report No. 1768 and USGS Professional Paper No. 800-C).

Geotechnical data for shallow glacial outwash deposits collected during the supplemental field program presented on **Table 3-1** indicates that the grain size distribution is consistent with that found during the initial field program.

The initial field program found that the outwash deposits appear to remain fairly consistent in nature through its vertical extent, although at a number of supplemental borings,

TABLE 3-1
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR SHALLOW GLACIAL OUTWASH DEPOSITS

Sample Identification		BBSB-42	BBSB-49	BBSB-50	BBSB-56	BBSB-65	BBSB-74	BBSB-74	BBSB-75
Depth (feet)		16-18	24-26	21-23	21-23	16-18	8-10	16-18	8-10
Date		2/12/02	2/11/02	2/11/02	2/13/02	2/14/02	2/13/02	2/13/02	2/14/02
CHARACTERISTIC	UNIT								
Sieve	%	<1	<1	1	<1	1	2	3	4
Hyd (2 μ)	%	<1	N/A	<1	<1	<1	N/A	N/A	N/A
G_s	none	2.66	2.66	2.64	2.67	2.68	2.67	2.66	2.67
d_{10}	mm	0.28	0.24	0.21	0.24	0.28	0.19	0.18	0.24

NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

TABLE 3-1 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR SHALLOW GLACIAL OUTWASH DEPOSITS

Sample Identification		BBSB-76	BBSB-77	BBMW-21	AVERAGE CHARACTERISTICS OF SHALLOW GLACIAL OUTWASH DEPOSITS
Depth (feet)		8-10	8-10	33-35	
Date		2/20/02	2/21/02	2/23/02	
CHARACTERISTIC	UNIT				
Sieve	%	5	2	2	2
Hyd (2 μ)	%	2	1	1	1
G_s	none	2.66	2.68	2.63	2.66
d_{10}	mm	0.17	0.27	0.25	0.23

NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

such as BBSB-54, BBSB-57 and BBSB-65, results indicated that deeper deposits (i.e., below 60 feet bgs) contained greater amounts of fine mica particles, principally muscovite/biotite. This increased concentration of fine mica particles likely reduces the hydraulic conductivity of the deeper outwash deposits at or near the base of the glacial outwash/Magothy Formation interface.

Geotechnical data for deep glacial deposits collected during the supplemental field program is summarized on **Table 3-2**. The grain size distribution is consistent with what was found during the intial field program. The supplemental data indicates an average percentage of particles passing through the 200 sieve of 11 compared to 4.45 for the initial data. However, BBSB-75 (68-70 feet), a sample of gray clay and silt most likely representative of the top of the Magothy formation, is skewing the results. Removing this sample reduces the sieve percentage to 5, which is consistent with the results from the initial field program. Furthermore, the average d_{10} (effective grain size – the diameter at which 10% of the sample is finer and 90% coarser) is 0.12 for the supplemental samples (0.13 if BBSB-75 [68-70 feet] is removed) compared to 0.13 from the initial samples. Overall, it is clear from the supplemental geotechnical results that the deep glacial deposits are finer (average d_{10} = 0.12) than the shallow glacial deposits (average d_{10} = 0.23), possibly due to the presence of fine mica particles described above.

Magothy Formation

Based on completed deep borings within the site as well as at downgradient locations, the glacial outwash deposits are directly underlain by a fine sand, silt and clay formation varying from light gray to black in color and ranging from hard to slightly plastic in texture. This low permeability unit is described as being highly micaceous with several samples containing lignite. Analysis of several undisturbed sediment samples (Shelby tube samples) conducted as part of the initial field program confirmed the low permeable nature of the Magothy formation with an average vertical permeability of only 1.74×10^{-5} cm/second or 0.05 feet/day. Therefore, the upper portion of the Magothy formation acts as an effective confining unit limiting the vertical migration of any chemical constituents beyond the glacial outwash deposits.

TABLE 3-2
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR DEEP GLACIAL DEPOSITS

Sample Identification		BBSB-42	BBSB-49	BBSB-50	BBSB-56	BBSB-65	BBSB-74	BBSB-75	BBSB-75	BBSB-76
Depth (feet)		63-65	64-66	64-66	68-70	62-64	52-54	52-54	68-70	40-44
Date		2/13/02	2/11/02	2/11/02	2/14/02	2/14/02	2/13/02	2/14/02	2/14/02	2/20/02
CHARACTERISTIC	UNITS									
Sieve	%	5	7	3	4	7	4	5	90	1
Hyd (2 μ)	%	2	<1	1	1	2	N/A	N/A	N/A	N/A
G_s	none	2.65	2.68	2.67	2.67	2.71	2.69	2.67	2.76	2.66
d_{10}	mm	0.1	0.085	0.16	0.15	0.085	0.17	0.095	<0.0014*	0.19

NOTES:

Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

TABLE 3-2 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR DEEP GLACIAL DEPOSITS

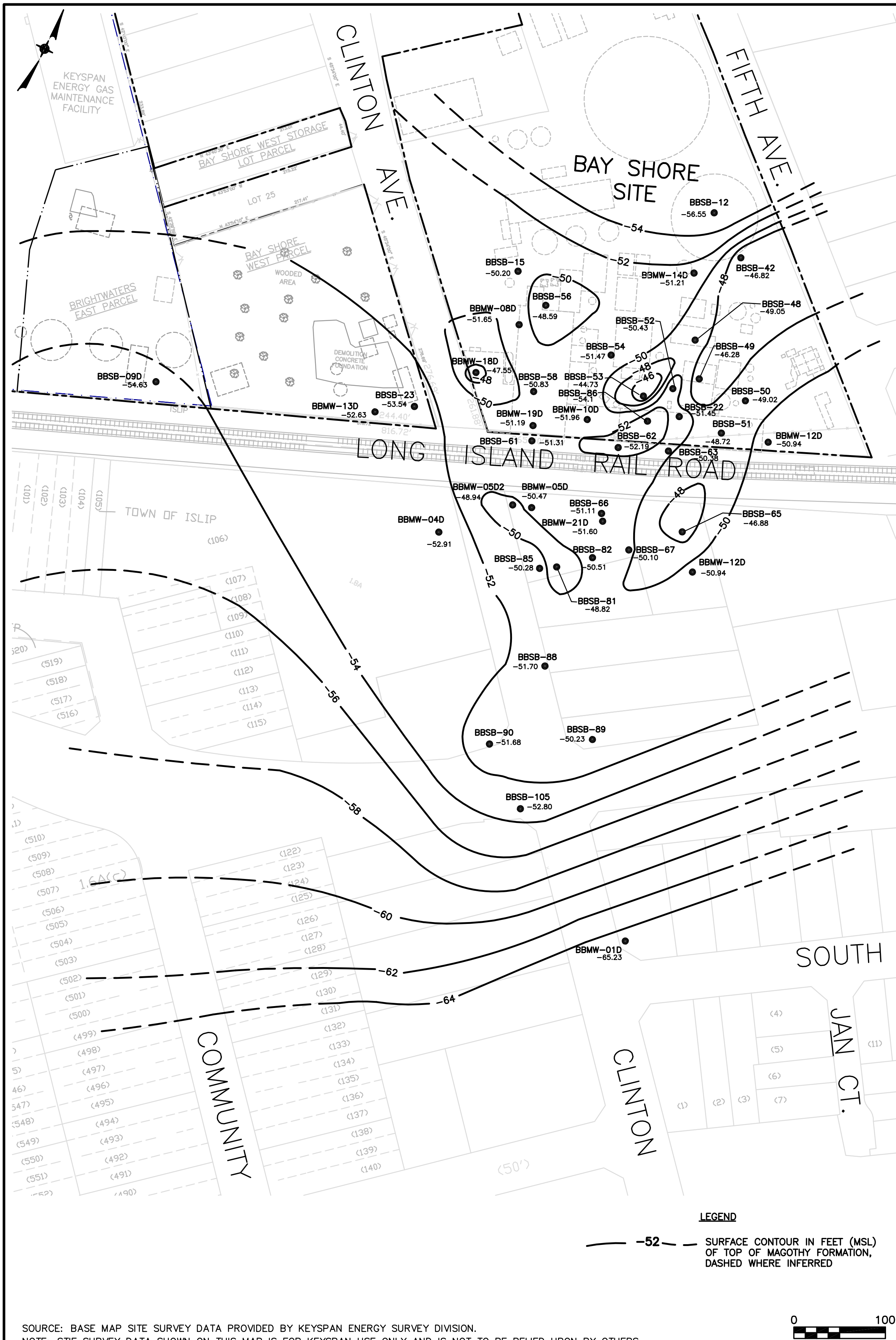
Sample Identification		BBSB-76	BBSB-77	BBSB-77	BBSB-81	BBMW-21	AVERAGE CHARACTERISTICS OF DEEP GLACIAL DEPOSITS
Depth (feet)		60-64	32-36	56-58	63-65	73-75	
Date		2/20/02	2/21/02	2/21/02	2/15/02	2/23/02	
CHARACTERISTIC	UNITS						
Sieve	%	11	1	4	3	9	11
Hyd (2 μ)	%	2	1	2	1	2	2
G_s	none	2.68	2.68	2.69	2.68	2.32	2.66
d_{10}	mm	0.07	0.17	0.15	0.16	0.1	0.12

NOTES:
Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd - % sample particles finer than 2 μ as determined through hydrometer analysis
G_s - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ - Micron
N/A - Not analyzed
* - d_{10} finer than endpoint of grain size analysis

As discussed in the April 2002 RI Report, the Magothy formation is approximately 800 to 900 feet thick within this area of Long Island. Furthermore, the Magothy formation comprises the Magothy aquifer which is the primary source of public water in Suffolk County. However, the upper portion of the Magothy formation contains extensive amounts of silt and clay and generally has poor water transmitting properties. As a result, public supply wells are screened within the mid to lower portions of the Magothy aquifer and are generally no less than 500 feet in depth.

A contour map depicting the top of the Magothy formation beneath the Bay Shore site, Bay Shore West Parcel and downgradient areas is presented as **Figure 3-8**. Due to the number of deep soil borings completed within the southern half of the Bay Shore site and adjacent off-site areas as part of the supplemental field program, data on the "topography" of the Magothy formation is much more complete for this area. On the other hand, data is more sparse in the remaining portions of the study area, including south of Union Boulevard, the northern half of the site and the Brightwaters Yard. As a result, the level of detail relative to the topography of the Magothy formation in these areas is not as complete. This distribution of data is clearly illustrated on **Figure 3-8**.

As shown on **Figure 3-8**, the Magothy formation is generally level within the southern portion of the Bay Shore south to Union Boulevard ranging from approximately –48 to –52 feet below mean sea level (msl). However, the surface of the Magothy formation appears to be shallowest in the south-central/south-eastern portion of the site as seen on **Figure 3-8** and on west-east cross section D-D' (**Figure 3-4**). Also, there appears to be a subtle trough running from the south-central/south-western portion of the Bay Shore site south/south-southeast to soil boring BBSB-105/BBMW-23 at the southwest corner of Clinton Avenue and Union Boulevard. This trough in the surface of the Magothy formation is apparent on north-south cross section A-A' south of monitoring well BBMW-08D (**Figure 3-1**), and on west-east cross section D-D' (**Figure 3-4**). This subtle trough is coincident with a zone of DNAPL identified above the Magothy formation immediately south of the Bay Shore site (refer to **Section 4.2.1.4**). It is possible that the trough is serving to facilitate the accumulation of DNAPL detected in this area.



SOURCE: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.
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BAY SHORE, NEW YORK

TOP OF MAGOTHY FORMATION

FIGURE 3-8

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Another prominent feature in the Magothy formation is an apparent mound in the south-central portion of the site identified at soil borings BBSB-53 (-44.73 feet msl) and BBSB-49 (-46.28 feet msl). Furthermore, there appears to be a second trough in the surface of the Magothy formation towards the northeast portion of the site (BBSB-12 at –56.55 feet msl). However, information on the Magothy formation is limited to the data gathered at this one boring in this area of the site.

Off-site to the south, the general trend from the southern portion of the site towards the south/south-southeast is a gradual slope to the south followed by a steeper slope towards BBMW-01D (-65.23 feet msl) into an apparent erosional valley, first identified in the April 2002 RI Report. This trend is identifiable on cross section E-E' (**Figure 3-5)**.

Due to the importance of the low permeability zone at the top of the Magothy formation, a deep boring, BBMW-05D2, was completed in order to determine the thickness of the zone. Soil characterization from this deep boring is graphically depicted in cross sections on **Figures 3-1** and **3-5**, and **Drawings 4A** and **4D**. The low permeable clays and silts at the top of the Magothy formation were estimated to be approximately 74 feet thick (from 72 to 146 feet bgs) followed by an 80-foot thick zone of medium-coarse sand (from 146 to 226 feet bgs, the base of the boring). This sand zone was found to contain some silt from 156 to 166 feet and some clay and silt near the base of the recovered material at approximately 214 feet bgs.

3.3 Groundwater Flow and Hydraulic Gradients

Based on depth to water measurements collected during June 2002 (see **Table 2-11**), groundwater at the Bay Shore Site is approximately 6 to 8 feet below grade. Downgradient of the Bay Shore Site, depth to groundwater is variable due to changes in ground surface elevation but gradually decreases with the shallowest measurements collected from monitoring wells located along Garner Lane, approximately 2,000 feet south of the site.

Based on water level measurements recorded at monitoring wells on August 28, 2002, an on-site water table contour map was developed and is presented as **Figure 3-9**. Based on water

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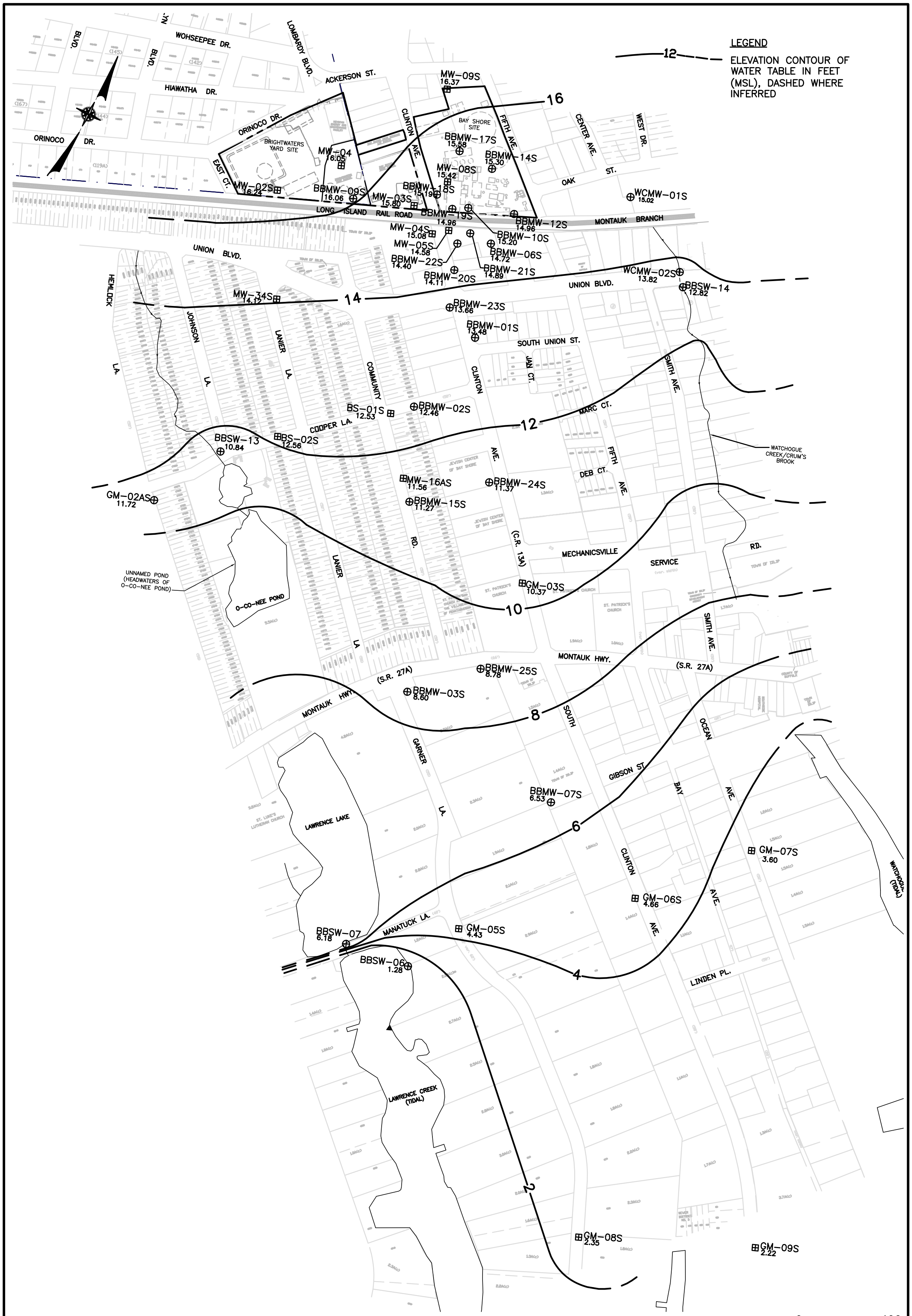
ON-SITE WATER TABLE CONTOUR MAP

AUGUST 28, 2002

FIGURE 3-9

F:\1620B12B\dwg\1620-ONSITE.dwg, 01/03/03 11:14:49 AM, PMartorano level measurements recorded at monitoring wells from June 6-10, 2002, an off-site water table contour map (**Figure 3-10**) and an off-site potentiometric surface map of the deep Upper Glacial aquifer (**Figure 3-11**) were developed.

As shown on **Figure 3-9**, on-site groundwater generally flows in a south to southeast direction throughout the site. Several of the minor localized anomalies detected in on-site groundwater flow during the initial field program are not apparent in the more recent round of water level measurements. However, groundwater appears to flow in a more southerly direction within the western portion of the Brightwaters Yard. Consistent with the findings of the initial field program, **Figure 3-10** indicates that shallow groundwater south of the site continues to flow in a south to southeasterly direction within a distance of approximately 1,000 feet downgradient. However, further south of the site, groundwater flow is influenced by the southern flowing surface water systems located to the east and west with groundwater west of Fifth Avenue flowing toward the O-Co-Nee Pond and Lawrence Lake/Lawrence Creek drainage system in a more south-southwesterly direction. Groundwater east of Fifth Avenue appears to flow in a more east-southeast direction, eventually discharging to the Watchogue Creek drainage system. Consistent with the findings of the initial field program, there appears to be a localized anomaly in groundwater flow east of the southernmost half of Lawrence Lake. We believe that this anomaly is caused by the fact that Lawrence Lake is artificially impounded at its southernmost end which has resulted in the localized mounding of groundwater at the southern half of lake. As a result of this mounding, groundwater which would normally flow in a more westerly direction and eventually discharge to the lake is deflected in a more southerly direction. East of the southern portion of Lawrence Lake, groundwater continues to flow south until reaching the tidal area of Lawrence Creek, south of Manatuck Lane. At this point, groundwater flow becomes predominantly westerly in response to a relatively strong westerly hydraulic gradient as determined by water elevations observed at the northeastern end of Lawrence Creek (gauging station BBSW-06) and monitoring well GM-05S, located approximately 300 feet to the east of the creek. Due to the tidal influence on the creek, the westerly gradient towards Lawrence Creek is strongest during periods of low tide and weakest during periods of high tide.



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OFF-SITE WATER TABLE CONTOUR MAP
JUNE 6-10, 2002

FIGURE 3-10

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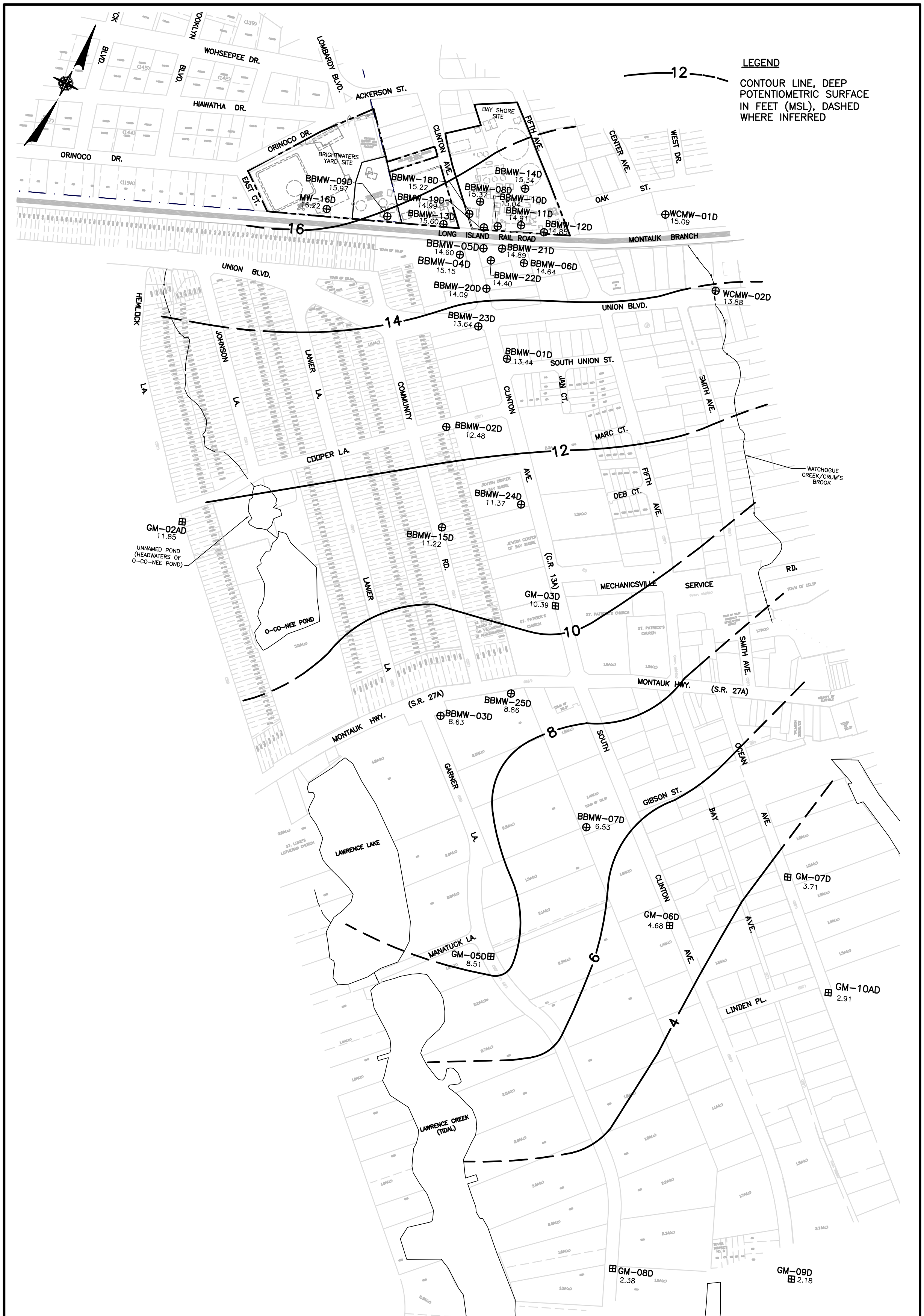

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POTENTIOMETRIC SURFACE OF DEEP UPPER GLACIAL AQUIFER
JUNE 6–10, 2002

FIGURE 3–11

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Consistent with the initial field program, the potentiometric surface of the deep zone of the Upper Glacial aquifer, shown on **Figure 3-11**, generally indicates a southerly groundwater flow direction for a distance of approximately 1,600 feet. However, at this point groundwater appears to flow predominantly in a southeasterly direction, towards the tidal portion of Watchogue Creek. Only deep groundwater west of Community Road and Garner Lane appears to flow towards Lawrence Creek. However, this apparent change in flow direction may not actually be occurring given that the potentiometric contours appear to be significantly shifted as result of one water level measurement recorded at monitoring well GM-05D which is under artesian conditions. The water level at GM-05D may be a much more localized effect than indicated by the potentiometric map. Furthermore, chemical data from deep monitoring wells and completed groundwater probes do not suggest a change in the direction of the Bay Shore plume migration south of Montauk Highway as this potentiometric surface map may suggest.

As seen on **Table 2-11**, monitoring wells located immediately downgradient of the site to points as far south as Montauk Highway show virtually no vertical head difference, indicating a predominantly horizontal groundwater flow within this area. Monitoring well cluster GM-07 located on Ocean Avenue south of Montauk Highway indicated a subtle upward vertical head distribution of 0.11 feet in June 2002, perhaps an indication of groundwater discharge to Watchogue Creek. However, this upward vertical head distribution was measured at only 0.05 feet in March 2002. The only substantial vertical head gradient was observed at well cluster GM-05 located on Garner Lane, approximately 300 feet east of Lawrence Creek, where the deep well static head was measured at 8.51 feet mean sea level (msl) and the shallow well exhibited a static water level of only 4.43 feet msl, a difference of 4.08 feet. This difference was reported as 5.64 feet in the initial field program and was 5.61 feet during the March 2002 round of water level measurements. These results indicate a strong upward vertical gradient and an area of groundwater discharge. Additionally, GM-05D appears to be under artesian conditions with the static head being above the top of the well casing at this location. As a result, groundwater will freely flow from this well when the well cap is removed.

Finally, the installation of deep well BBMW-05D2, screened from 126.5-136.5 feet bgs, allows one to compare the difference in the vertical head distribution between the Magothy and

Upper Glacial aquifers, at least at this one location. As shown on **Table 2-11**, in three rounds of water level measurements in 2002 - March, June and August – the static head of the deep well was greater than the static head of the shallow well, with differences of 0.55 feet, 0.32 feet and 0.14 feet, respectively. This indicates a slight upward vertical gradient between the two aquifer systems at this location.

3.4 Watchogue Creek/Crum's Brook Hydrogeology

Fill Material

Fill in the Watchogue Creek/Crum's Brook area tends to be dark gray to dark brown in color and contains varying amounts of brick and asphalt pieces, glass fragments, ash and vesicular slag. The fill, when found, is generally 4 to 6 feet in thickness. An exception was at soil boring WCSB-49, in the location of the former Knickerbocker Ice Co., where up to 12 feet of fill was observed.

Glacial Outwash Deposits

The glacial outwash deposits in the Watchogue Creek/Crum's Brook area are generally consistent in lithology and thickness with those found within and adjacent to the Bay Shore site. Additionally, as seen on the cross sections on **Figures 3-6** and **3-7**, there tends to be a number of gravel-rich lenses in this area, primarily south of the Long Island Rail Road. These lenses are usually found within 20 feet of the ground surface. Also, there was a zone of peat identified at soil boring WCSB-38 within 8 feet of the ground surface immediately beneath a zone of fill.

Magothy Formation

The surface of the Magothy formation is generally flat as seen on **Figure 3-6**. The surface elevation of the formation varies from approximately –52 to –55 feet msl. There does not seem to be any apparent trends in the topography of the Magothy formation in this area based on the currently available data.

Groundwater Flow and Hydraulic Gradients

Based on depth to water measurements taken during June 2002 (see **Table 2-11**), groundwater at the Watchogue Creek/Crum's Brook area is approximately 4 feet below grade (15.02 feet msl) north of the Long Island Rail Road, as measured at monitoring well WCMW-01S, and approximately 2 feet below grade (13.82 feet msl) south of the Long Island Rail Road, as measured at monitoring well WCMW-02S located along Union Boulevard. This indicates that groundwater generally flows in a southerly direction in this area. The deep wells, WCMW-01D (15.09 feet msl) and WCMW-02D (13.88 msl), indicate that groundwater in the deep glacial sediments flows in a similar fashion.

The water level data further suggests a slight upward gradient in the vertical head distribution between the deep and shallow wells at monitoring well clusters WCMW-01 and WCMW-02. The deep wells exhibit greater static heads when compared to the corresponding shallow wells with differences of 0.07 and 0.06 feet, respectively, possibly indicating an area of groundwater discharge.

4.0 FINDINGS

4.1 Introduction

This section provides a discussion of the chemical compounds and other MGP residuals identified in on-site and off-site areas based on the supplemental field program data. Where appropriate, data from the initial field program, as well as historical data, has been used in conjunction with supplemental data to provide a more comprehensive understanding with respect to the nature and extent of MGP-related chemical compounds and residuals associated with the site.

Consistent with the initial field program completed in the Fall of 2000, environmental samples collected as part of the supplemental field program from on-site locations have been grouped into what is referred to as the "On-site Field Investigation Program," and samples collected from off-site locations have been grouped into what is referred to as the "Off-site Field Investigation Program." However, consistent with the initial field program, the On-site Field Investigation includes "off-site" samples collected adjacent to the Bay Shore Site as far south as Union Boulevard. The Off-site Field Investigation Program includes all other off-site locations.

Drawing 2A presents the surveyed locations of all completed on-site and adjacent off-site sample locations along with the approximate locations of former MGP structures located on the site. **Drawing 2B** presents the location of all off-site sample locations. Sample locations related to the Watchogue Creek/Crum's Brook area are provided on **Figure 2-1**. Locations where private groundwater well and air samples were collected are shown on **Figure 2-2**. **Appendix C** contains data tables summarizing the analytical results of all samples collected during the supplemental field investigation. The total concentrations of all detected BTEX compounds for each sample location, as well as the total concentrations of all detected PAHs and carcinogenic PAHs (CaPAHs) for each sample location are also provided in the data summary tables. In addition, **Appendix E** summarizes all total BTEX and total PAH data for subsurface soil samples collected as part of the initial field program, as well as prior studies, and contains data tables summarizing the analytical results of all groundwater samples collected during the same investigations.

The assessment of the presence of chemicals in the environment was performed using sample analytical results and the visual observations and physical descriptions of recovered sample media. In the case of groundwater, upgradient groundwater quality was compared to downgradient quality. In the case of metals in soil, values were compared to typical metals concentrations observed within eastern United States soils (see **Table 4-1**). When relevant, data generated under this investigation was compared to data generated during prior investigations in order to assess any trends in the reduction or migration of chemical constituents.

In addition, the analytical results associated with the supplemental field program were compared to NYSDEC regulatory standards, criteria and guidance values (SCGs) for *screening* purposes. The analytical data tables provided in **Appendix C** include a column for SCGs including those presented in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 for soil and the Class GA groundwater standards and guidance values provided in the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 for groundwater. In addition, SCGs for surface water are from TOGS 1.1.1 and SCGs for surface water sediment were obtained from the NYSDEC Division of Fish, Wildlife and Marine Resources document entitled, “Technical Guidance for Screening Contaminated Sediments.” Concentrations of chemical constituents that exceeded the SCGs are bracketed on the data tables. Also, **Tables 4-2** through **4-10** summarize the concentration range, frequency of exceedances of SCGs and the specific SCG for chemical constituents typically associated with former MGP sites.

The following terminology and descriptions were used to describe the visual and olfactory observations made during the field investigation, as well as to describe the nature of the observed materials.

TABLE 4-1
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

TYPICAL BACKGROUND CONCENTRATIONS OF METALS IN SOIL

Metals	Background Levels - Eastern USA (mg/kg)
Aluminum	7,000 - 100,000
Antimony	< 1 - 8.8
Arsenic	< 0.1 - 73
Barium	10 - 1,500
Beryllium	< 1 - 7
Cadmium	-
Calcium	100 - 280,000
Chromium	1 - 1,000
Cobalt	< 0.3 - 70
Copper	< 1 - 700
Iron	100 - 100,000
Lead	< 10 - 300
Magnesium	50 - 50,000
Manganese	< 2 - 7,000
Mercury	0.01 - 3.4
Nickel	< 5 - 700
Potassium	50 - 37,000
Selenium	< 0.1 - 3.9
Silver	-
Sodium	500 - 50,000
Thallium	-
Vanadium	< 7 - 300
Zinc	< 5 - 2,900

NOTES:
From: H.T. Shacklette and J.G. Boerngen, USGS Professional Paper 1270, 1984
- : Not established.

TABLE 4-2
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES
DETECTED IN BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
SURFACE AND SUBSURFACE SOIL AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Surface Soil	**PCBs**	Aroclor 1260	1	ND to 4.7	2 of 7	BBSS-30(0-6")
		Aroclor 1254	1	ND	0 of 7	NA
		Aroclor 1221	1	ND	0 of 7	NA
		Aroclor 1232	1	ND	0 of 7	NA
		Aroclor 1248	1	ND	0 of 7	NA
		Aroclor 1016	1	ND	0 of 7	NA
		Aroclor 1242	1	ND	0 of 7	NA
Subsurface Soil	**VOCs**	Benzene	0.06	ND to 1,200	27 of 175	BBTP-04(5-6)
		Toluene	1.5	ND to 1,600	18 of 175	BBTP-04(5-6)
		Ethylbenzene	5.5	ND to 370	52 of 175	BBSB-49(9-10)
		Total Xylenes	1.2	ND to 2,500	72 of 175	BBTP-04(5-6)
	PAHs	Benzo(a)pyrene *	0.061	ND to 860	103 of 175	BBTP-04(5-6)
		Dibenzo(a,h)anthracene *	0.014	ND to 6.6	48 of 175	BBSB-43(0-2)
		Benzo(a)anthracene *	0.224	ND to 1,000	98 of 175	BBTP-04(5-6)
		Indeno(1,2,3-cd)pyrene *	3.2	ND to 280	34 of 175	BBTP-04(5-6)
		Benzo(b)fluoranthene *	1.1	ND to 580	77 of 175	BBTP-04(5-6)
		Benzo(k)fluoranthene *	1.1	ND to 260	52 of 175	BBTP-04(5-6)
		Chrysene *	0.4	ND to 1,000	100 of 175	BBTP-04(5-6)
		Naphthalene	13	ND to 20,000	73 of 175	BBTP-04(5-6)
		2-Methylnaphthalene	36.4	ND to 8,700	68 of 175	BBTP-04(5-6)
		Acenapthylene	41	ND to 2,500	25 of 175	BBTP-04(5-6)
		Acenapthene	50	ND to 440	20 of 175	BBTP-04(5-6)
		Dibenzofuran	6.2	ND to 270	22 of 175	BBTP-04(5-6)
		Fluorene	50	ND to 2,000	28 of 175	BBTP-04(5-6)

TABLE 4-2 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES
DETECTED IN BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
SURFACE AND SUBSURFACE SOIL AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Subsurface Soil (cont.)		Phenanthrene	50	ND to 5,600	52 of 175	BBTP-04(5-6)
		Anthracene	50	ND to 1,300	25 of 175	BBTP-04(5-6)
		Fluoranthene	50	ND to 1,500	23 of 175	BBTP-04(5-6)
		Pyrene	50	ND to 2,700	34 of 175	BBTP-04(5-6)
		Benzo(ghi)perylene	50	ND to 350	4 of 175	BBTP-04(5-6)
		Total CaPAHs	10	ND to 3,980	74 of 175	BBTP-04(5-6)
		Total PAHs	500 [1]	ND to 49,340	43 of 175	BBTP-04(5-6)

Notes:
SCGs: NYSDEC TAGM 4046 dated January 1994
NA: Not applicable
ND: Non-detect
* Carcinogenic PAH (CaPAH)
[1] SCG is for Total SVOCs

TABLE 4-3
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES
DETECTED IN BAY SHORE SITE AND ADJACENT OFF-SITE AREAS
GROUNDWATER AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater	**VOCs**	Benzene	1	ND to 4,100	60 of 159	BBGP-68(8-12)
		Toluene	5	ND to 5,600	49 of 159	MW-05S
		Ethylbenzene	5	ND to 13,000	74 of 159	BBMW-23S
		Total Xylenes	5	ND to 19,000	101 of 159	BBMW-23S
	PAHs	Benzo(a)pyrene *	NA	ND to 7,600	NA	BBGP-72(64-68)
		Dibenzo(a,h)anthracene *	NA	ND to 4	NA	BBMW-06ST
		Benzo(a)anthracene *	0.002	ND to 14,000	50 of 157	BBGP-72(64-68)
		Indeno(1,2,3-cd)pyrene *	0.002	ND to 10	21 of 157	BBMW-06ST MW-05D
		Benzo(b)fluoranthene *	0.002	ND to 5,200	36 of 157	BBGP-72(64-68)
		Benzo(k)fluoranthene *	0.002	ND to 21	18 of 157	BBGP-70(9-13)
		Chrysene *	0.002	ND to 13,000	48 of 157	BBGP-72(64-68)
		Naphthalene	10	ND to 340,000	95 of 157	BBGP-72(64-68)
		2-Methylnaphthalene	NA	ND to 180,000	NA	BBGP-72(64-68)
		Acenapthylene	NA	ND to 64,000	NA	BBGP-72(64-68)
		Acenapthene	20	ND to 6,600	50 of 157	BBGP-72(64-68)
		Dibenzofuran	NA	ND to 3,900	NA	BBGP-72(64-68)
		Fluorene	50	ND to 31,000	49 of 157	BBGP-72(64-68)
		Phenanthrene	50	ND to 80,000	61 of 157	BBGP-72(64-68)
		Anthracene	50	ND to 26,000	24 of 157	BBGP-72(64-68)
		Fluoranthene	50	ND to 22,000	19 of 157	BBGP-72(64-68)
		Pyrene	50	ND to 30,000	25 of 157	BBGP-72(64-68)
		Benzo(ghi)perylene	NA	ND to 51	NA	BBGP-69(9-13)
		Total CaPAHs	NA	ND to 39,800	NA	BBGP-72(64-68)
		Total PAHs	NA	ND to 823,300	NA	BBGP-72(64-68)

Notes:
SCGs: NYSDEC Class GA Groundwater Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

TABLE 4-4
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES DETECTED IN BAY SHORE WEST PARCEL/BRIGHTWATERS YARD SUBSURFACE SOIL AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Subsurface Soil	VOCs	Benzene	0.06	ND to 0.077	1 of 58	BBSB-93(6-8)
		Toluene	1.5	ND to 0.95	0 of 58	BBSB-96(8-10)
		Ethylbenzene	5.5	ND to 7.8	2 of 58	BBSB-96(8-10)
		Total Xylenes	1.2	ND to 54	6 of 58	BBSB-71(9-11)
	PAHs	Benzo(a)pyrene *	0.061	ND to 44	6 of 58	BBSB-78(0-2)
		Dibenzo(a,h)anthracene *	0.014	ND to 5.2	3 of 58	BBSB-78(0-2)
		Benzo(a)anthracene *	0.224	ND to 51	3 of 58	BBSB-78(0-2)
		Indeno(1,2,3-cd)pyrene *	3.2	ND to 15	1 of 58	BBSB-78(0-2)
		Benzo(b)fluoranthene *	1.1	ND to 41	1 of 58	BBSB-78(0-2)
		Benzo(k)fluoranthene *	1.1	ND to 15	2 of 58	BBSB-78(0-2)
		Chrysene *	0.4	ND to 53	2 of 58	BBSB-78(0-2)
		Naphthalene	13	ND to 130	1 of 58	BBSB-78(0-2)
		2-Methylnaphthalene	36.4	ND to 130	1 of 58	BBSB-78(0-2)
		Acenapthylene	41	ND to 31	0 of 58	BBSB-78(0-2)
		Acenapthene	50	ND to 9.5	0 of 58	BBSB-78(0-2)
		Dibenzofuran	6.2	ND to 6.5	1 of 58	BBSB-78(0-2)
		Fluorene	50	ND to 52	1 of 58	BBSB-78(0-2)
		Phenanthrene	50	ND to 160	1 of 58	BBSB-78(0-2)
		Anthracene	50	ND to 32	0 of 58	BBSB-78(0-2)
		Fluoranthene	50	ND to 61	1 of 58	BBSB-78(0-2)
		Pyrene	50	ND to 120	1 of 58	BBSB-78(0-2)
		Benzo(ghi)perylene	50	ND to 17	0 of 58	BBSB-78(0-2)
		Total CaPAHs	10	ND to 224.2	1 of 58	BBSB-78(0-2)
		Total PAHs	500 [1]	ND to 973.2	1 of 58	BBSB-78(0-2)

Notes:
SCGs: NYSDEC TAGM 4046 dated January 1994
NA: Not applicable
ND: Non-detect
* Carcinogenic PAH (CaPAH)
[1] SCG is for Total SVOCs

TABLE 4-5
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES DETECTED IN BAY SHORE WEST PARCEL/BRIGHTWATERS YARD GROUNDWATER AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater	**VOCs**	Benzene	1	ND to 11	2 of 12	BBGP-85(6-10)
		Toluene	5	ND	0 of 12	NA
		Ethylbenzene	5	ND to 2,500	5 of 12	BBGP-86(6-10)
		Total Xylenes	5	ND to 19,000	5 of 12	BBGP-86(6-10)
	PAHs	Benzo(a)pyrene *	NA	ND to 1	NA	BBMW-13D
		Dibenzo(a,h)anthracene *	NA	ND	NA	NA
		Benzo(a)anthracene *	0.002	ND to 2	1 of 12	BBMW-13D
		Indeno(1,2,3-cd)pyrene *	0.002	ND	0 of 12	NA
		Benzo(b)fluoranthene *	0.002	ND to 1	1 of 12	BBMW-13D
		Benzo(k)fluoranthene *	0.002	ND	0 of 12	NA
		Chrysene *	0.002	ND to 2	1 of 12	BBMW-13D
		Naphthalene	10	ND to 700	5 of 12	BBGP-86(6-10)
		2-Methylnaphthalene	NA	ND to 36	NA	BBGP-85(6-10)
		Acenapthylene	NA	ND to 2	NA	MW-03S BBGP-88(8-12)
		Acenapthene	20	ND to 1	0 of 12	BBGP-88(8-12)
		Dibenzofuran	NA	ND	NA	NA
		Fluorene	50	ND to 2	0 of 12	BBGP-88(8-12)
		Phenanthrene	50	ND to 15	0 of 12	BBMW-13D
		Anthracene	50	ND to 1	0 of 12	BBGP-88(8-12)
		Fluoranthene	50	ND to 5	0 of 12	BBMW-13D
		Pyrene	50	ND to 9	0 of 12	BBMW-13D
		Benzo(ghi)perylene	NA	ND	NA	NA
		Total CaPAHs	NA	ND to 6	NA	BBMW-13D
		Total PAHs	NA	ND to 732	NA	BBGP-86(6-10)

Notes:
SCGs: NYSDEC Class GA Groundwater Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

TABLE 4-6
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES DETECTED IN OFF-SITE GROUNDWATER AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater	VOCs	Benzene	1	ND to 980	67 of 116	BBGP-79(22-26)
		Toluene	5	ND to 1,600	35 of 116	BBGP-75(64-68)
		Ethylbenzene	5	ND to 2,700	54 of 116	BBGP-75(16-20)
		Total Xylenes	5	ND to 3,700	65 of 116	BBGP-75(16-20)
	PAHs	Benzo(a)pyrene *	NA	ND	NA	NA
		Dibenzo(a,h)anthracene *	NA	ND	NA	NA
		Benzo(a)anthracene *	0.002	ND	0 of 116	NA
		Indeno(1,2,3-cd)pyrene *	0.002	ND	0 of 116	NA
		Benzo(b)fluoranthene *	0.002	ND	0 of 116	NA
		Benzo(k)fluoranthene *	0.002	ND	0 of 116	NA
		Chrysene *	0.002	ND	0 of 116	NA
		Naphthalene	10	ND to 8,000	66 of 116	BBMW-01I
		2-Methylnaphthalene	NA	ND to 1,100	NA	BBGP-76(40-44) BBMW-01I
		Acenapthylene	NA	ND to 450	NA	BBMW-01I
		Acenapthene	20	ND to 240	31 of 116	BBGP-75(16-20)
		Dibenzofuran	NA	ND to 9	NA	BBGP-83(26-30)
		Fluorene	50	ND to 100	25 of 116	BBGP-82(26-30)
		Phenanthrene	50	ND to 100	23 of 116	BBGP-82(26-30)
		Anthracene	50	ND to 32	0 of 116	BBGP-77(60-64)
		Fluoranthene	50	ND to 4	0 of 116	BBGP-75(16-20)
		Pyrene	50	ND to 4	0 of 116	BBGP-75(16-20)
		Benzo(ghi)perylene	NA	ND	NA	NA
		Total CaPAHs	NA	ND	NA	NA
		Total PAHs	NA	ND to 9,720	NA	BBMW-01I

Notes:
SCGs: NYSDEC Class GA Groundwater Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

TABLE 4-7
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES DETECTED IN O-CO-NEE POND SURFACE WATER SEDIMENT AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Surface Water Sediment	VOCs	Benzene	0.021	ND	0 of 12	NA
		Toluene	0.037	ND	0 of 12	NA
		Ethylbenzene	0.018	ND	0 of 12	NA
		Total Xylenes	0.069	ND to 0.006	0 of 12	BWSD-04(0-6)
	PAHs	Benzo(a)pyrene *	NA	ND to 4.6	NA	BWSD-04(0-6)
		Dibenzo(a,h)anthracene *	NA	ND	NA	NA
		Benzo(a)anthracene *	0.009	ND to 3.9	3 of 12	BWSD-04(0-6)
		Indeno(1,2,3-cd)pyrene *	NA	ND to 2.6	NA	BWSD-04(0-6)
		Benzo(b)fluoranthene *	NA	ND to 7.2	NA	BWSD-04(0-6)
		Benzo(k)fluoranthene *	NA	ND to 4.5	NA	BWSD-04(0-6)
		Chrysene *	NA	ND to 7.1	NA	BWSD-04(0-6)
		Naphthalene	0.023	ND	0 of 12	NA
		2-Methylnaphthalene	0.026	ND	0 of 12	NA
		Acenapthylene	NA	ND	NA	NA
		Acenapthene	NA	ND	NA	NA
		Dibenzofuran	NA	ND	NA	NA
		Fluorene	0.006	ND	0 of 12	NA
		Phenanthrene	NA	ND to 5	NA	BWSD-04(0-6)
		Anthracene	0.08	ND	0 of 12	NA
		Fluoranthene	NA	ND to 10	NA	BWSD-04(0-6)
		Pyrene	0.721	ND to 12	5 of 12	BWSD-04(0-6)
		Benzo(ghi)perylene	NA	ND	NA	NA
		Total CaPAHs	NA	ND to 29.9	NA	BWSD-04(0-6)
		Total PAHs	NA	ND to 56.9	NA	BWSD-04(0-6)

Notes:

SCGs: NYSDEC Class C freshwater, benthic aquatic life
chronic toxicity, based on total organic carbon of 0.075%

NA: Not applicable

ND: Non-detect

* Carcinogenic PAH (CaPAH)

TABLE 4-8
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES
DETECTED IN O-CO-NEE POND SURFACE WATER AND PORE WATER
AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs[1] (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Pore Water	**VOCs**	Benzene	1	ND to 170	1 of 6	BWPW-03
		Toluene	5	ND	0 of 6	NA
		Ethylbenzene	5	ND to 3	0 of 6	BWPW-03
		Total Xylenes	5	ND to 4	0 of 6	BWPW-03
	PAHs	Benzo(a)pyrene *	NA	ND	NA	NA
		Dibenzo(a,h)anthracene *	NA	ND	NA	NA
		Benzo(a)anthracene *	0.002	ND	0 of 6	NA
		Indeno(1,2,3-cd)pyrene *	0.002	ND	0 of 6	NA
		Benzo(b)fluoranthene *	0.002	ND	0 of 6	NA
		Benzo(k)fluoranthene *	0.002	ND	0 of 6	NA
		Chrysene *	0.002	ND	0 of 6	NA
		Naphthalene	10	ND to 2	0 of 6	BWPW-02
		2-Methylnaphthalene	NA	ND	NA	NA
		Acenapthylene	NA	ND	NA	NA
		Acenapthene	20	ND	0 of 6	NA
		Dibenzofuran	NA	ND	NA	NA
		Fluorene	50	ND	0 of 6	NA
		Phenanthrene	50	ND	0 of 6	NA
		Anthracene	50	ND	0 of 6	NA
		Fluoranthene	50	ND	0 of 6	NA
		Pyrene	50	ND	0 of 6	NA
		Benzo(ghi)perylene	NA	ND	NA	NA
		Total CaPAHs	NA	ND	NA	NA
		Total PAHs	NA	ND to 2	NA	BWPW-02

TABLE 4-8 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES DETECTED IN O-CO-NEE POND SURFACE WATER AND PORE WATER AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs[2] (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Surface Water	**VOCs**	Benzene	210	ND	0 of 11	NA
		Toluene	100	ND	0 of 11	NA
		Ethylbenzene	17	ND	0 of 11	NA
		Total Xylenes	65	ND to 1	0 of 11	BWSW-01(B)
	PAHs	Benzo(a)pyrene *	NA	ND to 3	NA	BWSW-05(B)
		Dibenzo(a,h)anthracene *	NA	ND	NA	NA
		Benzo(a)anthracene *	0.03	ND to 2	2 of 11	BWSW-05(B)
		Indeno(1,2,3-cd)pyrene *	NA	ND to 2	NA	BWSW-05(B)
		Benzo(b)fluoranthene *	NA	ND to 5	NA	BWSW-05(B)
		Benzo(k)fluoranthene *	NA	ND to 3	NA	BWSW-05(B)
		Chrysene *	NA	ND to 4	NA	BWSW-05(B)
		Naphthalene	13	ND	0 of 11	NA
		2-Methylnaphthalene	4.7	ND	0 of 11	NA
		Acenapthylene	NA	ND	NA	NA
		Acenapthene	5.3	ND	0 of 11	NA
		Dibenzofuran	NA	ND	NA	NA
		Fluorene	NA	ND	NA	NA
		Phenanthrene	5	ND to 3	0 of 11	BWSW-05(B)
		Anthracene	3.8	ND	0 of 11	NA
		Fluoranthene	NA	ND to 6	NA	BWSW-05(B)
		Pyrene	4.6	ND to 6	1 of 11	BWSW-05(B)
		Benzo(ghi)perylene	NA	ND	NA	NA
		Total CaPAHs	NA	ND to 19	NA	BWSW-05(B)
		Total PAHs	NA	ND to 34	NA	BWSW-05(B)

Notes:
[1]: NYSDEC Class GA Groundwater Standards/Guidelines
[2]: NYSDEC Class C Surface Water Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

TABLE 4-9
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES DETECTED IN WATCHOGUE CREEK/CRUM'S BROOK SUBSURFACE SOIL AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Subsurface Soil	VOCs	Benzene	0.06	ND to 0.006	0 of 66	WCSB-38(4-6)
		Toluene	1.5	ND to 0.18	0 of 66	WCSB-39(8-10)
		Ethylbenzene	5.5	ND to 1.6	0 of 66	WCSB-39(8-10)
		Total Xylenes	1.2	ND to 6.6	3 of 66	WCSB-39(8-10)
	PAHs	Benzo(a)pyrene *	0.061	ND to 81	17 of 56	WCSB-49(4-6)
		Dibenzo(a,h)anthracene *	0.014	ND to 8.6	15 of 66	WCSB-49(4-6)
		Benzo(a)anthracene *	0.224	ND to 86	16 of 66	WCSB-49(4-6)
		Indeno(1,2,3-cd)pyrene *	3.2	ND to 33	3 of 66	WCSB-49(4-6)
		Benzo(b)fluoranthene *	1.1	ND to 96	14 of 66	WCSB-49(4-6)
		Benzo(k)fluoranthene *	1.1	ND to 45	13 of 66	WCSB-49(4-6)
		Chrysene *	0.4	ND to 83	16 of 66	WCSB-49(4-6)
		Naphthalene	13	ND to 80	6 of 66	WCSB-37(8-10)
		2-Methylnaphthalene	36.4	ND to 89	4 of 66	WCSB-37(8-10)
		Acenapthylene	41	ND to 33	0 of 66	WCSB-52(10-12)
		Acenapthene	50	ND to 120	3 of 66	WCSB-52(10-12)
		Dibenzofuran	6.2	ND to 35	3 of 66	WCSB-49(4-6)
		Fluorene	50	ND to 140	3 of 66	WCSB-52(10-12)
		Phenanthrene	50	ND to 440	10 of 66	WCSB-52(10-12)
		Anthracene	50	ND to 130	4 of 66	WCSB-52(10-12)
		Fluoranthene	50	ND to 200	3 of 66	WCSB-49(4-6)
		Pyrene	50	ND to 180	4 of 66	WCSB-49(4-6)
		Benzo(ghi)perylene	50	ND to 32	0 of 66	WCSB-49(4-6)
		Total CaPAHs	10	ND to 432.6	14 of 66	WCSB-49(4-6)
		Total PAHs	500 [1]	ND to 1,354.1	5 of 66	WCSB-52(10-12)

Notes:
SCGs: NYSDEC TAGM 4046 dated January 1994
NA: Not applicable
ND: Non-detect
* Carcinogenic PAH (CaPAH)
[1] SCG is for Total SVOCs

TABLE 4-10
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CHEMICAL CONSTITUENTS TYPICALLY ASSOCIATED WITH FORMER MGP SITES
DETECTED IN WATCHOGUE CREEK/CRUM'S BROOK GROUNDWATER AND COMPARISON TO NYSDEC SCGs

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater	**VOCs**	Benzene	1	ND to 8	5 of 43	WCGP-10D(5-9)
		Toluene	5	ND to 11	1 of 43	WCGP-14(4.5-8.5)
		Ethylbenzene	5	ND to 350	4 of 43	WCGP-14(4.5-8.5)
		Total Xylenes	5	ND to 550	4 of 43	WCGP-14(4.5-8.5)
	PAHs	Benzo(a)pyrene *	NA	ND to 7	NA	WCGP-15(18-22)
		Dibenzo(a,h)anthracene *	NA	ND	NA	NA
		Benzo(a)anthracene *	0.002	ND to 17	15 of 43	WCGP-15(18-22)
		Indeno(1,2,3-cd)pyrene *	0.002	ND to 2	2 of 43	WCGP-15(18-22) WCGP-16(2-6)
		Benzo(b)fluoranthene *	0.002	ND to 5	4 of 43	WCGP-15(18-22)
		Benzo(k)fluoranthene *	0.002	ND to 2	2 of 43	WCGP-15(18-22)
		Chrysene *	0.002	ND to 17	15 of 43	WCGP-15(18-22)
		Naphthalene	10	ND to 1,800	9 of 43	WCGP-14(4.5-8.5)
		2-Methylnaphthalene	NA	ND to 620	NA	WCGP-14(4.5-8.5)
		Acenapthylene	NA	ND to 110	NA	WCGP-15(18-22) WCGP-17(28-32)
		Acenapthene	20	ND to 300	6 of 43	WCGP-14(4.5-8.5)
		Dibenzofuran	NA	ND to 10	NA	WCGP-15(18-22) WCGP-15(4-8)
		Fluorene	50	ND to 89	4 of 43	WCGP-15(18-22)
		Phenanthrene	50	ND to 210	9 of 43	WCGP-15(18-22)
		Anthracene	50	ND to 169	2 of 43	WCGP-15(70-74)
		Fluoranthene	50	ND to 30	0 of 43	WCGP-15(18-22)
		Pyrene	50	ND to 47	0 of 43	WCGP-15(18-22)
		Benzo(ghi)perylene	NA	ND to 2	NA	WCGP-15(18-22) WCGP-16(2-6)
		Total CaPAHs	NA	ND to 50	NA	WCGP-15(18-22)
		Total PAHs	NA	ND to 3,015	NA	WCGP-14(4.5-8.5)

Notes:
SCGs: NYSDEC Class GA Groundwater Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

- **Nonaqueous phase liquid (NAPL):** NAPL is a liquid that does not readily dissolve in water and can exist as a separate fluid phase. Tar and oil released in a soil/water environment will behave as a NAPL. NAPLs are subdivided into two types, those that are lighter than water (light nonaqueous phase liquid or LNAPL) and those with a density greater than water (dense nonaqueous phase liquid or DNAPL). Being lighter than water, LNAPLs will float on water. A common example of an LNAPL would be gasoline or oil floating on water. DNAPLs, being denser than water, would tend to sink through water. Though examples of DNAPLs in everyday life are not very common, an analogy to a DNAPL in water would be an oil and vinegar salad dressing where, in this case, the vinegar represents the DNAPL and the oil represents the water. When the oil and vinegar mixture is shaken, it is momentarily mixed as an emulsion. However, after settling, the oil, being lighter than the vinegar, floats to the top of the container whereas the vinegar (representing the DNAPL) settles to the bottom as a separate phase layer.

- **Saturated:** The entire pore space of the soil matrix for a given soil sample was "filled" with a NAPL. The characteristics of the observed NAPL were used in the description (i.e., tar-saturated or petroleum-saturated).

- **Blebs:** Observed discrete sphericals or pockets of NAPL within a soil or groundwater sample. The characteristics of the observed NAPL were used in the description (i.e., tar blebs or petroleum blebs).

- **Stained:** The soil sample exhibited a discoloration not associated with natural processes. The color of the observed stain was used and if the characteristics of the staining material were discernible, they were also noted (i.e., tar-stained or petroleum-stained).

- **Sheen:** The iridescence observed within a soil sample or the surface of a groundwater sample created by the presence of small quantities of NAPL.

- **Odor:** If an odor was present, it was described based on its relative intensity and characteristics. Relative odor intensity was described using terms such as strong, moderate and faint. Descriptive terms such as tar-like, naphthalene-like, hydrocarbon-like or petroleum-like odors were also used when such determinations could be made.

- **MGP Tar:** MGP tar is a byproduct of the manufactured gas process and is typically comprised of a broad spectrum of hydrocarbon compounds including BTEX compounds, PAHs and phenols. However, it should be noted that elevated concentrations of phenols have generally not been encountered in association with investigations being conducted by KeySpan at its former MGP sites. MGP tar can be encountered in a solid, semi-solid or liquid state. Similar to petroleum, MGP tar does not readily dissolve in water and will exist as a NAPL when released in a soil/water environment.

BTEX compounds were the principal VOCs detected in samples and are the common VOCs associated with tar. Semivolatile organic compounds (SVOCs) were also detected at the site with PAHs being the common subset of SVOCs in tar. For purposes of this report, PAHs include the compounds listed below.

- 2-Methylnaphthalene
- Benzo(b)fluoranthene
- Fluorene
- Acenaphthene
- Benzo(g,h,i)perylene
- Indeno(1,2,3-c,d)pyrene
- Acenaphthylene
- Benzo(k)fluoranthene
- Naphthalene
- Anthracene
- Chrysene
- Phenanthrene
- Benzo(a)anthracene
- Dibenzo(a,h)anthracene
- Pyrene
- Benzo(a)pyrene
- Fluoranthene
- Dibenzofuran

Of these PAHs, the following constituents are considered carcinogenic PAHs by EPA.

- Benzo(a)anthracene
- Dibenzo(a,h)anthracene
- Benzo(a)pyrene
- Benzo(k)fluoranthene
- Indeno(1,2,3-cd)pyrene
- Benzo(b)fluoranthene
- Chrysene

The analytical results of this investigation and previous investigations are discussed relative to the presence of total BTEX and total PAHs.

4.2 On-Site Investigation

Consistent with the Supplemental Field Investigation Work Plan and the operable unit designations discussed in **Section 1.5**, the on-site field program has been further divided into the following areas:

- Bay Shore Site and adjacent off-site locations (Operable Unit 1)
- The Bay Shore West Parcel (Operable Unit 1)
- The Bay Shore West Storage Lot Parcel (Operable Unit 3)

4.2.1 Bay Shore Site and Adjacent Off-site Locations (Operable Unit 1)

4.2.1.1 - Surface Soil

A total of seven surface soil samples were collected at the Bay Shore site. Surface soil samples BBSS-30, 31, 32 and 38 were collected from the southwest corner of the site near the southern end of the former Generator House, in order to delineate the presence of PCBs identified in surface soil sample BBSS-09 collected during the initial field program. In addition, BBSS-33 was collected approximately 130 feet north of this area in order to determine if the source of the PCBs identified at BBSS-09 was a former electrical transformer located in this area. Samples BBSS-36 and BBSS-37 were collected from the northwest corner of the site in the vicinity of the active electrical substation located adjacent to the site.

The analytical results for PCBs in the samples collected are summarized in **Table C-1**. In the vicinity of BBSS-09, PCBs were detected at concentrations that ranged from 0.10 mg/kg in BBSS-31 to 4.7 mg/kg in BBSS-30. PCBs were detected at a concentration of 0.17 mg/kg at BBSS-33 located in the vicinity of the former Transformer. Aroclor-1260 was the only PCB compound detected in the above samples. PCBs were not detected above the Contract Required Detection Limit (CRDL) of 0.03 mg/kg in BBSS-36 and BBSS-37.

4.2.1.2 - Subsurface Soil

A total of 39 soil borings and probes were completed at the Bay Shore Site and adjoining areas with a total of 170 subsurface soil samples selected for chemical analysis, including BTEX, PAHs and petroleum fingerprint. The objectives of the soil boring program included:

- Further delineate the presence of BTEX and PAHs in subsurface soil in source areas identified during the initial field program;
- Define the vertical and areal extent of NAPL within suspected source areas; and
- Define the nature and extent of off-site NAPL migration downgradient of the Bay Shore Site.

In addition, 14 test pits were completed within the site with a total of 16 subsurface soil samples selected for analysis. The objectives of the test pits included:

- Observe shallow subsurface conditions;
- Determine if LNAPL is present at or near the water table; and
- Locate and identify subsurface MGP structures and foundations.

Analytical results for BTEX and PAHs in subsurface soil samples collected from soil borings are summarized in **Tables C-2** and **C-3** and analytical results for petroleum fingerprint/total petroleum hydrocarbons (TPH) are summarized in **Table C-4**. The analytical results for subsurface soil samples collected from test pits for BTEX, PAHs and petroleum fingerprint/TPH are summarized in **Tables C-5** through **C-7**.

BTEX

Table 4-11 summarizes data related to subsurface soil samples collected from on-site and adjacent off-site locations which exhibited the highest total BTEX and total PAH concentrations along with the approximate location of each sample with respect to former MGP structures/ features where appropriate. The table also includes PID measurements and lists any significant

TABLE 4-11

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (ppm)	Field Description of Recovered Sample
BBSB-37 (12-14')	0.2	2,075.6	Within eastern portion of Oxide Bed and adjacent to northern portion of Purifiers. Downgradient of Cesspool.	282.0	Black staining, NAPL saturated, strong naphthalene-like odor
BBSB-40 (0-2')	872.0	2,326.0	Between 100,000 cu. ft. Gas Holder and Former 0.5 Million cu. ft. Relief Gas Holder. Downgradient of Former 2 Million cu. ft. Main Storage Gas Holder.	203.0	Black staining w/strong naphthalene-like odor in top 3", black staining w/faint naphthalene-like odor in bottom 2"
BBSB-44 (4-6')	0.0	2,448.1	Outside southeast portion of Former 0.5 Million cu. ft. Relief Gas Holder.	99.5	Black banding, tar staining, moderate naphthalene like odor
BBSB-49 (4-6')	924.0	2,809.0	Within Tar Seperators. Downgradient of Demulsifier Pump House.	2,000+	Black staining, NAPL saturated, heavy hydrocarbon-like and naphthalene-like odors
BBSB-49 (9-10')	744.0	3,241.2	Within Tar Seperators. Downgradient of Demulsifier Pump House.	1,100.0	Black staining, heavy hydrocarbon-like odor
BBSB-52 (1-3')	469.0	1,775.0	Between Centrifix Pit and 75,000 gallon Tar Tank. Downgradient of Demulsifier Pump House.	900.0	Heavy staining, hydrocarbon-like odor
BBSB-53 (6-8')	617.0	519.4	In vicinity of Catch Basin, Drip House and Blow Down Tank. Downgradient of Tar Settling Tanks.	800.0	Heavy black staining, heavy hydrocarbon-like odor
BBSB-58 (6-8')	859.1	759.1	Within Generator House in the vicinity of Tar Well. Downgradient of Oil Unload Tank.	650.0	Heavy black staining, heavy hydrocarbon-like odor
BBSB-63 (34-36')	27.4	4,932.0	Adjacent to southern portion of Compressor House. Downgradient of Compressor House.	475.0	Heavy staining-NAPL saturated w/tar from 33.5-35.5', heavy naphthalene-like odor
BBSB-66 (36-37')	20.1	3,051.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	232.0	Saturated w/tar - flowable, naphthalene-like odor

TABLE 4-11 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (ppm)	Field Description of Recovered Sample
BBSB-66 (53-54')	77.0	5,538.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	250.0	Black tar saturated band from 53-53.5', sheen, strong naphthalene-like odor
BBSB-81 (36-38')	0.6	2,633.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Generator House.	150.0	Intermittant heavy staining, heavy naphthalene-like odor
BBSB-81 (69-71')	250.0	4,075.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Generator House.	800.0	NAPL saturated at 70.5', heavy naphthalene-like odor
BBSB-82 (69-71')	167.8	11,009.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	433.0	Black-brown staining, sheen, hydrocarbon-like odor from 69-70.5'
BBSB-86 (15-17')	514.8	725.1	Within eastern portion of Compressor House. Downgradient of 54,000 cu. ft. Gas Holder & Heavy Oil Tank.	300.0	Blue staining, tar/oil lenses at 15.5' and 16.5', hydrocarbon-like odor
BBTP-03 (5-6')	287.0	10,997.0	Partially within Cesspool, in the vicininty of Former 2 Million cu. ft. Main Storage Gas Holder. Downgradient of Concrete Basin Cooling Coils.	254.0	Saturated w/flowing tar, moderate tar-like odor
BBTP-04 (5-6')	5,510.0	49,340.0	Outside eastern portion of Former 0.5 Million cu. ft. Relief Gas Holder. Downgradient of Former 2 Million cu. ft. Main Storage Gas Holder.	685.0	Saturated w/tar, strong naphthalene-like odor
BBTP-08 (6-7')	660.0	20,270.0	In vicinity of Tar Separators and Effluent Water Treatment House. Downgradient of Demulsifier Pump House.	150.0	Solidified tar chunks, naphthalene-like odor
BBTP-09 (7-8')	581.0	1,002.7	In vicinity of Tar Settling Tanks, Centrifix Pit and Catch Basin. Downgradient of Meter House.	940.0	Heavy black tar staining, strong naphthalene/tar-like odor
BBTP-10 (5-7')	636.0	594.2	Partially within Boiler House, Drip House and 54,000 cu. ft. Gas Holder & Heavy Oil Tank. Downgradient of Gas Condenser Cooler.	784.0	Black staining, strong tar/hydrocarbon-like odor

field observations noted for the samples. Also, note that **Section 4.2.1.4** provides additional details regarding the nature and extent of NAPL in subsurface soil.

As presented in **Table 4-11**, with regard to the supplemental field program, the maximum total BTEX concentration of 5,510.0 mg/kg was detected in subsurface soil sample BBTP-04 (5 to 6 feet) collected immediately to the north of the former Naphthalene Scrubber and west of the former Relief Holder. This sample consisted of tar-saturated soil and produced a PID reading of 685.0 ppm. In addition, sample BBTP-04 (5 to 6 feet), which was collected as part of the initial field program from a location approximately 20 feet north of soil boring BBSB-11, exhibited a total BTEX concentration of 41,100.0 mg/kg. This particular sample represents the highest concentration of BTEX detected in subsurface soil samples collected as part of the initial field program. In general, the highest total BTEX concentrations were observed west of the former Relief Holder (BBTP-04 and BBSB-40) and within the area of the former Tar Separator/Effluent Treatment House (BBSB-49, BBTP-08 and BBTP-09). In addition, soil sample BBSB-58 (6 to 8 feet) exhibited a total BTEX concentration of 859.1 mg/kg. BBSB-58 was completed adjacent to the former Tar Well located in the southwestern portion of the Bay Shore site. Consistent with the initial field program findings, samples containing the highest total BTEX concentrations were collected from shallow subsurface soil (less than 12 feet below grade) and exhibited heavy tar staining and/or tar/NAPL-saturated conditions. At most on-site locations, BTEX concentrations decrease rapidly with increasing depth. However, at a number of off-site borings completed during the supplemental field program immediately downgradient of the site, BTEX was detected at deeper soil intervals including:

Sample ID	Total BTEX Concentration (mg/kg)
BBSB-66 (53 to 54 feet)	77.0
BBSB-81 (69 to 71 feet)	250.0
BBSB-82 (69 to 71 feet)	167.8

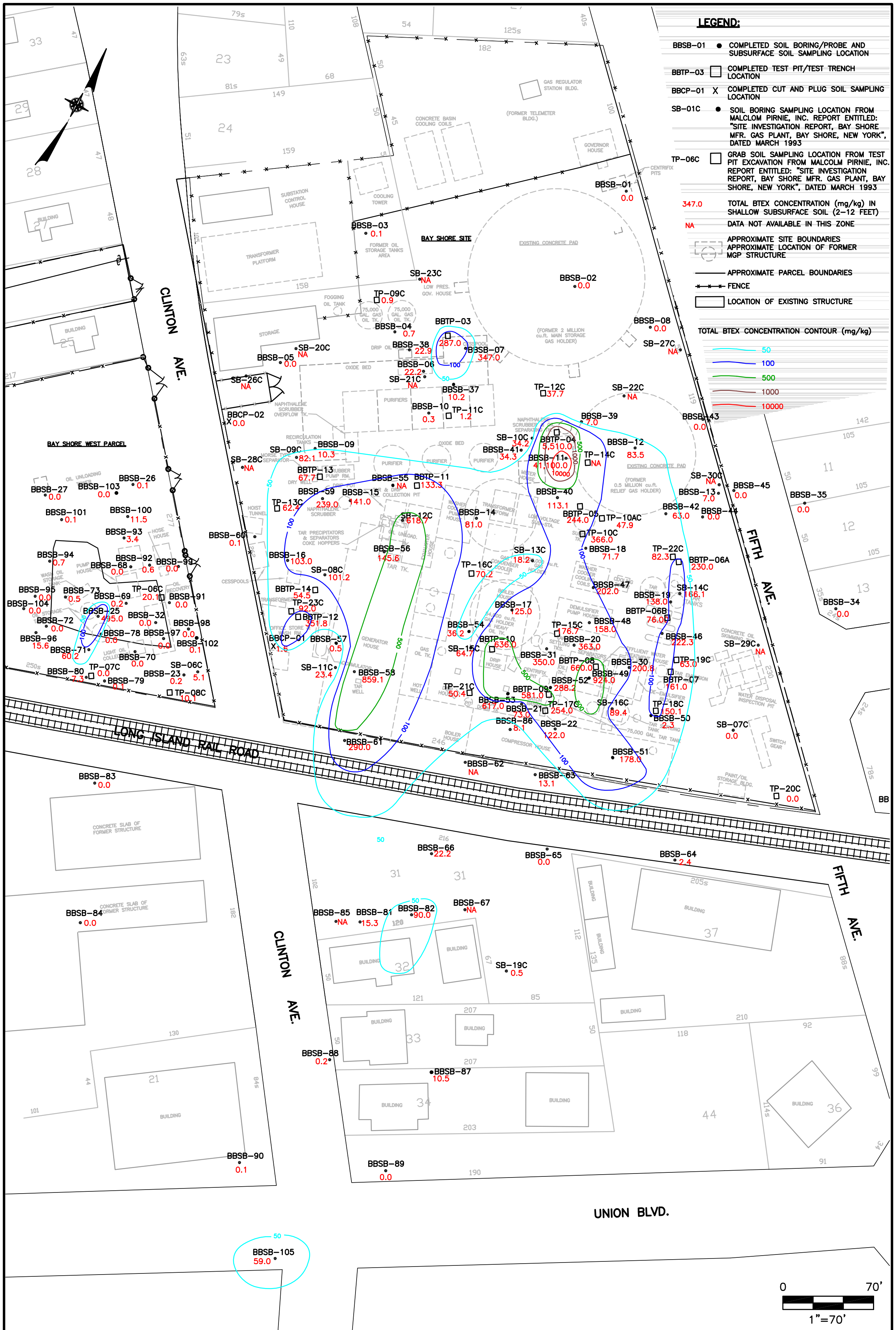
The deeper samples listed above also exhibited tar staining and/or tar/NAPL-saturated conditions.

The total BTEX observed in the samples listed in **Table 4-11** are comprised predominantly of ethylbenzene and xylenes. An exception to this distribution was observed in soil boring BBSB-49 located within the former Tar Separator in the southeast portion of the site. Soil in this boring contained elevated concentrations of toluene in addition to the ethylbenzene and xylenes. This and similar exceptions may reflect a unique source material or varying degrees of weathering of the material in the vicinity of these borings.

Figures 4-1 through **4-3** depict total BTEX concentrations in subsurface soil at on-site and adjacent off-site sample locations. The figures are based on soil data generated from the supplemental field program, the initial field program completed in the Fall of 2000, the cut and plug IRM conducted in the Winter of 1999, as well as the Malcolm Pirnie investigation conducted in 1992. Details concerning the 1992 Malcolm Pirnie investigation, as well as the cut and plug IRM are presented in the April 2002 RI report. The data used for **Figure 4-1** is based on the analytical results of subsurface soil samples collected at shallow depths ranging from 2 to 12 feet bgs, and includes the groundwater interface encountered between 6 and 8 feet bgs at on-site locations. The data used for **Figure 4-2** is based on the analytical results of subsurface soil samples collected at intermediate depths ranging from 12 to 32 feet bgs. The data used for **Figure 4-3** is based on the analytical results of subsurface soil samples collected from deep intervals at depths greater than 32 feet bgs. It is important to note that at sample locations where more than one sample within a given depth range was analyzed for BTEX, the highest concentration detected was utilized in developing **Figures 4-1** through **4-3**.

Based on a review of these figures and the supporting data, the following are noteworthy observations.

1. With the exception of the former Cesspool area located immediately southwest of the former Main Gas Holder, subsurface soil in the northern third of the Bay Shore Site does not contain elevated levels of BTEX. In fact, total BTEX concentrations in this area do not exceed 0.92 mg/kg. In addition, it appears that subsurface soil in the southeastern portion of the Bay Shore Site does not contain BTEX compounds.



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

TOTAL BTEX CONCENTRATIONS IN SHALLOW SUBSURFACE SOIL (2 TO 12 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-1

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

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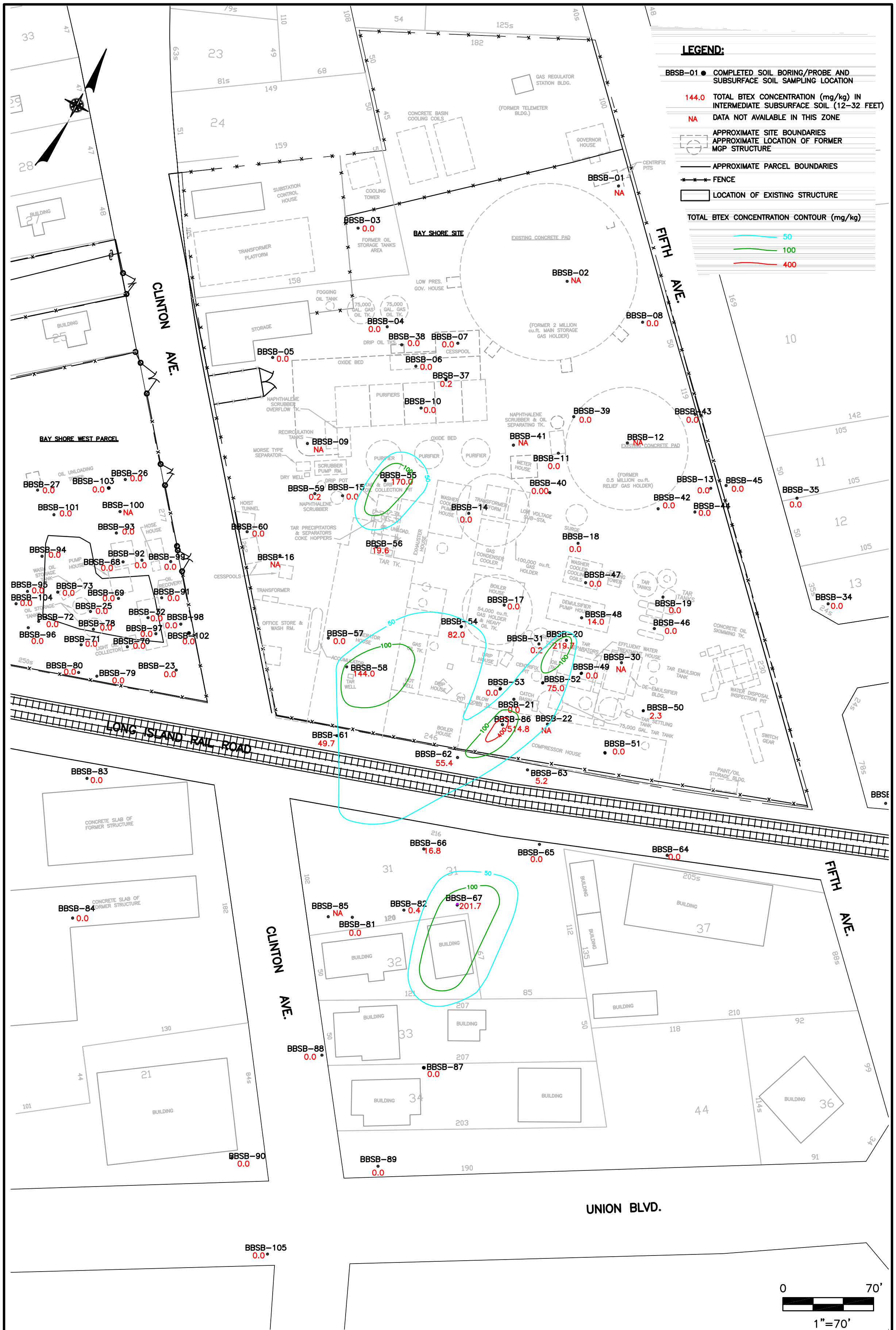

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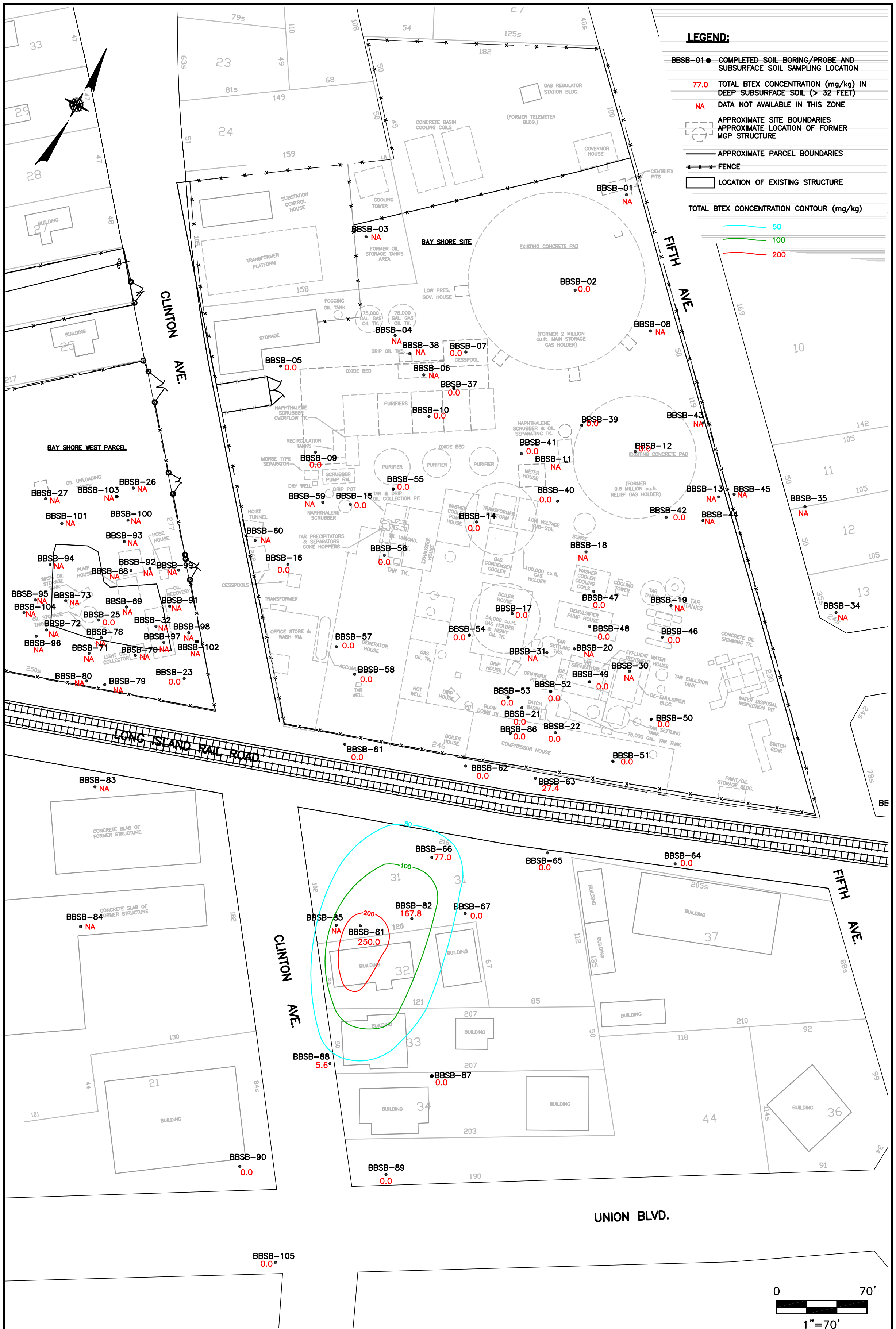
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

TOTAL BTEX CONCENTRATIONS IN INTERMEDIATE SUBSURFACE SOIL (12 TO 32 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-2



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BAY SHORE, NEW YORK

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TOTAL BTEX CONCENTRATIONS IN DEEP SUBSURFACE SOIL (> 32 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-3

\\Nt4\CADwork\1620B12B\dwg\11X17\FIG-4C.dwg, 10/28/02 02:03:41 PM, APostyn

2. The highest concentrations of BTEX in subsurface soil are found in the shallow soil interval, southwest of the former Relief Holder and within the general vicinity of a former Naphthalene Scrubber. This area extends south to the former locations of the Effluent Water Treatment Facilities, Tar Separators and Tar Settling and Tar Holding Tanks. A second area of elevated BTEX in subsurface soil is present in the vicinity of the former Tar and Drip Oil Collecting Pits, as indicated by the analytical results for soil samples collected from Malcolm Pirnie soil boring SB-12C, which exhibited a total BTEX concentration of 618.7 mg/kg. In addition, shallow soil in the vicinity of the former Tar Well, which was located in the southwest corner of the site contained elevated total BTEX at a concentration of 859.1 mg/kg.

3. In the adjacent off-site areas south of the site, shallow subsurface soil contains relatively low BTEX concentrations with the exceptions of BBSB-61 (6 to 8 feet), which exhibited a total BTEX concentration of 290.0 mg/kg, and BBSB-82 (10 to 12 feet), which exhibited a total BTEX concentration of 90.0 mg/kg. In addition, BBSB-105 (8 to 10 feet), which is located approximately 410 feet south of the site, exhibited a total BTEX concentration of 59.0 mg/kg.

4. As shown on **Figure 4-2**, BTEX concentrations in intermediate subsurface soil (i.e., below a depth of 12 feet) at the majority of on-site locations are notably lower than those in shallow subsurface soil and are generally less than 100 mg/kg. Several exceptions to this observation include soil borings BBSB-55 located immediately north of the former Tar and Drip Oil Collection Pit, BBSB-58 located adjacent to the former Tar Well and borings BBSB-20 and BBSB-86, both completed within the vicinity of the former Tar Separator and Effluent Water Treatment House.

5. As shown on **Figure 4-3**, total BTEX concentrations in deep subsurface soil below a depth of 32 feet, are less than 0.03 mg/kg throughout the Bay Shore site. However, immediately downgradient of the site, BTEX was detected in deep subsurface soil, as indicated by soil samples BBSB-66 (53 to 54 feet) with a total BTEX concentration of 77.0 mg/kg, BBSB-82 (69 to 71 feet) with a total BTEX concentration of 167.8 mg/kg and BBSB-81 (69 to 71 feet) with a total BTEX concentration of 250.0 mg/kg. The detection and distribution of BTEX in deep subsurface soil off-site is consistent with field observations of tar/NAPL staining, as well as tar/NAPL at saturated levels within deep subsurface soil borings immediately downgradient of the Bay Shore site.

PAHs

Table 4-11 summarizes the analytical data of subsurface soil samples collected from on-site locations which exhibited the highest total PAH concentrations along with the approximate location of each sample in relation to former MGP structures/features where appropriate. The table also includes PID measurements and significant field observations noted for the samples.

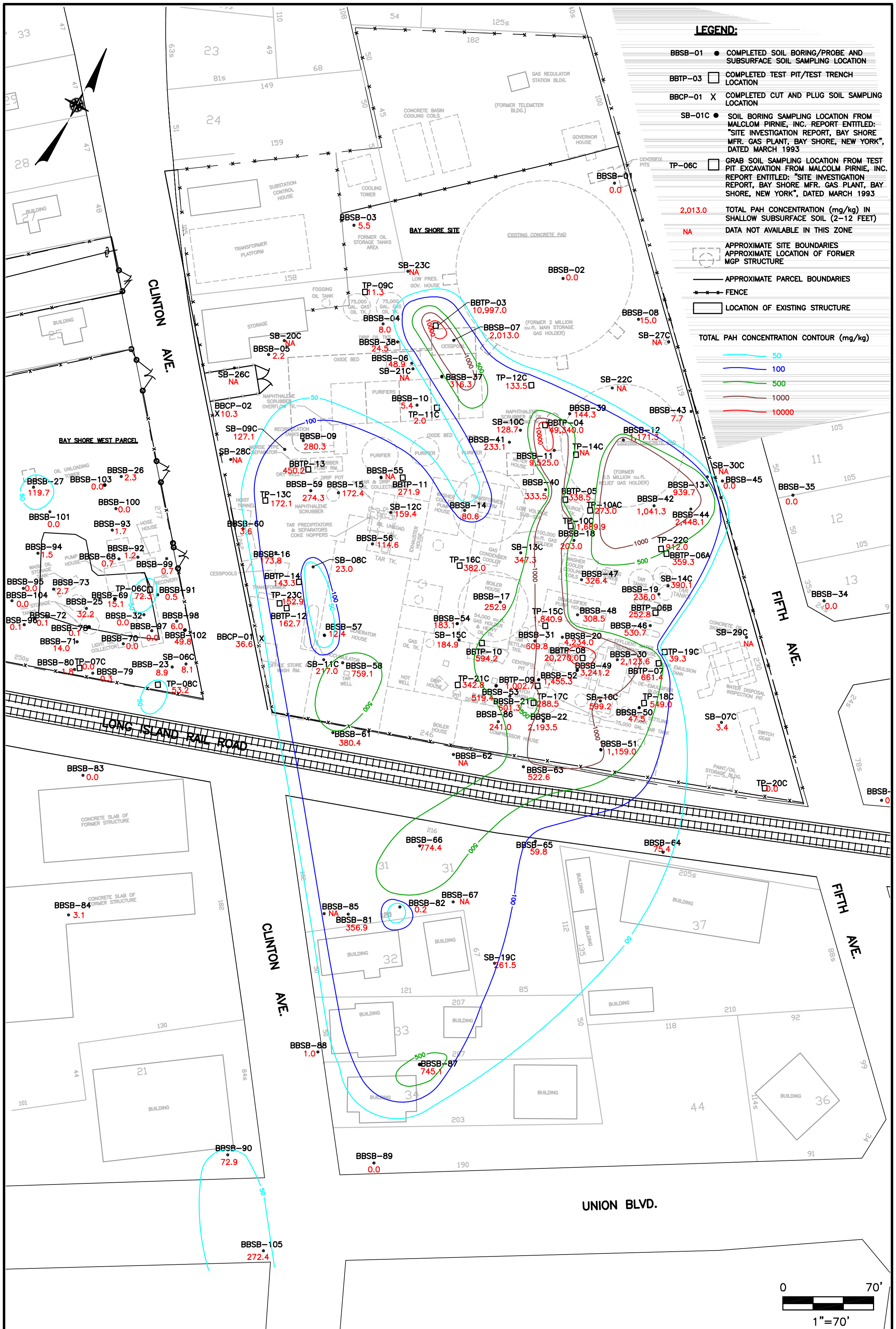
Also, note that **Section 4.2.1.4** provides additional detail as to the nature and extent of NAPL in subsurface soil.

As shown in **Table 4-11**, the maximum total PAH concentration observed in on-site subsurface soil was 49,340.0 mg/kg detected in soil sample BBTP-04 (5 to 6 feet), the same sample that contained the highest total BTEX concentration in subsurface soil collected as part of the supplemental field program. This sample was collected immediately north of the former Tar Scrubber located west of the former Relief Holder and is also located 20 feet north of BBSB-11, which contained the maximum total PAH concentration of 9,525.0 mg/kg detected in subsurface soil samples collected during the initial field program. In general, the highest PAH concentrations observed on-site were identified in shallow subsurface soil west and south of the former Relief Holder (BBTP-04), the former Tar Separator/Effluent Water Treatment House (BBTP-08 and BBSB-49) and the former Cesspool located west of the former Gas Holder (BBTP-03). Off-site to the south, a number of soil samples collected at depths greater than 50 feet exhibited PAHs, including:

Sample ID	Total BTEX Concentration (mg/kg)
BBSB-66 (53 to 54 feet)	5,538.0
BBSB-81 (69 to 71 feet)	4,075.0
BBSB-82 (69 to 71 feet)	11,009.0

The deeper samples listed above also exhibited tar staining and/or tar/NAPL-saturated conditions.

Figures 4-4 through **4-6** depict total PAH concentrations in subsurface soil at on-site and adjacent off-site sample locations. These figures are based on soil data generated from the supplemental field program completed in the Summer of 2002, the initial field program completed in the Fall of 2000, the cut and plug IRM conducted in the Winter of 1999, as well as the Malcolm Pirnie investigation conducted in 1992. Details of the 1992 Malcolm Pirnie investigation, as well as the cut and plug IRM, are presented in the April 2002 RI report. The



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

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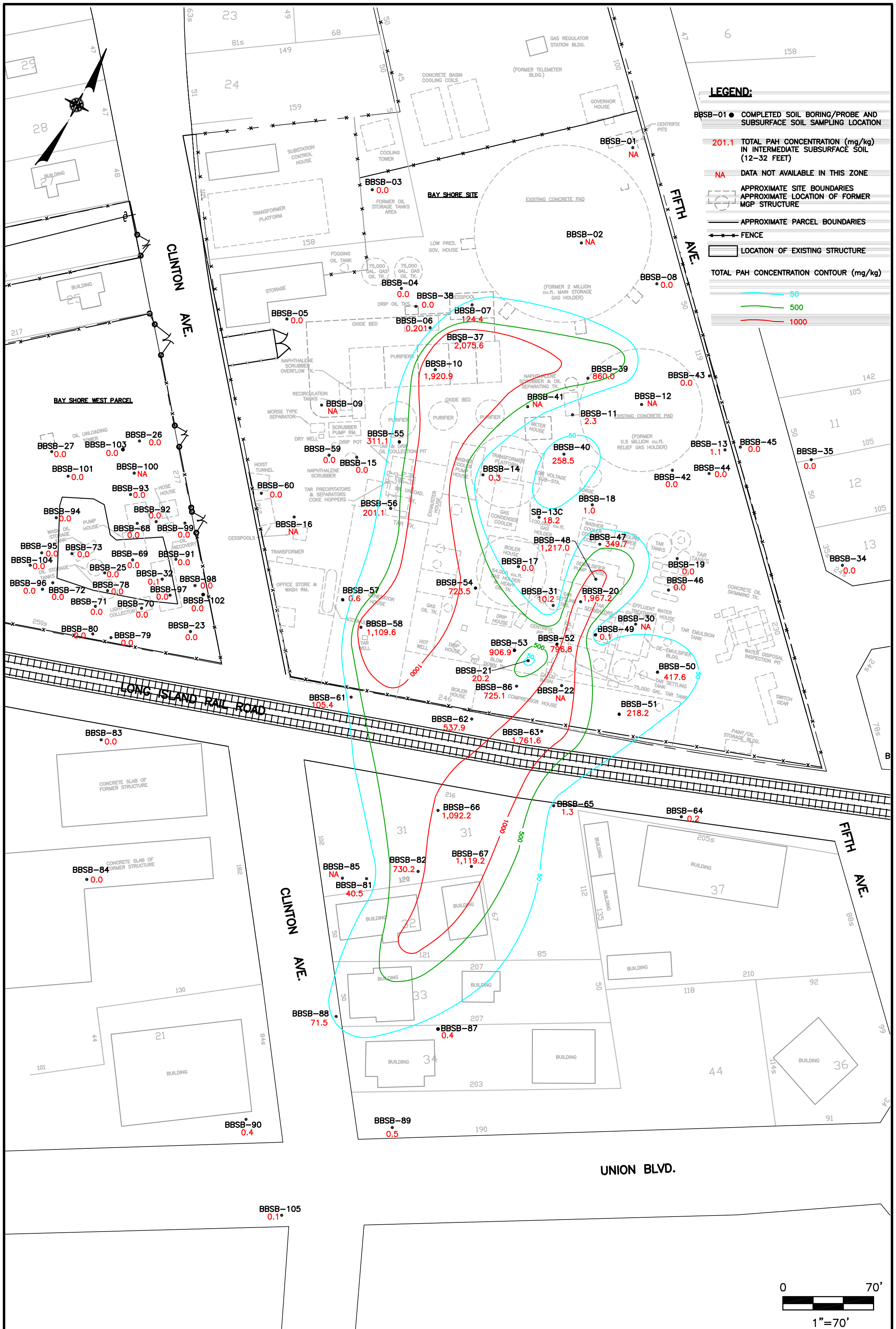
TOTAL PAH CONCENTRATIONS IN SHALLOW SUBSURFACE SOIL (2 TO 12 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-4

\\Nt4\CADwork\1620B12B\dwg\11X17\FIG-4D.dwg, 10/28/02 02:04:53 PM, APostyn



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

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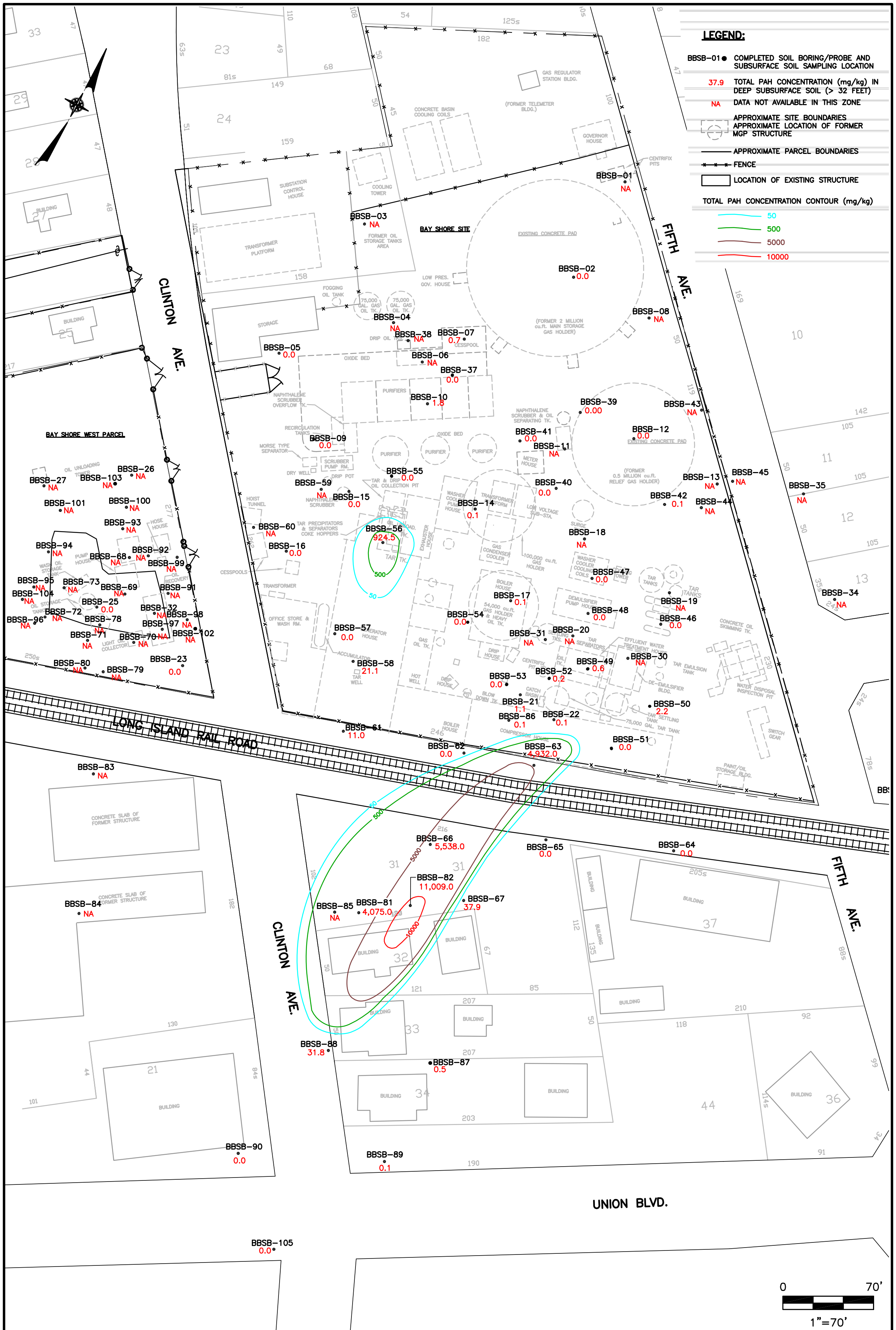
TOTAL PAH CONCENTRATIONS IN INTERMEDIATE SUBSURFACE SOIL (12 TO 32 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-5

\\Nt4\CADwork\1620B12B\dwg11X17\FIG-4E.dwg, 10/28/02 02:06:08 PM, APostyn



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

TOTAL PAH CONCENTRATIONS IN DEEP SUBSURFACE SOIL (> 32 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-6

Dvirka and Bartilucci
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\\Nt4\CADwork\1620B12B\dwg11X17\FIG-4F.dwg, 10/28/02 02:07:10 PM, APostyn data used for **Figure 4-4** is based on the analytical results of shallow subsurface soil samples collected at depths ranging from 2 to 12 feet bgs, and includes those soil samples that were collected at the groundwater interface, which was encountered between 6 and 8 feet bgs at on-site locations. The data used for **Figure 4-5** is based on the analytical results of subsurface soil samples collected from intermediate depths ranging from 12 to 32 feet bgs. The data used for **Figure 4-6** is based on the analytical results of subsurface soil samples collected at deep intervals greater than 32 feet bgs. It is important to note that at sample locations where more than one sample was analyzed within a given depth range for PAHs, the highest concentration detected was utilized in developing **Figures 4-4** through **4-6**.

Based on a review of these figures and the supporting data, the following are noteworthy observations.

1. The distribution of PAHs in subsurface soil is generally consistent with the pattern exhibited by total BTEX concentrations. Specifically, subsurface soil within the northern third of the Bay Shore Site does not exhibit elevated PAH concentrations. In this case, total PAH concentrations do not exceed 11.5 mg/kg. In addition, the subsurface soil within the southeastern corner of the site does not exhibit elevated PAH concentrations, with total PAH concentrations not exceeding 3.5 mg/kg. However, the former Cesspool, which is located southwest of the former Main Holder, contained elevated concentrations of PAHs. At this isolated location, total PAH concentrations of up to 10,997.0 mg/kg were detected at BBTP-03.

2. As shown on **Figure 4-4**, the highest concentrations of PAHs in shallow subsurface soil are found south and southwest of the former Relief Holder, as well as areas further south in the vicinity of the former Tar Settling Tanks, Tar Holding Tanks, Tar Separators and Effluent Water Treatment Facilities. In addition, the area to the southeast of the former Relief Holder appears to exhibit PAHs in shallow subsurface soil as indicated by samples collected from soil borings BBSB-13, BBSB-42 and BBSB-44. However, data for soil samples collected from soil boring BBSB-45 indicates that the area of shallow soil containing PAHs does not extend a significant distance off-site.

3. Shallow subsurface soil samples collected at or immediately below the water table from several soil borings located downgradient of the site, including BBSB-66, BBSB-81 and BBSB-87, exhibit total PAH concentrations ranging from 356.9 to 1,119.2 mg/kg. In addition, a total PAH concentration of 272.4 mg/kg was detected immediately below the water table at soil boring BBSB-105 located approximately 410 feet downgradient of the site.

4. **Figure 4-5** clearly indicates that PAH concentrations in soil samples collected from intermediate depths (i.e., below a depth of 12 feet) are significantly lower than those detected in shallow soil samples at the majority of on-site sample locations. However, PAHs remain present downgradient of the former Cesspool (BBSB-10 and BBSB-37), the former Naphthalene Scrubber southwest of the Relief Holder (BBSB-11) and in the vicinity of the former Tar Separators/Effluent Treatment House (BBSB-20, BBSB-21 and BBSB-31). Off-site and downgradient of the former Tar Separators/Effluent Treatment House, PAHs were detected in subsurface soil samples collected below a depth of 12 feet from soil borings BBSB-62, BBSB-63, BBSB-66, BBSB-67 and BBSB-82.

5. **Figure 4-6** indicates that, similar to total BTEX concentrations, the total PAH concentrations detected in deep subsurface soil (i.e., below a depth of 32 feet are relatively low, with total PAH concentrations not exceeding 2.0 mg/kg at most on-site locations. One exception was the detection of total PAHs at a concentration of 924.5 mg/kg in deep soil sample BBSB-56 (43 to 44 feet) located immediately downgradient of the former Tar and Drip Oil Collection Pit.

6. Soil borings completed immediately downgradient of the Bay Shore site contained elevated PAH concentrations in soil deeper than 32 feet including BBSB-83, BBSB-66, BBSB-81 and BBSB-82. The highest total PAH concentration observed in off-site soil was detected in BBSB-82 (69 to 71 feet) at a concentration of 11,009.0 mg/kg. The distribution of PAH concentrations in deep subsurface soil is consistent with field observations which indicated the presence of tar/NAPL stained and tar/NAPL saturated soil immediately downgradient of the Bay Shore Site and in subsurface soil at depths greater than 32 feet below grade.

Petroleum Fingerprint/TPH Analysis

The analytical results for the 13 subsurface soil samples selected for petroleum fingerprint/TPH analysis are summarized in **Tables C-4** and **C-7** for samples collected from soil borings and test pits, respectively. The TPH concentrations for soil boring samples ranged from 3,100.0 mg/kg in sample BBSB-47 (10 to 12 feet) to 34,000.0 mg/kg in sample BBSB-58 (6 to 8 feet). Soil boring BBSB-58 was located inside the former Generator House adjacent to the former Tar Well. As indicated in the boring log for this soil boring (**Appendix A**), soil in the interval exhibited visible tar staining, a strong hydrocarbon-like odor and PID measurements ranging up to 650 parts per million (ppm). It is noted that soil sample BBSB-58 (13 to 15 feet) exhibited a TPH concentration of 4,000.0 mg/kg.

The next highest TPH concentration was detected in soil sample BBSB-63 (6 to 8 feet) at 19,000.0 mg/kg. Soil boring BBSB-63 was located downgradient of the former Compressor House, between the southern site boundary and the LIRR right-of-way (ROW). As indicated in the boring log for this soil boring, soil in the interval sampled contained NAPL at saturated levels, staining, a tar-like odor and PID measurements ranging up to 600 parts per million (ppm). The TPH concentration for soil sample BBSB-63 (34 to 36 feet), the next deeper interval, was 9,000.0 mg/kg.

The TPH concentrations for test pit samples ranged from 8,400.0 mg/kg in test pit sample BBTP-11 (9 to 10 feet) to 490,000.0 mg/kg in test pit sample BBTP-10 (4-inch pipe). Test pit BBTP-11 was excavated in the central portion of the site in the vicinity of the former Oil Unloading Tank and Exhauster House. Test pit BBTP-10 was excavated in the south central portion of the site in the former 54,000 Cubic Foot Gas Holder and Heavy Oil Tank, Drip House and Boiler House. It is noted that as discussed above, soil boring BBSB-54 was also located near test pit BBTP-10; however, TPH concentrations in the soil boring were several orders of magnitude lower than that detected in the test pit sample.

Fingerprint analysis of the selected samples indicated that seven of the total of 13 samples collected were found to be most characteristic of “middle distillate” petroleum products, such as No. 2 fuel oil or diesel. The remaining six samples were found to be most characteristic of MGP tar. It is likely that the samples classified as middle distillate petroleum were associated with a petroleum based feedstock used in the MGP process and the samples classified as MGP tar were associated with various pyrogenic materials that were created as byproducts of the MGP process. However, the fingerprint analysis does not indicate a clear pattern as to the likely source of the MGP residuals present in subsurface soil at the Bay Shore site. Instead, the distribution of the soil exhibiting petroleum and MGP tar appear to be random and in a number of cases, samples collected from the same boring, but at different depths, vary in characteristics from petroleum to MGP tar.

4.2.1.3 – Groundwater

As part of the supplemental field program, a total of 20 groundwater probes were completed within the Bay Shore site and at adjacent off-site locations and 23 new groundwater monitoring wells were installed. All newly installed wells, along with all existing wells, were checked for NAPL and sampled. All groundwater samples were analyzed for BTEX and PAHs. In addition, several samples of NAPL collected from a number of adjacent off-site wells were selected for petroleum fingerprint analysis. The objectives of the well installation and groundwater sampling program included:

- Further delineate the presence of BTEX and groundwater in suspected source areas identified as part of the initial field program;
- Define the vertical and areal extent of NAPL within suspected source areas;
- Provide additional data as to the potential mobility and recoverability of identified NAPL;
- Define the nature and extent of off-site NAPL migration;
- Determine if site related chemicals have migrated vertically into the Magothy aquifer; and
- Obtain additional data needed to evaluate the potential applicability/effectiveness of various remedial technologies under a Remedial Action Plan (RAP).

BTEX and PAH results for groundwater samples collected from on-site and adjacent off-site monitoring wells are summarized in **Table C-8** and **Table C-9**, respectively. Petroleum fingerprint/TPH analytical results are presented in **Table C-10**. Analytical data for BTEX and PAHs in groundwater probe samples are presented in **Table C-11** and **Table C-12**, respectively.

Based on the hydrogeologic setting of the site, the groundwater chemical data has been grouped into three hydrogeologic zones including:

Shallow Groundwater

For the purpose of this investigation, the shallow groundwater zone has been defined as groundwater encountered from the water table to a depth of 26 feet bgs.

Intermediate Groundwater

The intermediate groundwater zone has been defined as groundwater from 26 to 50 feet bgs.

Deep Groundwater

The deep groundwater zone has been defined as groundwater between 50 and 80 feet bgs. The deep zone is located immediately above the low permeable Magothy formation sediments described in **Section 3.2**.

The following discussion presents the findings of the on-site groundwater sampling completed at the Bay Shore site and adjacent off-site locations as part of the supplemental field program.

BTEX

Table 4-12 summarizes on-site groundwater samples that exhibited the highest total BTEX and total PAH concentrations along with the approximate locations of these samples in relation to former MGP structures/features. The table also indicates any significant field observations noted in these samples. Additional detail as to the distribution of NAPL in groundwater is provided in **Section 4.2.1.4**.

As indicated in **Table 4-12**, the highest levels of BTEX were generally observed in shallow groundwater at or near the water table and within the southern half of the Bay Shore site and at off-site sample locations immediately downgradient of this area. However, during the

TABLE 4-12

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
BBGP-60 (8-12')	7,590.0	3,561.0	Between 100,000 cu. ft. Gas Holder and 54,000 cu. ft. Gas Holder & Heavy Oil Tank. Downgradient of 100,000 cu. ft. Gas Holder.	Sheen, strong naphthalene-like odor
BBGP-62 (8-12')	4,950.0	1,033.0	Within eastern portion of the Generator House. Downgradient of Morse Tar Seperator.	None
BBGP-64 (8-12')	7,170.0	3,127.0	Within Cesspool in eastern portion of site. Downgradient of Hoist Tunnel.	Heavy sheen, strong naphthalene-like odor
BBGP-65 (8-12')	13,150.0	3,531.0	Within Office Store & Wash Room. Downgradient of Transformer in eastern portion of site.	None
BBGP-66 (6-10')	331.0	6,084.0	Adjacent southern portion of Generator House. Downgradient of Generator House.	Light-moderate sheen, hydrocarbon-like odor
BBGP-66 (14-18')	6,420.0	3,436.0	Adjacent southern portion of Generator House. Downgradient of Generator House.	None
BBGP-67 (9-13')	7,020.0	5,754.0	Outside southwest corner of Compressor House. Downgradient of 54,000 cu. ft. Gas Holder & Heavy Oil Tank.	Sheen, hydrocarbon-like odor
BBGP-68 (8-12')	13,000.0	6,634.0	Outside southern portion of Compressor House. Downgradient of Compressor House.	None
BBGP-68 (32-36')	2,650.0	10,830.0	Adjacent to southern portion of Compressor House. Downgradient of Compressor House.	None
BBGP-69 (9-13')	1,308.0	9,954.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	Light sheen, hydrocarbon-like odor

TABLE 4-12 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
BBGP-69 (20-24')	149.0	8,361.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	Light sheen, moderate naphthalene-like odor
BBGP-69 (34-38')	208.0	13,200.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	Moderate sheen, moderate naphthalene-like odor
BBGP-69 (40-44')	41.0	6,306.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	Light-moderate sheen, moderate naphthalene-like odor
BBGP-69 (56-60')	433.0	8,627.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	Light sheen, moderate naphthalene-like odor
BBGP-69 (71-75')	1,051.0	6,298.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	None
BBGP-70 (9-13')	5,910.0	4,011.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the eastern portion of Compressor House.	Heavy sheen, strong naphthalene-like odor
BBGP-70 (20-24')	34.0	9,520.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the eastern portion of Compressor House.	Sheen, moderate naphthalene-like odor
BBGP-72 (8-12')	3,736.0	2,277.0	Within Clinton Avenue south of the railroad tracks. Approximately 233 ft. downgradient of site.	Sheen, hydrocarbon-like odor
BBGP-72 (16-20')	3,520.0	3,128.0	Within Clinton Avenue south of the railroad tracks. Approximately 233 ft. downgradient of site.	Moderate sheen, hydrocarbon-like odor
BBGP-72 (40-44')	174.0	8,218.0	Within Clinton Avenue south of the railroad tracks. Approximately 233 ft. downgradient of site.	Light sheen, strong naphthalene-like odor

TABLE 4-12 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
BBGP-72 (56-60')	3,603.0	65,000.0	Within Clinton Avenue south of the railroad tracks. Approximately 233 ft. downgradient of site.	Tar blebs, sheen, strong naphthalene-like odor
BBGP-72 (64-68')	9,660.0	823,300.0	Within Clinton Avenue south of the railroad tracks. Approximately 233 ft. downgradient of site.	Tar blebs, sheen, strong naphthalene-like odor
BBGP-72 (71-75')	5,244.0	17,181.0	Within Clinton Avenue south of the railroad tracks. Approximately 233 ft. downgradient of site.	Tar blebs, sheen, strong naphthalene-like odor
BBGP-73 (32-36')	500.0	8,820.0	Within southeast corner of plot south of the railroad tracks and east of Clinton Avenue. Approximately 330 ft. downgradient of site.	None
BBGP-73 (40-44')	77.0	7,910.0	Within southeast corner of plot south of the railroad tracks and east of Clinton Avenue. Approximately 330 ft. downgradient of site.	None
BBGP-73 (72-76')	7,830.0	5,040.0	Within southeast corner of plot south of the railroad tracks and east of Clinton Avenue. Approximately 330 ft. downgradient of site.	Brown-gray discoloration, strong odor
BBGP-74 (16-20')	3,400.0	3,794.0	Directly on southern border of plot south of the railroad tracks and east of Clinton Avenue. Approximately 315 ft. downgradient of site.	None
BBGP-89 (7-11')	3,600.0	1,695.0	Directly on southern border of plot south of the railroad tracks and east of Clinton Avenue. Approximately 310 ft. downgradient of site.	None
BBGP-89 (16-20')	1,040.0	6,500.0	Directly on southern border of plot south of the railroad tracks and east of Clinton Avenue. Approximately 310 ft. downgradient of site.	None
BBMW-06ST (5-15')	6,352.0	2,073.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Compressor House.	Sheen, slight hydrocarbon-like odor

TABLE 4-12 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
BBMW-06S (5-15')	4,723.0	2,784.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Compressor House.	Sheen, slight hydrocarbon-like odor
BBMW-14S (5-15')	9,200.0	3,064.0	Outside southern portion of Former 0.5 Million cu. ft. Relief Gas Holder. Downgradient of Former 0.5 Million cu. ft. Relief Gas Holder.	Small particles floating in water, strong hydrocarbon-like odor
BBMW-18S (6-16')	4,700.0	1,493.0	Within Office Store & Wash Room. Downgradient of Transformer in eastern portion of site.	None
BBMW-19S (10-20')	6,070.0	2,637.0	Within southern portion of Generator House. Downgradient of Scrubber Pump Room.	Light sheen, possible mild naphthalene-like odor
BBMW-20S (4-14')	15,140.0	2,248.0	Within Clinton Avenue south of the railroad tracks. Approximately 262 ft. downgradient of site.	Naphthtalene-like odor
BBMW-20I (35-45')	40.0	7,134.0	Within Clinton Avenue south of the railroad tracks. Approximately 262 ft. downgradient of site.	None
BBMW-20D (62-72')	3,505.0	14,594.0	Within Clinton Avenue south of the railroad tracks. Approximately 262 ft. downgradient of site.	5.3' of DNAPL, Tar blebs, moderate-strong naphthalene-like odor
BBMW-21S (7.5-17.5')	3,410.0	5,671.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	None
BBMW-21I (30-40')	236.0	9,444.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	1/4" product on bailer, moderate naphthalene-like odor
BBMW-21D (66.3-76.3')	3,140.0	9,016.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of the southern most Boiler House.	> 8' of product

TABLE 4-12 (continued)

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE SITE AND ADJACENT OFF-SITE AREAS GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
BBMW-22S (5-10')	13,610.0	3,954.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Generator House.	Strong naphthalene-like odor
BBMW-22I (30-40')	36.0	8,810.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Generator House.	None
BBMW-22D (64-74')	8,600.0	11,436.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Generator House.	Tar blebs, moderate sheen, moderate naphthalene-like odor
BBMW-23S (5-15')	32,850.0	2,397.0	Within Plume approximately 410 ft. downgradient of site.	Naphthalene-like odor
MW-04S (4-14')	8,033.0	1,021.0	Within plot south of the railroad tracks and west of Clinton Avenue. Downgradient of the southeast corner of Bay Shore West Parcel.	None
MW-05S (4-14')	24,320.0	2,682.0	Within plot south of the railroad tracks and east of Clinton Avenue. Downgradient of Generator House.	Naphthalene-like odor
MW-07D (35-45')	94.0	4,813.0	In vicinity of 75,000 Gallon Tar Tank and Tar Seperators. Downgradient of Tar Separators.	1' of heavy black tar, very viscous, strong naphthalene-like odor
MW-08S (7-17')	5,200.0	1,100.0	Within northeast portion of Generator House. Downgradient of Scrubber Pump Room.	Black blobs, strong hydrocarbon-like odor

supplemental field program, the highest concentration of total BTEX in groundwater (32,850 ug/l) was detected in the sample collected from monitoring well BBMW-23S, which is located approximately 410 feet south of the site. This sample exhibited a naphthalene-like odor; however, NAPL was not observed. The second, third and fourth highest total BTEX concentrations detected in groundwater were 24,320 ug/l, 15,140 ug/l and 13,610 ug/l, detected in samples collected from off-site shallow monitoring wells MW-05S, BBMW-20S and BBMW-22S, respectively. These three samples exhibited a naphthalene-like odor. The highest total BTEX concentration in on-site groundwater was detected in monitoring well BBMW-14S at 9,200 ug/l. Monitoring well BBMW-14S is located southwest of the former Relief Holder. Groundwater sampling conducted as part of the initial field program also identified this on-site area as containing elevated levels of BTEX.

While the majority of samples exhibiting elevated BTEX concentrations were collected at or near the water table, several off-site samples collected from the deep groundwater zone also exhibited BTEX including:

Sample ID	Total BTEX Concentration (ug/l)
BBMW-22D	8,600
BBGP-72 (64 to 68 feet)	9,660
BBGP-73 (72 to 76 feet)	7,830

The three groundwater samples listed above exhibited visible tar blebs, sheens and a naphthalene-like odor. These findings are consistent with field observations which indicated that deep subsurface soil within these off-site areas contained tar staining and/or tar/NAPL-saturated conditions.

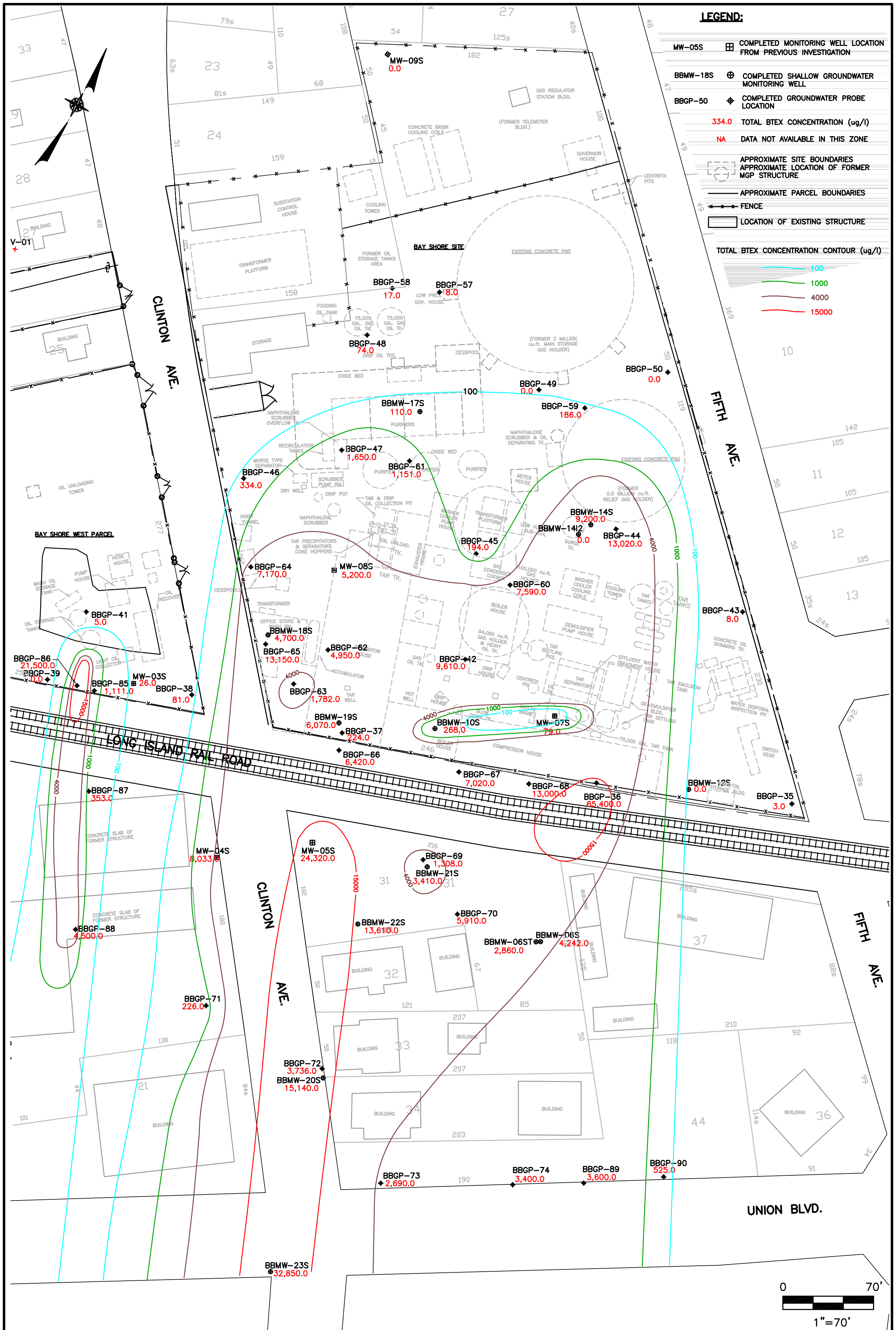
Analysis of the initial groundwater sample collected from deep monitoring well BBMW-05D2 screened within the Magothy aquifer indicated the presence of BTEX at a total concentration of 16 ug/l. However, further sampling of this well indicated nondetectable levels of BTEX.

Figures 4-7 through **4-9** depict total BTEX concentrations in groundwater collected from on-site and adjacent off-site sample locations. The data used for **Figure 4-7** is based on the analytical results of shallow groundwater samples collected from the water table (approximately 6 to 8 feet bgs) to a maximum depth of 26 feet bgs. The data used for **Figure 4-8** is based on the analytical results of groundwater samples collected from the intermediate groundwater zone ranging from 26 feet to 50 feet bgs. The data used for **Figure 4-9** is based on the analytical results of groundwater samples collected from the groundwater zone ranging from 50 feet to 80 feet bgs. Note that the data used in these figures was collected during the initial field program, as well as the supplemental field program, and as a result, the data set used in the graphics spans several years. However, all newly installed and existing monitoring wells were sampled as part of the supplemental field program, and, all monitoring well data presented on the figures is from this Spring 2002 sample round. Furthermore, all groundwater samples from BBGP-57 through BBGP-90 were collected during the Winter/Spring of 2002. Therefore, the majority of the data presented in these figures were collected in early 2002 and provide an accurate picture of total BTEX distribution within the Upper Glacial aquifer.

Based on a review of these figures and the supporting data, the following are noteworthy observations:

1. Consistent with subsurface soil data, a review of **Figure 4-7** indicates that shallow groundwater in the northern third of the Bay Shore site does not exhibit elevated BTEX concentrations. Total BTEX concentrations in this area do not exceed 100 ug/l. In addition, analytical data for samples collected from the southeast corner of the site also indicate that shallow groundwater in this area does not exhibit BTEX concentrations above 10 ug/l.

2. Consistent with the initial field program findings, shallow groundwater in the southern half of the site exhibited BTEX concentrations. The highest concentrations were observed in samples collected from areas southwest of the former Relief Holder, downgradient of the former 54,000 Cubic Foot Gas Holder/Heavy Oil Tank and downgradient of the former Tar and Drip Oil Collection Pit. In addition, BTEX compounds are present in groundwater downgradient of the former Tar Well located in the southwestern portion of the site. However, the most recent groundwater samples collected from shallow wells BBMW-10S and MW-07S located



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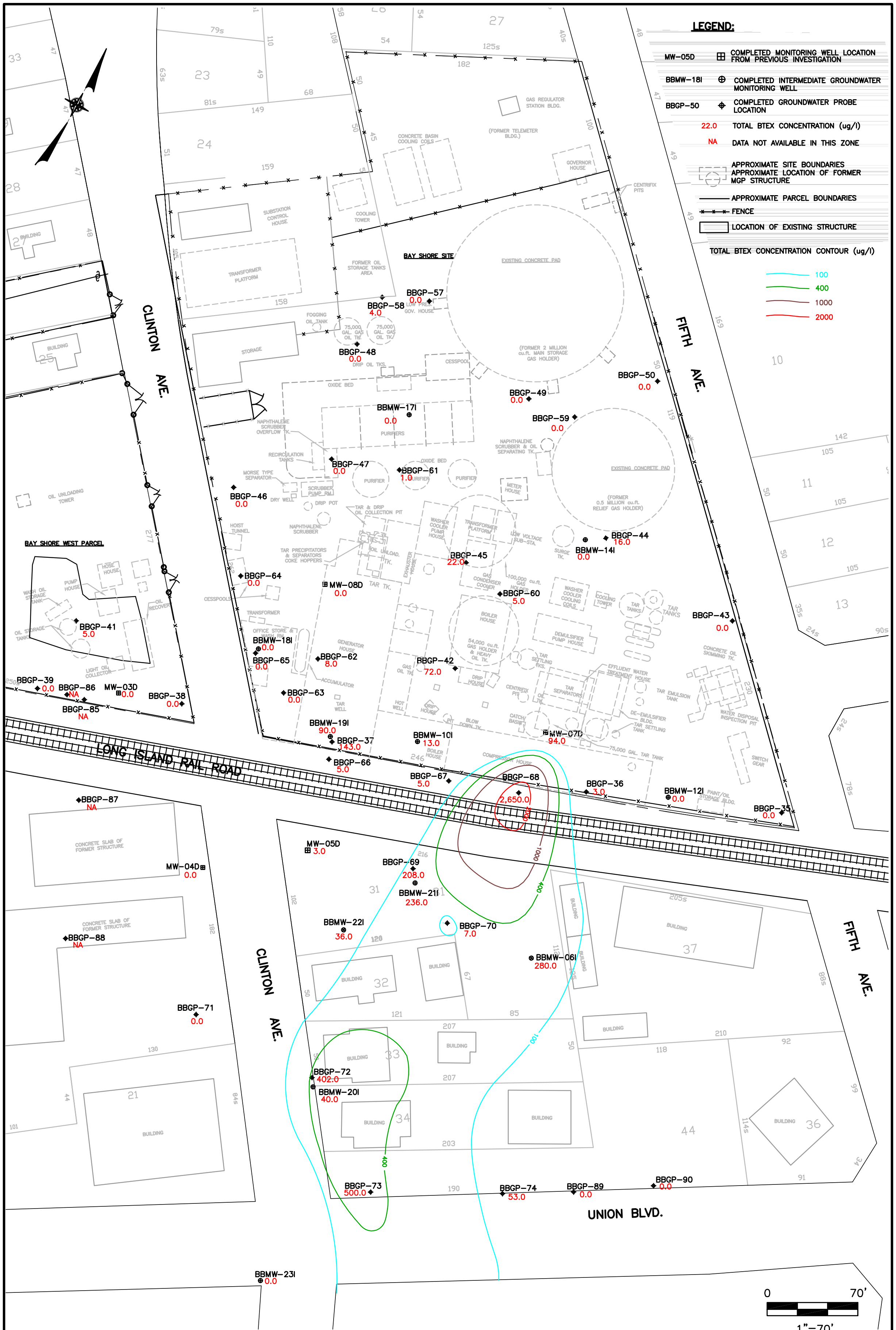
TOTAL BTEX CONCENTRATIONS IN SHALLOW GROUNDWATER (WATER TABLE TO 26 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-7

\\Nt4\CADwork\1620B12B\dwg\11X17\FIG-4M.dwg, 10/28/02 02:08:13 PM, APostyn



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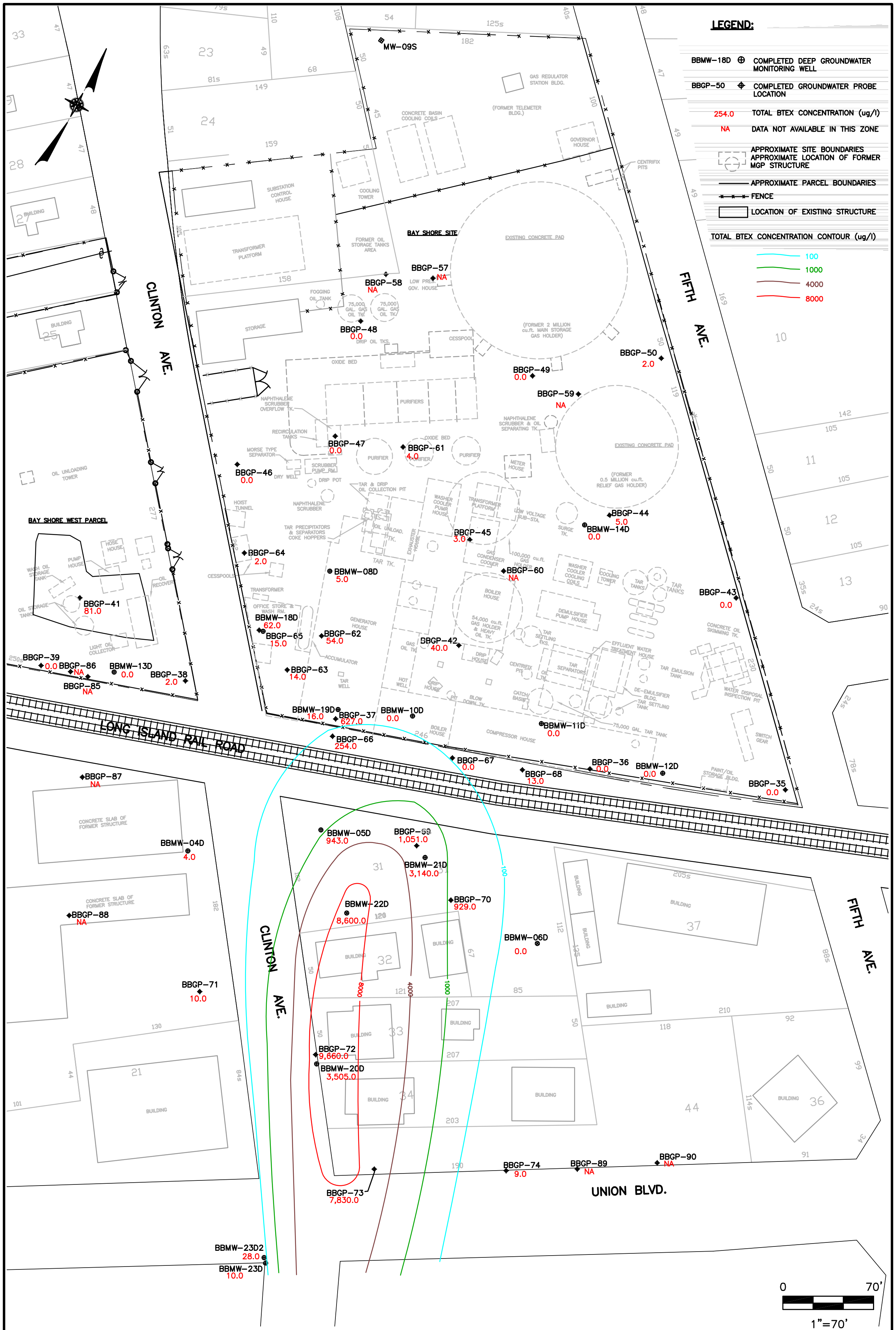
TOTAL BTEX CONCENTRATIONS IN INTERMEDIATE GROUNDWATER (26 TO 50 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-8



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TOTAL BTEX CONCENTRATIONS IN DEEP GROUNDWATER (50 TO 80 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-9

downgradient of the former Tar Separators/Effluent Treatment House exhibited relatively low total BTEX concentrations of 268 ug/l and 79 ug/l, respectively. As a result, **Figure 4-7** shows a zone of lower total BTEX in this location, though prior samples collected from this area exhibited significantly higher concentrations in the past. While the subsurface soil sample collected near the former Cesspool located southwest of the former Gas Holder contained elevated levels of BTEX, total BTEX concentrations for samples collected downgradient from this area in monitoring well BBMW-17S was only 110 ug/l.

3. **Figure 4-7** illustrates the fact that some of the highest total BTEX concentrations observed in shallow groundwater were collected from off-site locations including groundwater probes BBGP-67, BBGP-68 and BBGP-72, as well as monitoring wells MW-04S, MW-05S, BBMW-20S, BBMW-22S and BBMW-23S.

4. **Figure 4-8** indicates that groundwater in the intermediate zone is relatively free of BTEX throughout the Bay Shore site with total BTEX concentrations generally not exceeding 100 ug/l at most locations. This is consistent with subsurface soil data for the Bay Shore Site, which indicate that on-site soil below a depth of 32 feet does not exhibit total BTEX concentrations greater than 0.03 mg/kg. Off-site groundwater samples collected from the intermediate groundwater zone immediately downgradient of the site generally exhibited higher concentrations than on-site points, with a maximum total BTEX concentration of 2,650 ug/l detected at BBGP-68 (32 to 36 feet). However, farther downgradient, total BTEX concentrations appear to decrease in this zone with total BTEX concentrations not exceeding 500 ug/l.

5. Similar to the intermediate zone, the on-site deep groundwater zone contains little BTEX with the majority of deep on-site locations exhibiting nondetectable to trace levels of total BTEX (i.e., not exceeding 5 ug/l). However, samples collected along the southern property boundary contained higher levels of BTEX with a maximum total BTEX concentration of 627 ug/l detected at BBGP-37 (71 to 75 feet). As shown on **Figure 4-9**, deep groundwater samples collected from downgradient locations, including groundwater probe points BBGP-69, BBGP-70 and BBGP-72, as well as monitoring wells BBMW-20D, BBMW-21D and BBMW-22D, contained elevated BTEX concentrations. Subsurface soil in this adjacent off-site area also exhibited elevated levels of BTEX, as well as tar staining and tar/NAPL at saturated levels.

PAHs

Table 4-12 summarizes on-site groundwater samples that exhibited the highest total PAH concentrations along with the approximate locations of these samples in relation to former MGP structures/features where appropriate. The table also indicates any significant field observations noted in these samples. Additional detail as to the distribution of NAPL in groundwater is provided in **Section 4.2.1.4**.

A review of **Table 4-12** indicates that, unlike BTEX concentrations which were observed to be highest in shallow on-site groundwater, PAH concentrations detected in groundwater were observed to be highest in off-site groundwater samples collected from the deep and, to a lesser extent, intermediate groundwater zones. The highest total PAH concentrations detected in groundwater as part of the supplemental field program were observed at groundwater probe BBGP-72 located approximately 250 feet south of the site with total PAH concentrations of 823,300 ug/l at 64 to 68 feet, 65,000 ug/l at 56 to 60 feet and 17,181 ug/l at 71 to 75 feet. In addition, deep monitoring well BBMW-20D installed adjacent to groundwater probe BBGP-72 exhibited the fourth highest total PAH concentration of 14,594 ug/l. Note that all listed samples collected from this area exhibited tar blebs and sheens. A comparison of the PAH concentrations detected in groundwater samples collected from areas that also contained NAPL at saturated levels in soil with published solubility data for respective compounds, indicates that a number of the PAH compounds were detected at concentrations well above their maximum solubility in water. Based on this comparison, as well as field observations, the BTEX and PAH concentrations observed in groundwater within these areas do not represent true dissolved-phase concentrations, but are likely biased high due to the presence of NAPL in collected samples (i.e., sheens, separate phase layers and/or blebs).

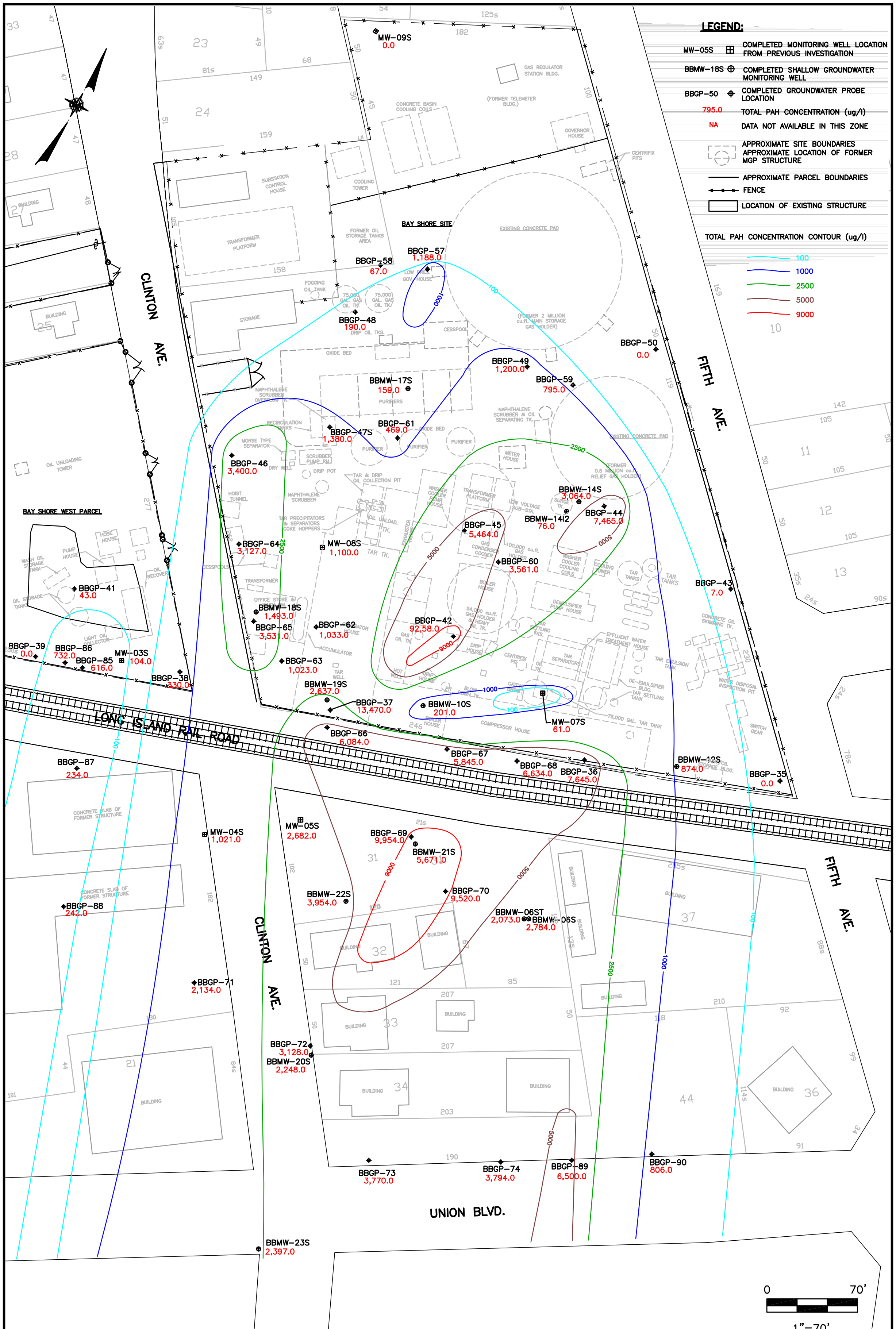
Consistent with the findings of the initial field program, the highest PAH concentrations detected at on-site sample locations were observed in the shallow groundwater zone, downgradient of the former Relief Holder (BBMW-14S and BBGP-44) within the vicinity of the former 54,000-gallon Cubic Foot Gas Holder/Heavy Oil Tank (BBGP-60) and downgradient of the former Tar and Drip Oil Collection Pit (BBGP-62, BBGP-66, BBMW-18S and MW-08S).

Analysis of the initial groundwater sample collected from deep monitoring well BBMW-05D2, screened in the Magothy formation, indicated a total PAH concentration of 147 ug/l. However, further sampling conducted at this well indicated nondetectable levels of PAHs.

Figures 4-10 through **4-12** depict total PAH concentrations in groundwater collected from on-site and adjacent off-site sample locations. The data used for **Figure 4-10** is based on the analytical results of groundwater samples collected from the water table (approximately 6 to 8 feet bgs) to a maximum depth of 26 feet bgs. The data used for **Figure 4-11** is based on the analytical results of groundwater samples collected from the intermediate groundwater zone ranging from 26 feet to 50 feet bgs. The data used for **Figure 4-12** is based on the analytical results of groundwater samples collected from the deep groundwater zone ranging from 50 feet to 80 feet bgs. Note that the data used in these figures was collected during the initial field program, as well as the supplemental field program, and as a result, the data set used in the graphics spans several years. However, all newly installed and existing monitoring wells were sampled as part of the supplemental field program, and all monitoring well data presented on the figures is from the Spring 2002 sampling program. Furthermore, all groundwater samples from BBGP-57 through BBGP-90 were collected during the winter/spring of 2002. Therefore, the majority of the data presented in these figures was collected in early 2002 and provide an accurate picture of the present total PAH distribution within the Upper Glacial aquifer.

Based on a review of these figures and the supporting data, the following are noteworthy observations:

1. **Figure 4-10** indicates that shallow groundwater in the northernmost third of the Bay Shore site is relatively free of elevated levels of PAHs, with total PAH concentrations not exceeding 200 ug/l in most samples. One anomaly is that PAHs were detected at a total concentration of 1,188 ug/l at BBGP-57 located west of the former Gas Holder. In addition, shallow groundwater in the southeastern corner of the Bay Shore site does not contain PAHs above 10 ug/l. Shallow groundwater at sample locations within the southern half of the site contains elevated PAHs, including BBGP-45 (5,464 ug/l), BBGP-44 (7,465 ug/l), BBGP-42 (9,258 ug/l) and BBGP-37 (13,470 ug/l). However, the most recent groundwater samples collected from shallow wells BBMW-10S and MW-07S located downgradient of the former Tar Separators/Effluent Treatment House exhibited relatively low total PAH concentrations of 201 ug/l and 61 ug/l, respectively. As a result, **Figure 4-10** shows a zone of lower total PAH in this location, though prior samples collected from this area exhibited significantly higher concentrations in the past. Downgradient of the Bay shore site, total PAHs were detected at a concentration of 2,397 ug/l in shallow groundwater at monitoring well BBMW-23S, which is located approximately 410 feet south of the site.



\\Nt4\CADwork\1620B12B\dwg11X17\FIG-4P.dwg, 10/28/02 02:11:05 PM, APostyn

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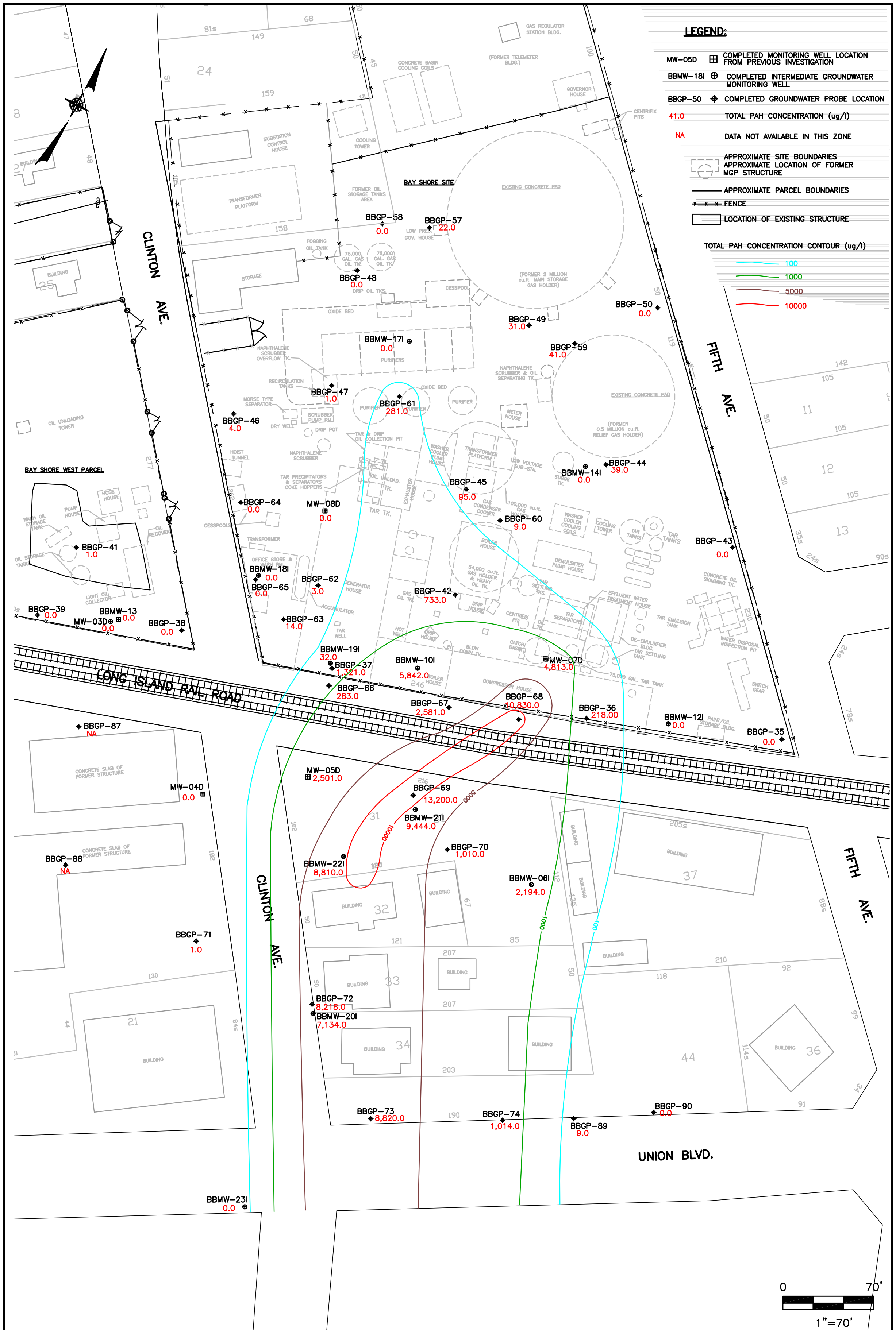
TOTAL PAH CONCENTRATIONS IN SHALLOW GROUNDWATER (WATER TABLE TO 26 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-10



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TOTAL PAH CONCENTRATIONS IN INTERMEDIATE GROUNDWATER (26 TO 50 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-11

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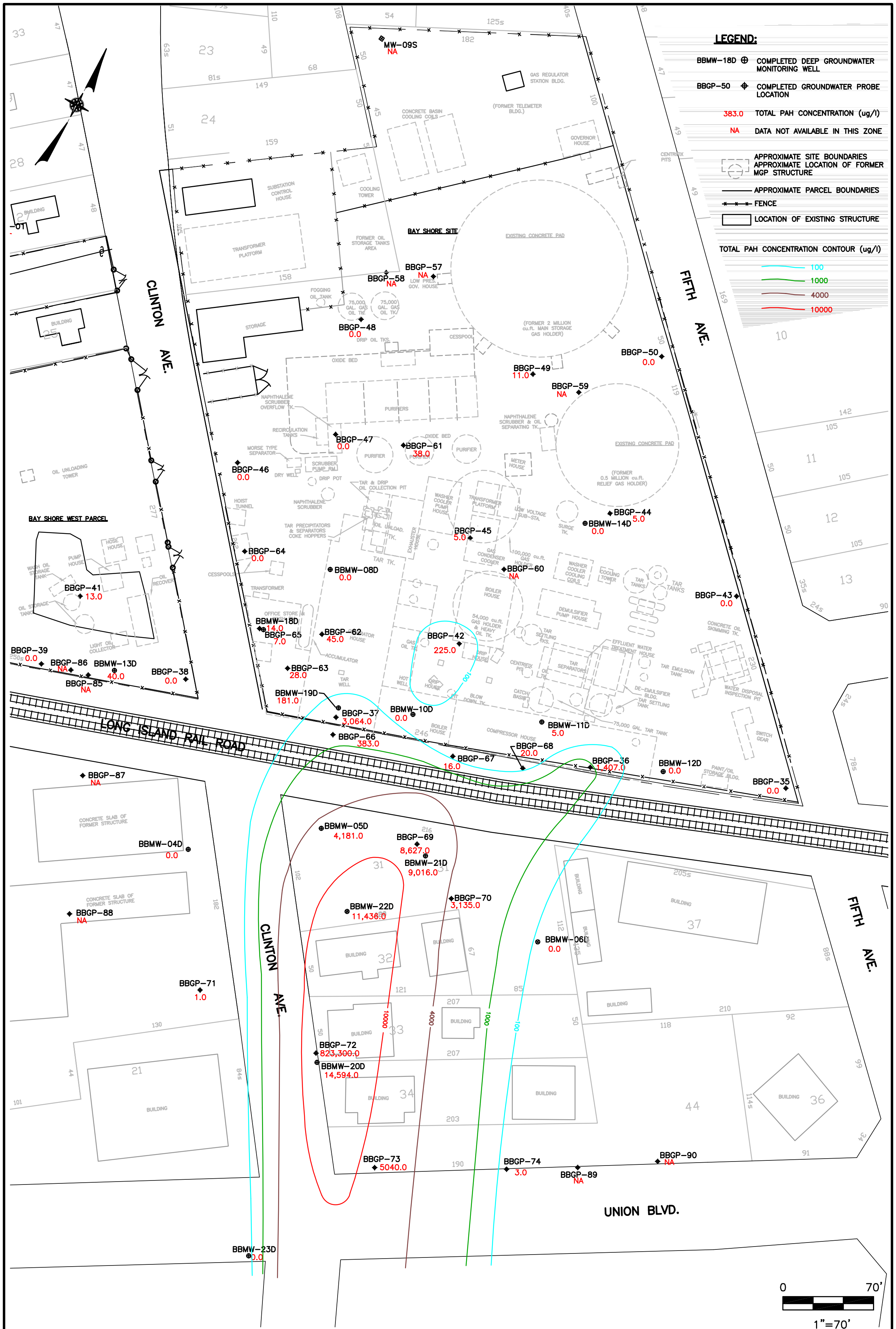

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TOTAL PAH CONCENTRATIONS IN DEEP GROUNDWATER (50 TO 80 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-12

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\\Nt4\CADwork\1620B12B\dwg\11X17\FIG-4R.dwg, 10/28/02 02:12:50 PM, APostyn

2. **Figure 4-11** clearly indicates total PAH concentrations in groundwater in the intermediate zone (i.e., below a depth of 26 feet) at the majority of on-site locations did not exceed 300 ug/l throughout the northern two-thirds of the site. However, PAHs were detected in intermediate groundwater in the southernmost portion of the site and downgradient of the former 54,000 Cubic Foot Gas Holder/Heavy Oil Tank (BBGP-42 and BBMW-10I), as well as downgradient of the former Tar Separators/Effluent Treatment House as indicated by MW-07D. Immediately off-site and downgradient of these former structures, PAHs were detected in the samples from the intermediate groundwater zone at groundwater probes BBGP-67, BBGP-68, BBGP-69, BBGP-72 and BBGP-73, as well as monitoring wells BBMW-20I, BBMW-21I and BBMW-22I.

3. As illustrated on **Figure 4-12**, the deep groundwater zone within the Bay Shore site does not contain elevated levels of PAHs, with total PAH concentrations not exceeding 50 ug/l throughout the majority of the site. However, PAHs were detected in samples collected from the deep groundwater zone at locations along the southern property boundary of the site as indicated by samples collected from BBGP-36 and BBGP-37. As discussed previously, the highest total PAH concentrations observed in groundwater were actually collected from off-site locations within the deep groundwater zone, including groundwater probes BBGP-69, BBGP-70, BBGP-72 and BBGP-73, as well as monitoring wells BBMW-05D, BBMW-20D, BBMW-21D and BBMW-22D. The presence of PAHs in the deep groundwater zone is consistent with field observations indicating tar staining, as well as tar/NAPL at saturated conditions within deep subsurface soil immediately downgradient of the Bay Shore site.

Historical Total BTEX/PAH Concentrations at the Bay Shore Site

Changes in total BTEX and total PAH concentrations with time in monitoring wells MW-07S and MW-08S and 08D within the on-site groundwater plume are shown graphically on **Figures 4-13** through **4-15**. Similarly, groundwater data for monitoring wells MW-04S, MW-04D, MW-05S and MW-05D are plotted on **Figures 4-16** through **4-19** to evaluate conditions in the adjacent off-site areas of the plume immediately downgradient from the Bay Shore site. The wells used to evaluate possible trends in total BTEX and total PAH concentrations were selected based on their relative location to potential source areas, as well as the availability of analytical data from multiple sampling events at each well. Additionally, several of these wells have historically exhibited some of the highest total BTEX/PAH concentrations. Where appropriate, data from all wells in a monitoring well cluster were evaluated and all available data for a given well was utilized.

FIGURE 4-13
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CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ON-SITE GROUNDWATER MONITORING WELL MW-07S

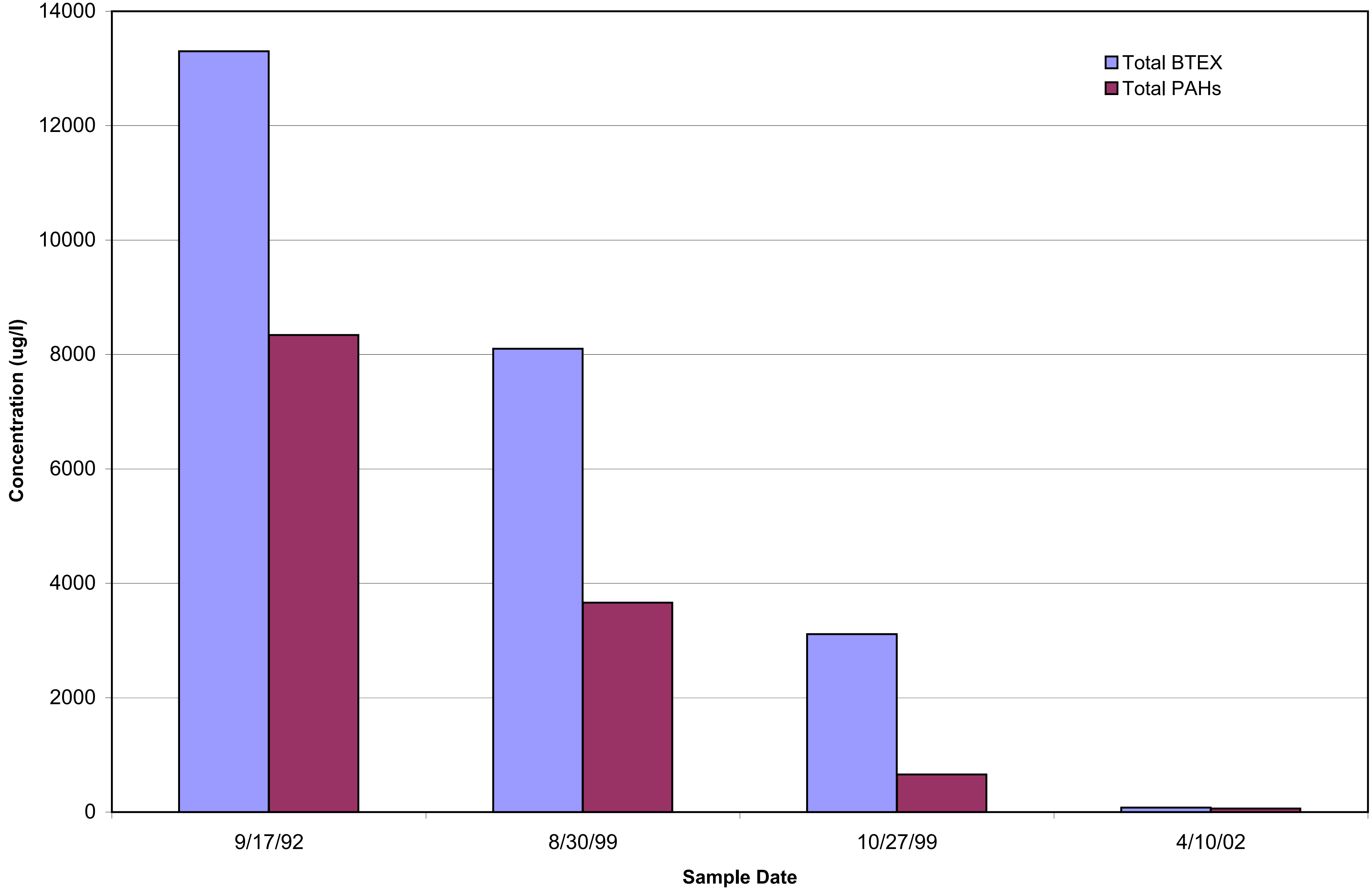

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FIGURE 4-14
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CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ON-SITE GROUNDWATER MONITORING WELL MW-08S

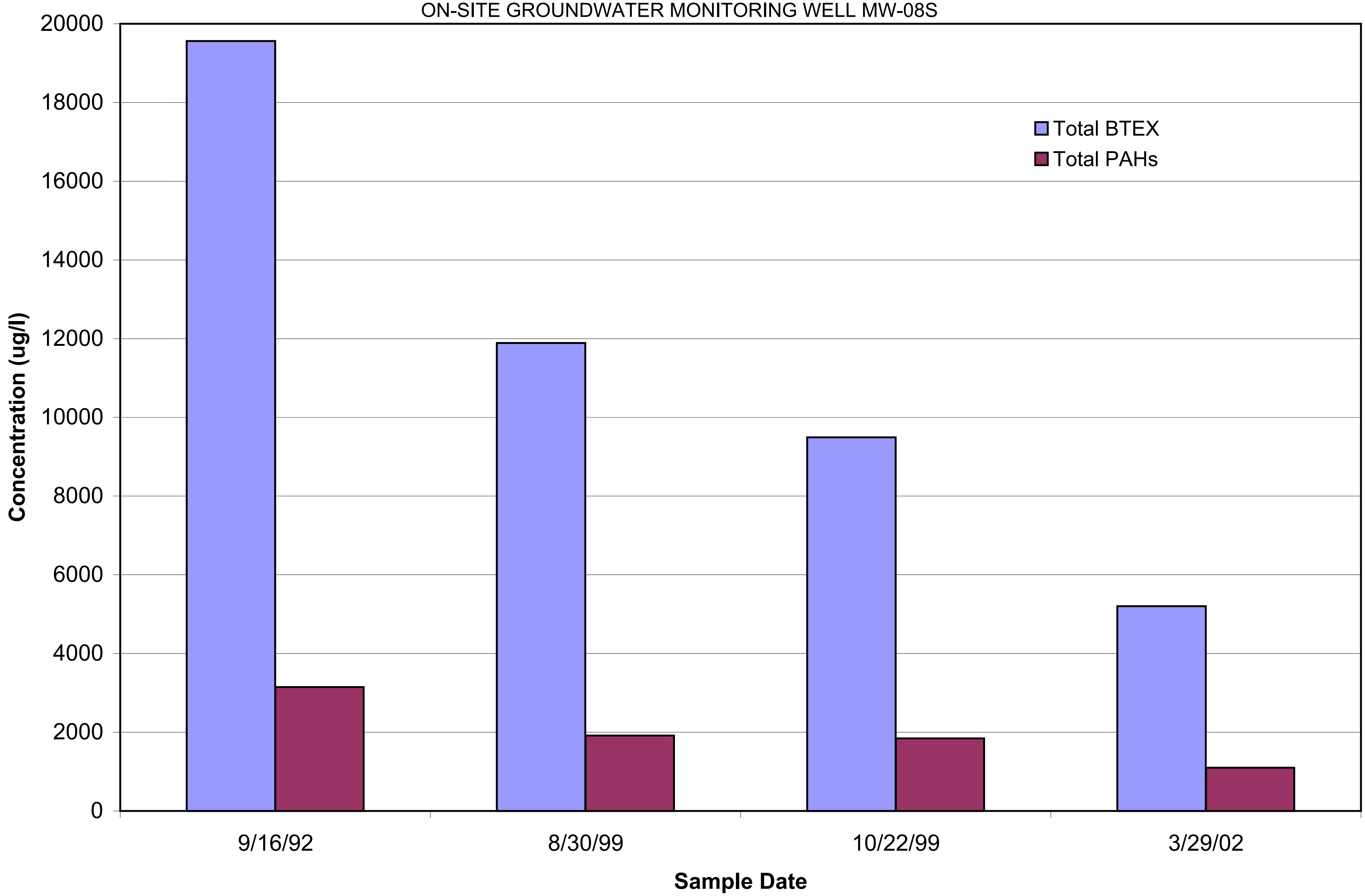

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FIGURE 4-15
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CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ON-SITE GROUNDWATER MONITORING WELL MW-08D

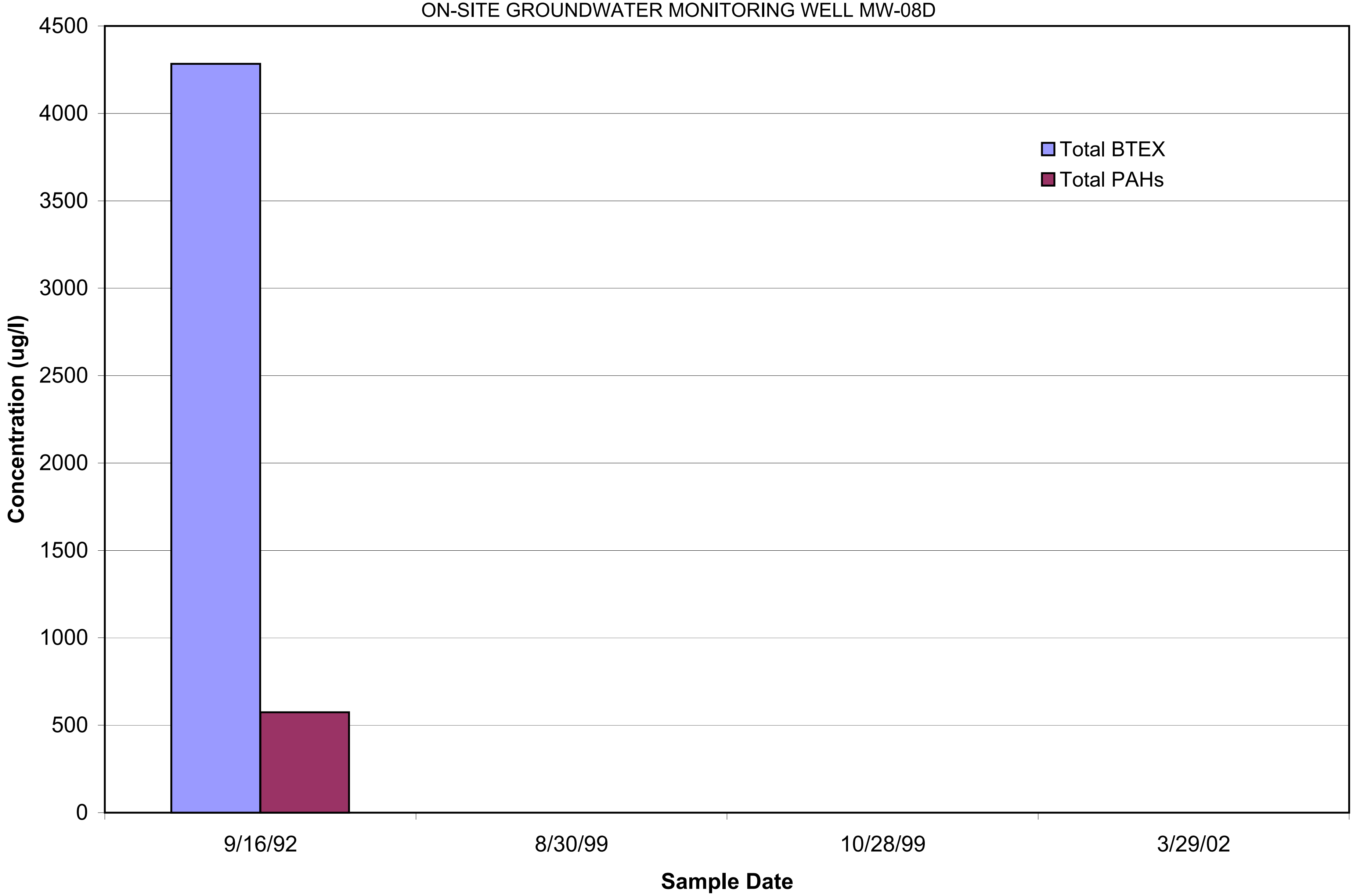

FIGURE 4-16
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ADJACENT OFF-SITE GROUNDWATER MONITORING WELL MW-04S

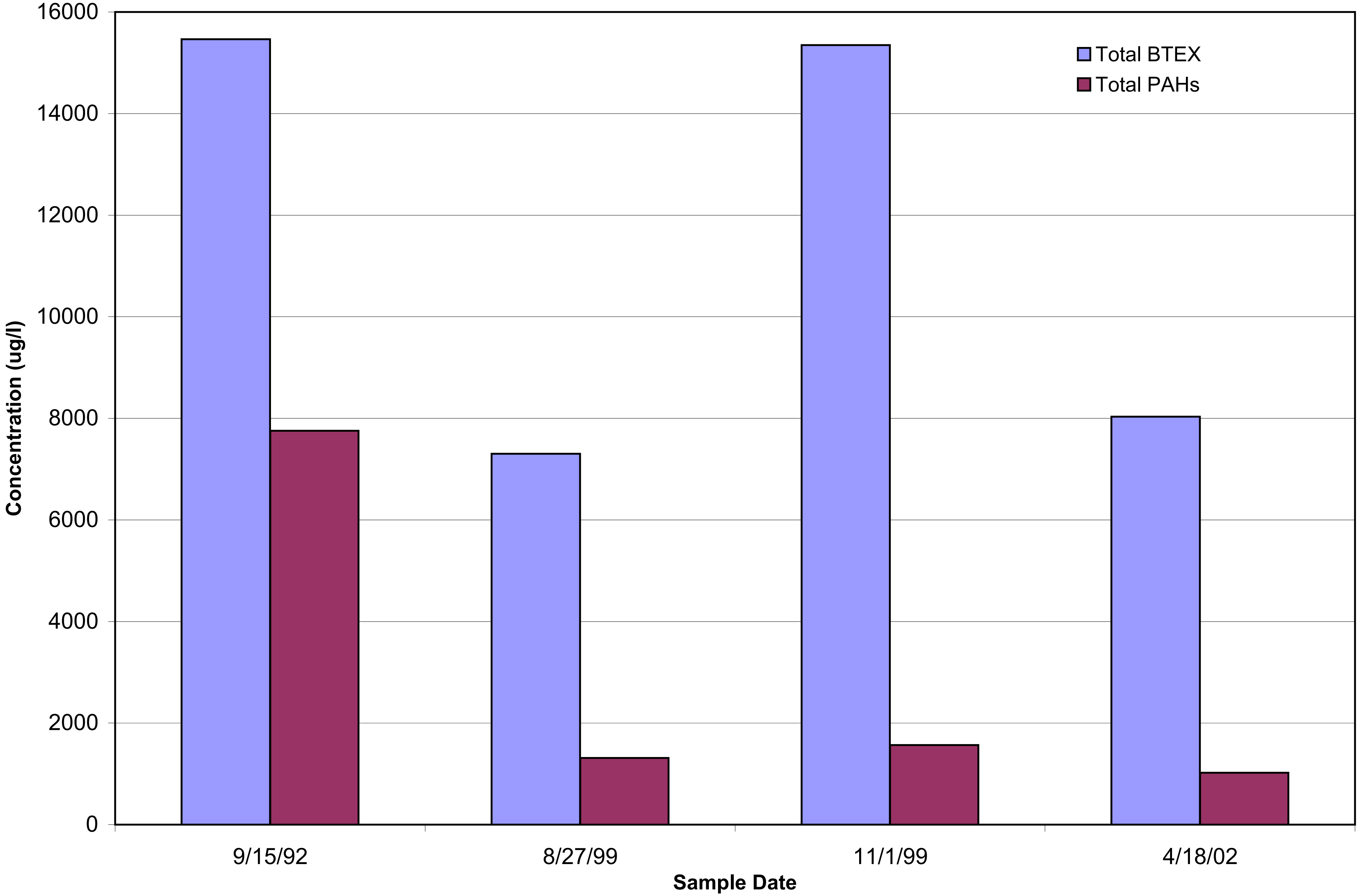

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FIGURE 4-17
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ADJACENT OFF-SITE GROUNDWATER MONITORING WELL MW-04D

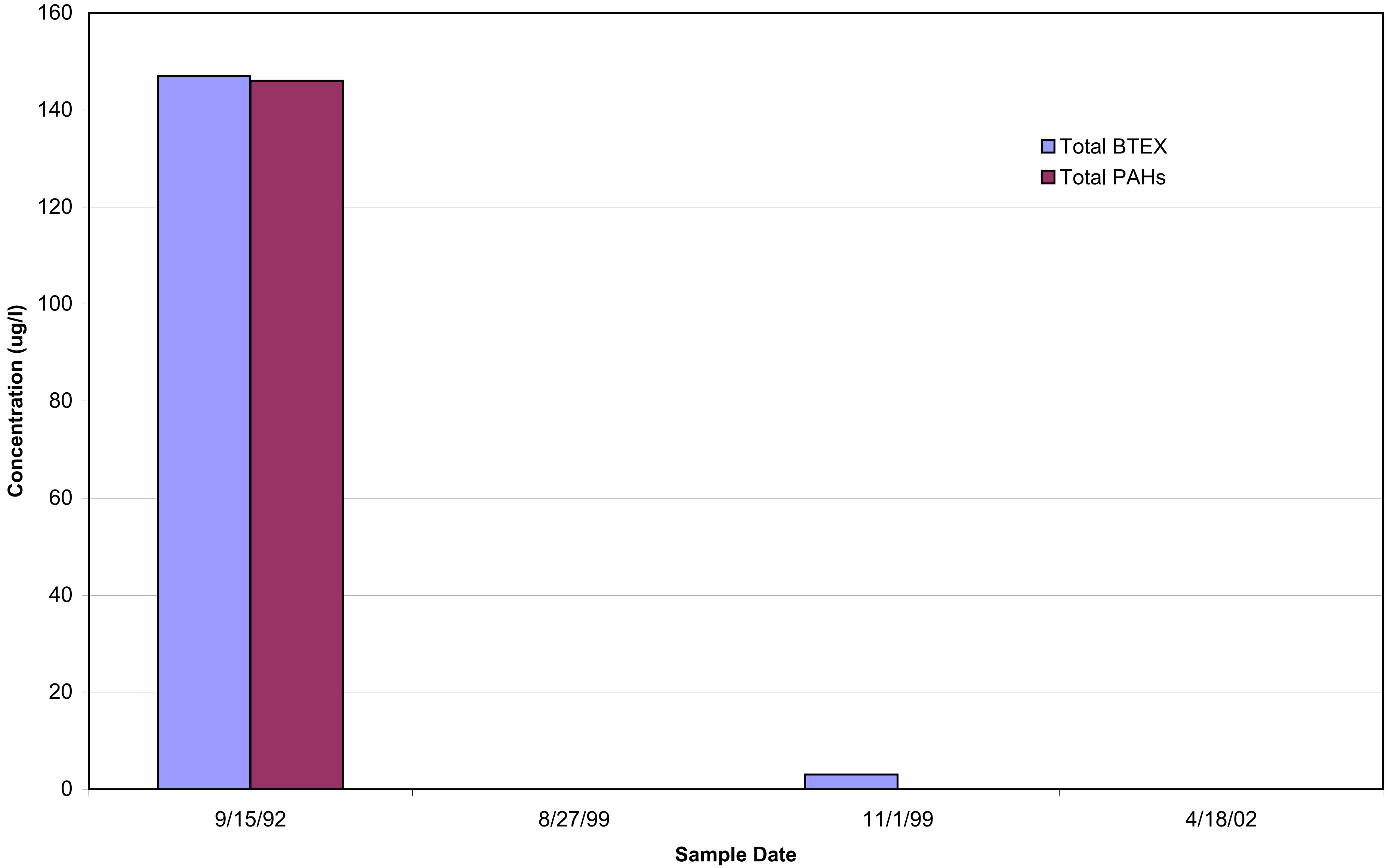

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FIGURE 4-18
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CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ADJACENT OFF-SITE GROUNDWATER MONITORING WELL MW-05S

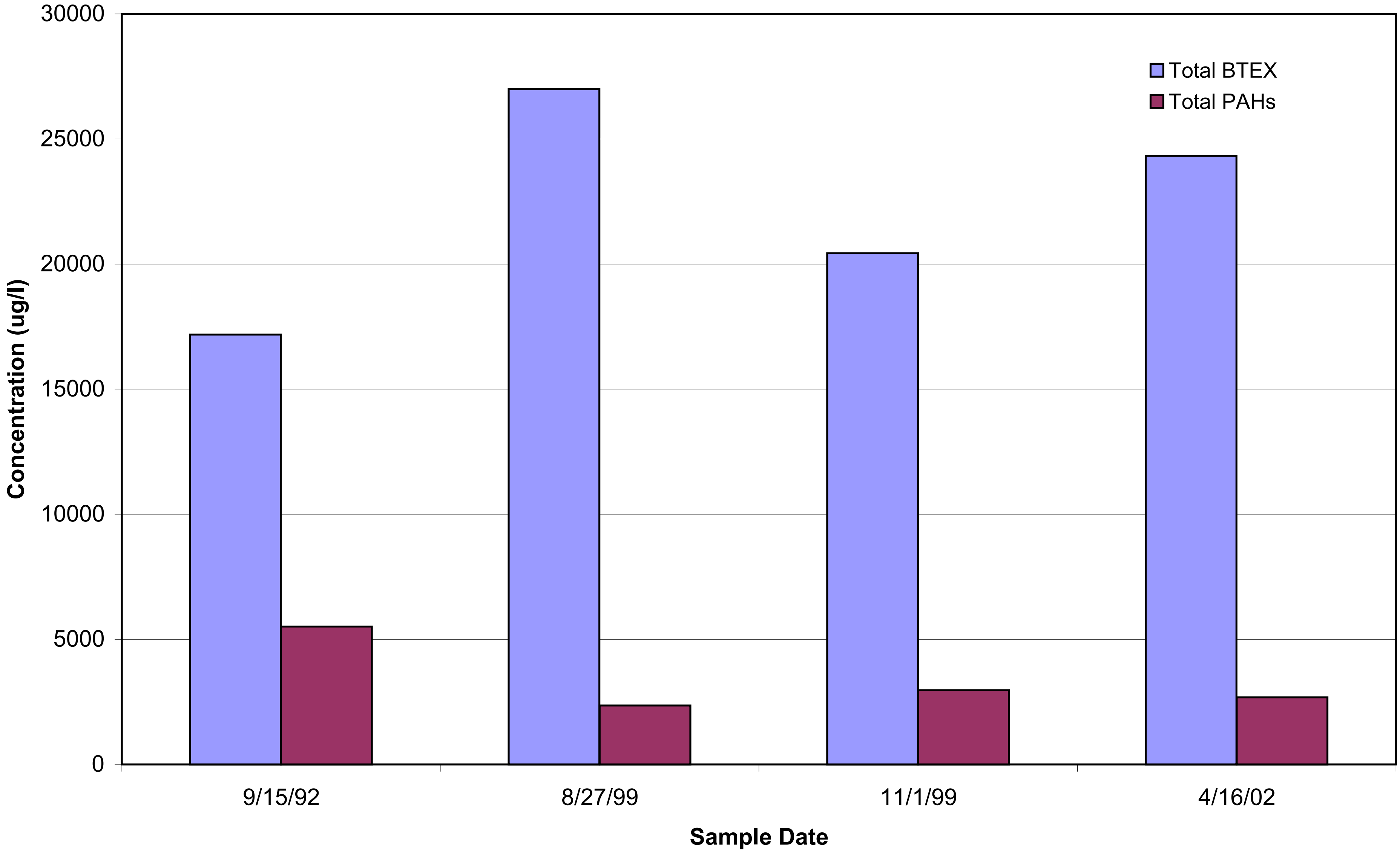

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FIGURE 4-19
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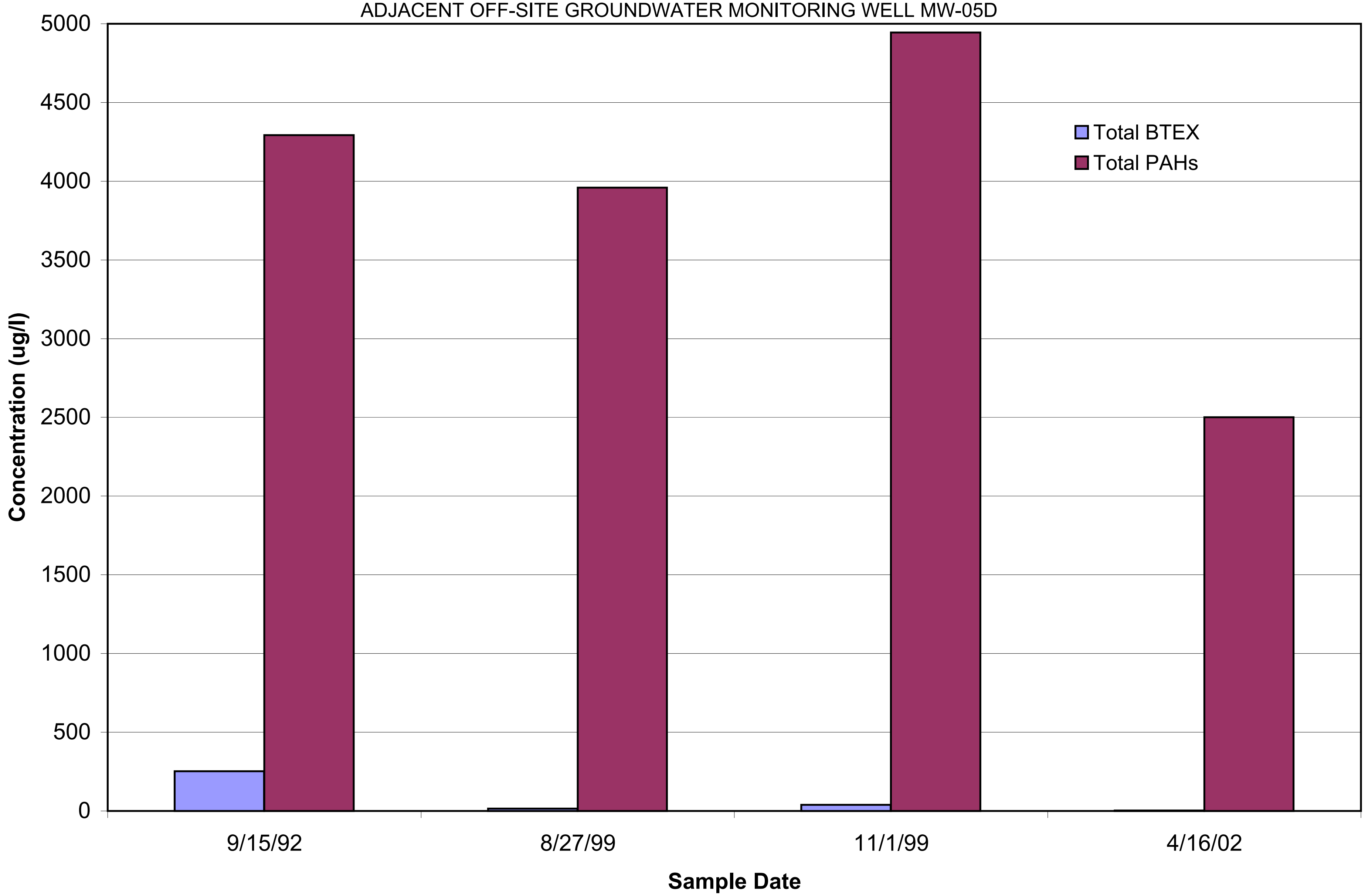
CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
ADJACENT OFF-SITE GROUNDWATER MONITORING WELL MW-05D



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Historically, monitoring of the selected wells that were used to evaluate possible changes of BTEX and PAH concentrations in groundwater over time was not performed on a routine schedule. Accordingly, the trends presented in the graphs provide an overview of long-term changes in concentrations of these parameters over time. It is likely that BTEX and PAH concentrations in groundwater fluctuate in response to seasonal changes in water elevations produced by precipitation; however, no groundwater elevation and precipitation data is available for the historical monitoring events. Therefore, the influence of groundwater elevation on the observed fluctuations of total BTEX and total PAHs over time cannot be evaluated.

A review of **Figures 4-13** and **4-14** shows that the concentrations of total BTEX and total PAHs in on-site groundwater appear to have decreased since regular monitoring was initiated in September 1992. Specifically, the concentrations of total BTEX at well MW-07S decreased from 13,300 ug/l in September 1992 to 79 ug/l in April 2002. During this same period total PAHs decreased from 8,340 ug/l to 61 ug/l. Monitoring well MW-07S is located in the area of the former Tar Separators and former 75,000-gallon Tar Tank in the south-central portion of the site. Monitoring wells MW-08S and MW-08D are located adjacent to the northwestern end of the former Generator House and downgradient from the former Purifiers, Tar and Drip Oil Collection Tanks and Naphthalene Scrubber Overflow Tank. The concentrations of total BTEX and total PAHs appear to have decreased over time in samples collected from monitoring well MW-08S. However, the analytical results from the most recent sampling event in March 2002 detected total BTEX at 5,200 ug/l and total PAHs at 1,100 ug/l.

As shown on **Figures 4-16** and **4-18** the total BTEX concentrations in groundwater at monitoring wells MW-04S and MW-05S located in the adjacent off-site areas immediately south of the site have fluctuated between September 1992 and April 2002 with concentrations that ranged from 7,300 ug/l to 15,463 ug/l in well MW-04S and from 17,180 ug/l to 27,000 ug/l in well MW-05S. During this same monitoring period the concentrations of total PAHs have decreased to at or near the current levels which have remained relatively constant since August 1999. The trends exhibited by the total BTEX and total PAHs on these figures shows that, while there has been no net decrease in concentrations, the concentrations have not increased. As shown in **Figure 4-17**, since sampling of monitoring well MW-04D was initiated in September

1992, total BTEX was only detected at a concentration of 3 ug/l. It is noted that total PAHs predominate in the monitoring well MW-05D (**Figure 4-19**) with total BTEX being at very low concentrations. Accordingly, the plume in this area of the off-site is considered to be stable or in a steady state.

Petroleum Fingerprint/Specific Gravity/Viscosity Analysis

Analytical results for TPH and fuel fingerprint for monitoring well groundwater samples are summarized in **Table C-10**. Samples of DNAPL present in monitoring wells BBMW-21D and BBMW-22D were analyzed for fingerprint. Refer to **Section 4.2.1.4** for additional information on the DNAPL identified in these wells. The results of the fingerprint analyses showed that the type and distribution of PAHs that comprised the NAPL in these samples were typical of those produced by MGP by-products. Further environmental forensic analysis was performed on the two DNAPL samples collected from BBMW-21D and BBMW-22D. In addition, both samples were analyzed for specific gravity and viscosity. A copy of the forensic analysis report is provided as **Appendix D**. Based on this further analysis, it was determined that:

- The DNAPL collected from BBMW-21D contained a pyrogenic substance. Pyrogenic substances are complex mixtures of primarily hydrocarbons produced from organic matter subjected to high temperatures, but with insufficient oxygen for complete combustion. Pyrogenic materials are produced by fires, internal combustion engines, and furnaces. They also are formed when coke or gas are produced from coal or oil. Coal-tar based products, such as roofing, pavement sealers, waterproofing, pesticides, and some shampoos contain pyrogenic materials. The pattern of PAHs, especially the ratios of fluoranthene to pyrene and dibenzofuran to fluorine indicate that the pyrogenic material in this sample is MGP tar, probably from a carbureted water gas (CWG) process. The slightly reduced monocyclic aromatic hydrocarbon (MAH) concentrations relative to PAHs may be indicative of very mild weathering. In addition, the DNAPL from BBMW-21D was found to have a specific gravity of 1.07 indicating it is denser than water. The sample exhibited a kinematic viscosity at 25° Celsius (°C) of 39.1 centistokes (cSt). Water at 25°C has a kinematic viscosity of approximately 1.0 cSt.

- The DNAPL sample collected from BBMW-22D also contained a pyrogenic substance. The pattern and ratios of PAHs indicate that the pyrogenic material in this sample is MGP tar, probably CWG. The slightly reduced MAH concentrations relative to PAHs may be indicative of very mild weathering. In addition, the DNAPL from BBMW-22D exhibited a specific gravity of 1.03 and a kinematic viscosity of 23.19 cSt.

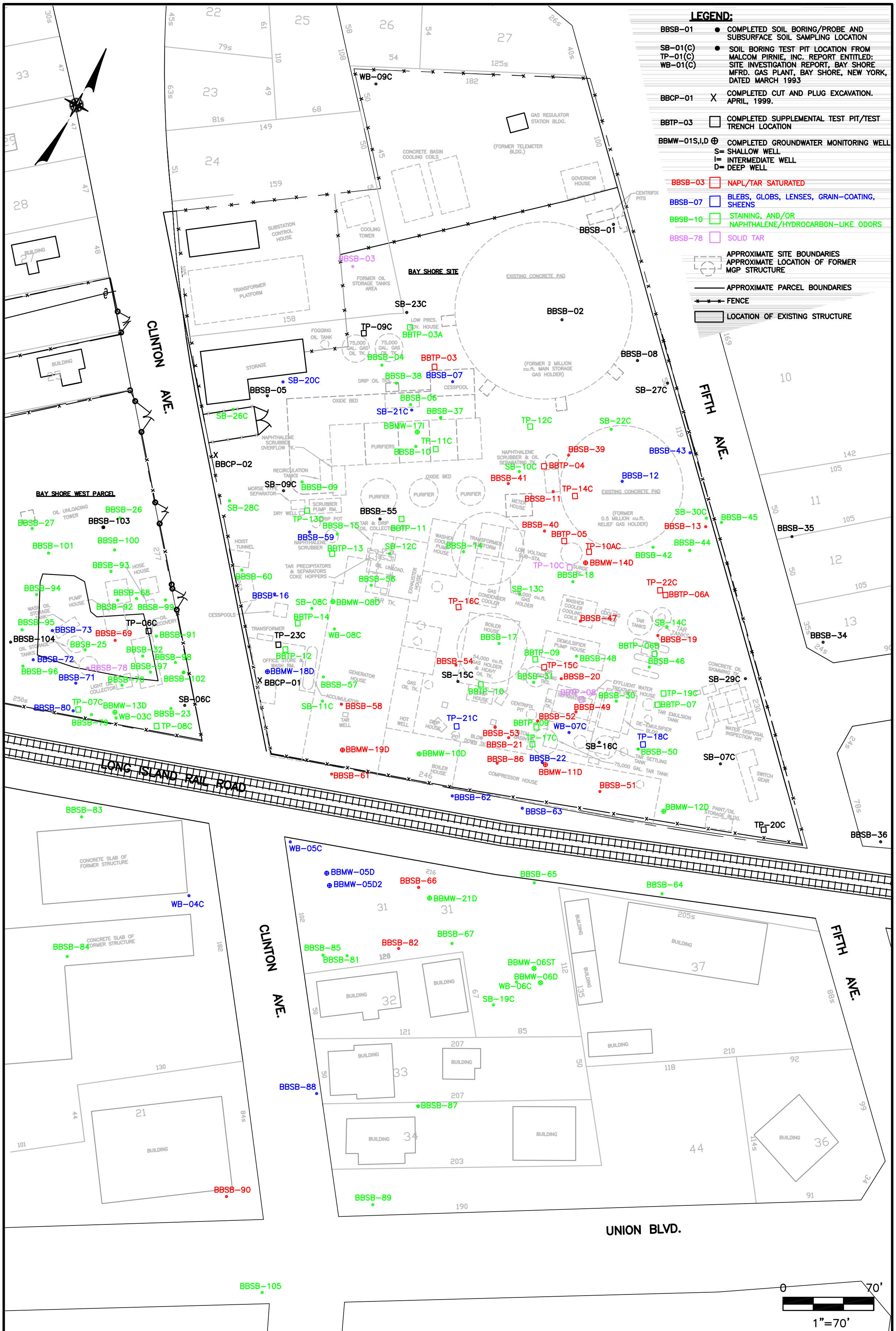
4.2.1.4 - Extent of NAPL

Figures 4-20 through **4-22** graphically depict the locations of soil borings and test pits completed as part of this remedial investigation, as well as prior studies where the following field observations were noted in subsurface soil: NAPL or tar-saturated conditions, blebs and lenses of NAPL; observations of soil grains coated by NAPL or tar; soil staining; soil with naphthalene/hydrocarbon-like odors; as well as areas of solid tar in the Bay Shore site, the Bay Shore West Parcel, and adjacent off-site areas. **Figures 4-20** through **4-22** also show where these conditions were encountered if one or more soil samples exhibited these physical conditions in the shallow (2 to 12 feet bgs), intermediate (12 to 32 feet bgs) and deep (greater than 32 feet deep) soil zones, respectively. In addition, **Drawings 4A** through **4C** graphically depict this same information vertically in geologic cross sections which run through the Bay Shore site and adjoining properties. All listed drawings are provided in map pockets at the end of this section.

Shallow Soil

Note that the shallow soil zone includes the groundwater interface located between 6 and 8 feet below grade at the Bay Shore site. As shown in **Figure 4-20**, NAPL and/or tar-saturated conditions were observed in shallow subsurface soil primarily within the vicinity of or adjacent to former MGP structures, including:

- Cesspool located west of the Main Storage Holder;
- The western half of the Relief Holder;
- Naphthalene Scrubber, Oil Separating Tank and Surge Tank located west of the Relief Holder;
- Washer Cooler Cooling Coils located south of the Relief Holder;



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FIELD OBSERVATIONS OF SHALLOW SUBSURFACE SOIL (2 TO 12 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-20

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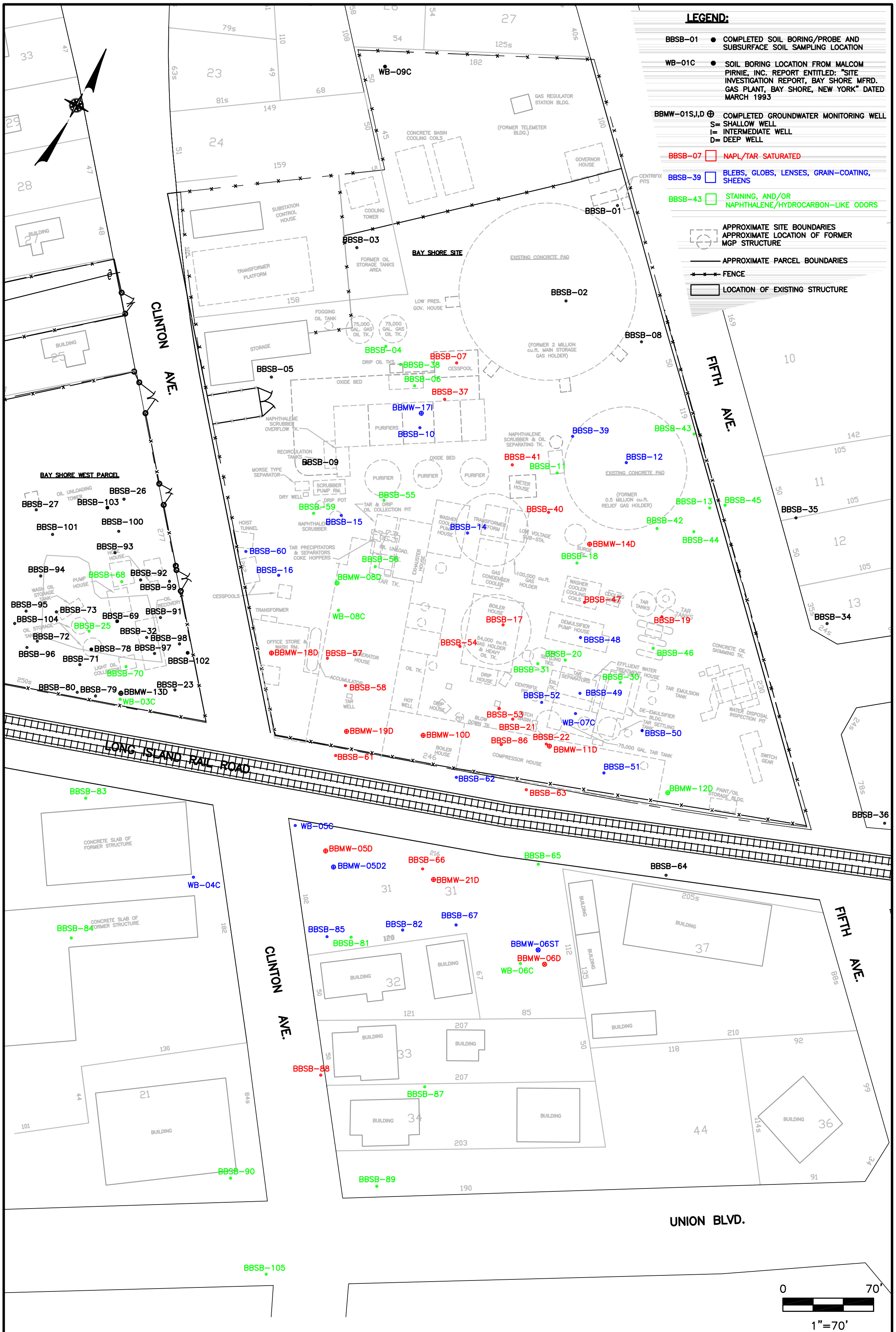

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FIELD OBSERVATIONS OF INTERMEDIATE SUBSURFACE SOIL (12 TO 32 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-21

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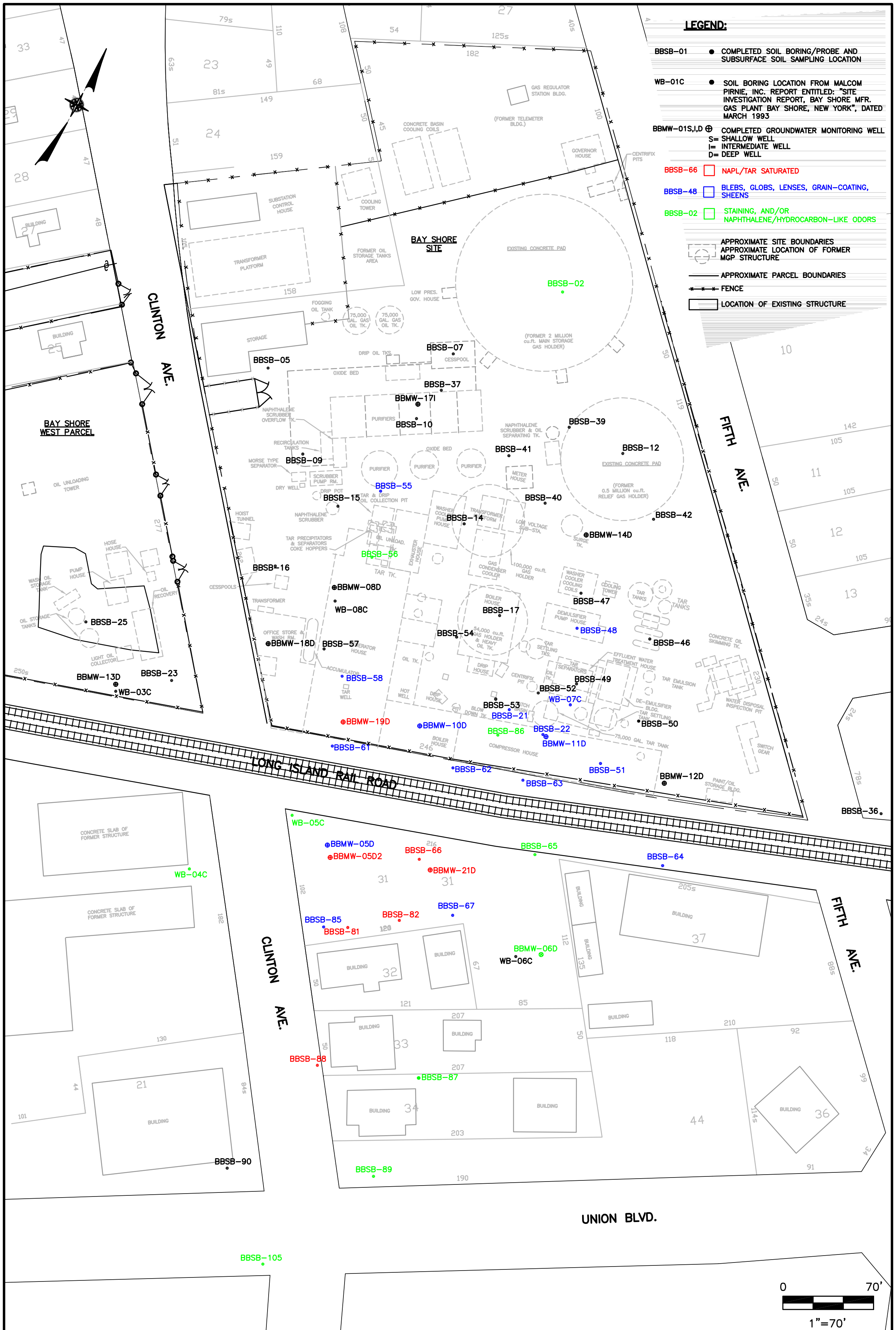

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FIELD OBSERVATIONS OF DEEP SUBSURFACE SOIL (> 32 FEET) AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 4-22

\\Nt4\CADwork\1620B12B\dwg\11X17\FIG-4I.dwg, 10/28/02 02:16:29 PM, APostyn

- The Tar Separators, Tar Tanks and Effluent Water Treatment House located in the southern portion of the site;
- 54,000 cubic feet Gas Holder and Heavy Oil Tank; and
- Tar well located in the southern portion of the Generator House.

As described in **Section 4.2.1.2**, the areas in the vicinity of the former structures listed above generally exhibited the highest total BTEX and total PAH concentrations in shallow subsurface soil. Based on the presence of shallow NAPL/tar-saturated soil, as well as total BTEX and total PAH concentrations in subsurface soil, the former structures listed above are considered potential source areas. **Figure 4-20** also illustrates that, with the exception of the former Cesspool, the northernmost third of the Bay Shore site does not contain soil exhibiting NAPL or tar at saturated conditions. However, staining and/or odors were observed at a number of locations in this area of the site, including BBTP-03A, SB-26C, BBSB-04, BBSB-06 and BBSB-37.

Figure 4-20 also shows that, with the exception of soil boring BBSB-90, saturated NAPL in shallow subsurface soil in the adjacent off-site areas was generally restricted to the adjacent off-site area south of the site and north of Union Boulevard. Specifically, NAPL was detected in this area in soil borings BBSB-61, BBSB-82 and BBSB-86. Soil boring BBSB-61 was located immediately downgradient from the former Generator House and associated Tar Well. Soil borings BBSB-82 and 86 were located downgradient from the south-central portion of the site, which included the former Tar Separator and Effluent Water Treatment House listed above. In addition, soil exhibiting NAPL/tar blebs and sheens was noted in shallow soil collected from WB-05C, BBMW-05D and BBMW-05D2 which were also located immediately downgradient of the Bay Shore site and the 54,000 cubic foot Gas Holder and Heavy Oil Tank. While NAPL/tar-saturated conditions, NAPL/tar blebs and sheens were noted in the shallow soil zone at off-site locations, the geologic cross sections shown on **Drawings 4A** and **4B** clearly indicate that these conditions are observed at or below the water table.

Soil boring BBSB-90 was located at the northwest corner of the intersection of Union Boulevard and Clinton Avenue and immediately downgradient of an automotive repair shop.

Although saturated NAPL was noted in shallow soil at soil boring BBSB-90, it was described as gray and was accompanied with gray stained soil and a gasoline/hydrocarbon-like odor. Accordingly, the NAPL at BBSB-90 is attributed to an unknown off-site source, and is not considered to be related to former MGP operations at the site.

Intermediate Soil

Figure 4-21 depicts that the overall distribution of soil borings containing NAPL in the intermediate zone (i.e., from 12 to 32 feet bgs) is similar to that observed for NAPL in soil in the shallow zone. The majority of NAPL and/or tar-saturated soil was observed at intermediate depths in soil borings completed in the southern third of the site, west of the former Relief Holder and in the adjacent off-site areas immediately south (downgradient) of the site. In addition, NAPL-saturated soil was encountered in soil borings BBSB-07 and BBSB-37, completed in the vicinity of the former Cesspool located west of the former Gas Holder. **Figure 4-21** illustrates the fact that the majority of the soil borings exhibiting NAPL/tar-saturated conditions within the intermediate soil zone are located along the southern property boundary and adjacent downgradient areas. The north-south geologic cross-sections shown on **Drawings 4A** and **4B** illustrate the fact that soil in borings completed in the northern portion of the site shows little, if any, evidence of NAPL/tar-saturated conditions (with the exception of the area around the former Cesspool). However, further south, NAPL/tar-saturated conditions are more common and appear to be more frequently detected in the intermediate zone at the southern property boundary and in off-site adjacent downgradient locations.

Deep Soil

A review of **Figure 4-22** shows that saturated NAPL in the deep soil zone was only encountered in on-site soil borings BBMW-11D and BBMW-19D and in six soil borings in the adjacent off-site area including BBSB-66, BBSB-81, BBSB-82, BBSB-88, BBMW-21D and BBMW-05D2. Soil boring BBMW-11D was located in the south central portion of the Bay Shore Site immediately downgradient from the former Tar Separators and 75,000-gallon Tar Tank. Soil boring BBMW-19D was located in the southwestern portion of the site in the former

Generator House and near the former Tar Well. In addition, a number of soil borings completed in the southern portion of the site exhibited NAPL/tar blebs and sheens.

As indicated on **Figure 4-22**, with the exception of soil boring BBSB-88, all off-site soil borings that contained saturated NAPL in the deep soil zone were located in the northwestern corner of the adjacent off-site area. A review of cross sections provided on **Drawings 4A** and **4B** and logs for the soil borings that contained saturated NAPL/tar in the deeper zone, including BBSB-66, BBSB-81, BBSB-82, BBSB-88, BBMW-21D and BBMW-05D2, shows that the intervals where NAPL/tar was observed occurred intermittently between 32 feet bgs and the top of the low permeability sediments of the Magothy formation (approximately 72 feet bgs). While staining and odors were observed within the first several feet of the Magothy formation sediments, no evidence of NAPL/tar-saturated conditions was observed below the Glacial/Magothy formation interface, indicating that the low permeable nature of the Magothy formation is limiting the vertical migration of this material. The boring logs also showed that the presence of saturated NAPL was typically accompanied by the presence of naphthalene-like odors, moderate to heavy staining, and elevated PID readings.

Based on the discussion above the following summarizes the observed distribution of NAPL/tar-saturated soil at the site and adjacent areas:

- With the exception of the former Cesspool, no NAPL/tar was observed in the northern third of the site. This is expected as little, if any, operations of the former MGP took place in this portion of the site.
- Where detected, saturated NAPL/tar observed in subsurface soil in the central third of the site is generally limited to approximately 20-30 feet bgs. The sources of this relatively shallow NAPL/tar are former MGP structures.
- The occurrence of saturated NAPL/tar in deep soils (i.e., greater than 32 feet bgs) is generally limited to the southern third of the site and adjacent downgradient areas.
- The most extensive occurrence of NAPL/tar at saturated conditions in subsurface soil was observed within the southernmost third of the Bay Shore site and adjacent downgradient areas.
- The observed distribution of NAPL/tar in subsurface soil indicates a southerly migration of this material below the water table from on-site source areas primarily

located in the southernmost third of the site to downgradient areas. NAPL/tar migration appears to be predominantly horizontal in nature; however, in the vicinity of the southern property boundary, a significant downward vertical migration component is present. As a result, there appears to be a deep NAPL/tar zone located above the Glacial/Magothy formation interface from the property boundary to as far south as BBSB-88.

NAPL/Tar in Groundwater

Since the Summer of 1999, on-site and adjacent off-site monitoring wells have been periodically checked for LNAPL and DNAPL components within the screen zones. This was accomplished through the use of an oil/water interface probe as well as the use of a hand bailer to confirm the probe results. Based on measurements taken to date, there has been no measurable LNAPL noted within on-site or off-site monitoring wells. Furthermore, as part of the test pitting program conducted during the supplemental field program, each of the 14 test pits were excavated to a depth in which the water table was encountered in order to determine if LNAPL was present at or near the water table. At all 14 test pit locations no evidence of a separate phase LNAPL was observed.

As shown in **Table 4-12**, a measurable layer of DNAPL was detected in on-site monitoring well MW-07D and off-site monitoring wells BBMW-20D, BBMW-21D and BBMW-22D. The three off-site wells have 2-foot sumps, are located immediately downgradient of the Bay Shore site and are screened immediately above the Glacial/Magothy formation interface. MW-07D has a 0.5-foot sump on the end of the screen. DNAPL thicknesses ranged from a minimum of 2.5 feet detected in MW-07D to a maximum of 7.0 detected in BBMW-21D and BBMW-22D. The four monitoring wells are located in the same area identified as containing a deep NAPL/tar-saturated soil zone as described above. A sample of the DNAPL present in monitoring wells BBMW-21D and BBMW-22D was sent for petroleum fingerprint analysis, the results of which are discussed in **Section 4.2.1.3**.

4.2.2 Bay Shore West Parcel (Operable Unit 1)

4.2.2.1 - Subsurface Soil

As discussed in the April 2002 RI Report, a total BTEX concentration of 495 mg/kg was identified at BBSB-25 completed within the vicinity of the former Oil Storage Tanks located on the Bay Shore West Parcel. As part of the supplemental field program, a total of 25 soil probes were completed up to a depth of 26 feet bgs within and downgradient of the Bay Shore West Parcel in order to delineate the horizontal and vertical extent of BTEX identified in this area during the initial field program. A total of 59 subsurface soil samples were selected for BTEX and PAH analysis. Analytical results for BTEX and PAHs in subsurface soil samples collected from soil borings are summarized in **Tables C-13** and **C-14**, respectively, and analytical results for petroleum fingerprint are summarized in **Table C-15**. In addition, total BTEX and total PAH data associated with the collected samples are summarized on **Figures 4-1** through **4-6** referenced in **Section 4.2.1.2**.

BTEX

Six of the 59 samples collected from the Bay Shore West Parcel and analyzed as part of the supplemental field program exhibited a total BTEX concentration greater than 1.0 mg/kg with a maximum total BTEX concentration of 60.2 mg/kg detected at BBSB-71 (9 to 11 feet). As shown on **Figure 4-1**, BBSB-71 was located approximately 25 feet south of BBSB-25 completed during the initial field program. As shown on **Figure 4-2**, BTEX concentrations were found to be less than 0.1 mg/kg below a depth of 12 feet and in most locations were found to be nondetectable, indicating that BTEX present in subsurface soil within the Bay Shore West Parcel is limited to shallow soil. This is generally consistent with moderate to strong hydrocarbon-like odors and PID readings of up to 2,000 ppm in shallow soil at or immediately below the water table. However, odors and PID readings were significantly lower or absent below a depth of 12 feet at most locations.

PAHs

Twelve out of 59 soil samples collected from the Bay Shore West Parcel and analyzed as part of the supplemental field program exhibited total PAH concentrations greater than 10.0 mg/kg with the majority of these samples not exceeding 10.0 mg/kg total PAHs. The highest total PAH concentration of 973.0 mg/kg was detected in a sample collected from BBSB-78 from (0 to 2 feet). However, as shown in the boring log for BBSB-78, this sample contained a portion of hardened tar. As shown on **Figure 4-4**, the remaining total PAH concentrations observed within subsurface soil at the Bay Shore West Parcel did not exceed 120.0 mg/kg. Furthermore, **Figure 4-5** indicates total PAH concentrations below a depth of 12 feet were found to be nondetectable at virtually all locations consistent with BTEX concentrations.

4.2.2.2 - Groundwater

Groundwater quality was characterized through the collection and analysis of groundwater samples from six existing monitoring wells and six groundwater probes. BTEX and PAH results for groundwater samples collected from the monitoring wells are summarized in **Tables C-16** and **C-17**, respectively, and from the groundwater probe points are summarized in **Tables C-18** and **C-19**, respectively. In addition, total BTEX and total PAH concentrations in groundwater are summarized on **Figures 4-7** through **4-12**, referenced in **Section 4.2.1.3**.

BTEX

Table 4-13 summarizes the groundwater samples collected from the Bay Shore West Parcel site that exhibited the highest total BTEX and total PAH concentrations along with approximate locations of these samples in relation to former MGP structures/features where appropriate. The table also provides any significant field observations noted during the collection of these samples. Also note that additional detail as to the distribution of NAPL in groundwater is provided in **Section 4.2.1.4**.

TABLE 4-13

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

BAY SHORE WEST PARCEL GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
BBGP-85 (6-10')	1,111.0	616.0	Adjacent to fence along south side of Bay Shore West Parcel. Downgradient of Oil Storage Tanks.	None
BBGP-86 (6-10')	21,500.0	732.0	Adjacent to fence along south side of Bay Shore West Parcel. Downgradient of Oil Storage Tanks.	Light sheen, solvent-like odor
BBGP-88 (8-12')	4,500.0	242.0	Within L-shaped Concrete Slab of Former Structure south of the Long Island Railroad. Downgradient of Oil Storage Tanks.	None

As indicated in **Table 4-13**, the highest levels of total BTEX were observed in shallow groundwater at or near the water table and downgradient of former MGP structures which also coincided with elevated BTEX concentrations in subsurface soil, as described in **Section 4.2.2.1**. The highest total BTEX concentration of 21,500 ug/l was detected in groundwater probe sample BBGP-86 (6 to 10 feet) located directly downgradient of soil boring BBSB-25 and the former Oil Storage Tanks. During sampling, a light sheen was observed in the sample and solvent-like odors were detected. A total BTEX concentration of 1,111 ug/l was detected in groundwater probe sample BBGP-85 (6 to 10 feet), which was located in the vicinity of BBGP-86. No evidence of NAPL was detected in BBGP-85 during sampling. BTEX was also detected in samples collected in shallow groundwater at BBGP-87 and BBGP-88 both located downgradient of the Bay Shore West Parcel and south of the LIRR ROW at concentrations of 353 ug/l and 4,500 ug/l, respectively.

Based on a review of **Figures 4-7** through **4-9** and the supporting data, the following are noteworthy observations:

1. As shown on **Figure 4-7**, BTEX compounds were detected in groundwater collected from the approximate midpoint of the southern boundary of the Bay Shore West Parcel in groundwater probe locations BBGP-85 and 86 and along a downgradient flow path from these locations at groundwater probe points BBGP-87 and BBGP-88. These sample points are located downgradient of soil boring BBSB-25 at varying distances which exhibited a total BTEX concentration of 425.0 mg/kg in shallow subsurface soil.
2. BTEX compounds were primarily detected in the shallow groundwater zone. BTEX was only detected up to a concentration of 5 ug/l in the intermediate zone (**Figure 4-8**). Total BTEX was detected in the deep groundwater interval at groundwater probe locations BBGP-38 and BBGP-41 at concentrations of 2 ug/l and 81 ug/l, respectively (**Figure 4-9**).

Based on the direction of groundwater flow (refer to **Section 3.3**) and the location of the groundwater samples exhibiting the highest total BTEX concentrations, the likely source of BTEX compounds in groundwater at the Bay Shore West Parcel are the former Oil Storage Tanks.

PAHs

The data in **Table 4-13** shows that the highest concentration of total PAHs was detected in groundwater probe sample BBGP-86 (6 to 10 feet). As discussed above, a light sheen was observed and a solvent-like odor was detected in this sample during collection. Relatively low concentrations of PAHs were also detected in samples collected from groundwater probe locations BBGP-85, 87 and 88 at respective total PAH concentrations of 616 ug/l, 234 ug/l and 242 ug/l.

Based on a review of **Figures 4-10** through **4-12** and the supporting data, the following are noteworthy observations:

1. As shown on **Figure 4-10**, PAHs were detected in groundwater collected from the center of the southern boundary of the Bay Shore West Parcel in groundwater probe locations BBGP-85 and 86 and along a downgradient flow path from these locations at groundwater probe points BBGP-87 and BBGP-88. Again, these points are located downgradient of completed soil boring BBSB-25.
2. With only few exceptions, PAH compounds were generally detected only in shallow groundwater. PAHs were detected in the intermediate groundwater interval (**Figure 4-11**) in samples collected from probe point BBGP-41 at a concentration of 41 ug/l. PAHs were also detected in the deep groundwater interval at groundwater probe location BBGP-41 at a concentration of 13 ug/l and at monitoring well BBMW-13D at a concentration of 40 ug/l (**Figure 4-12**).

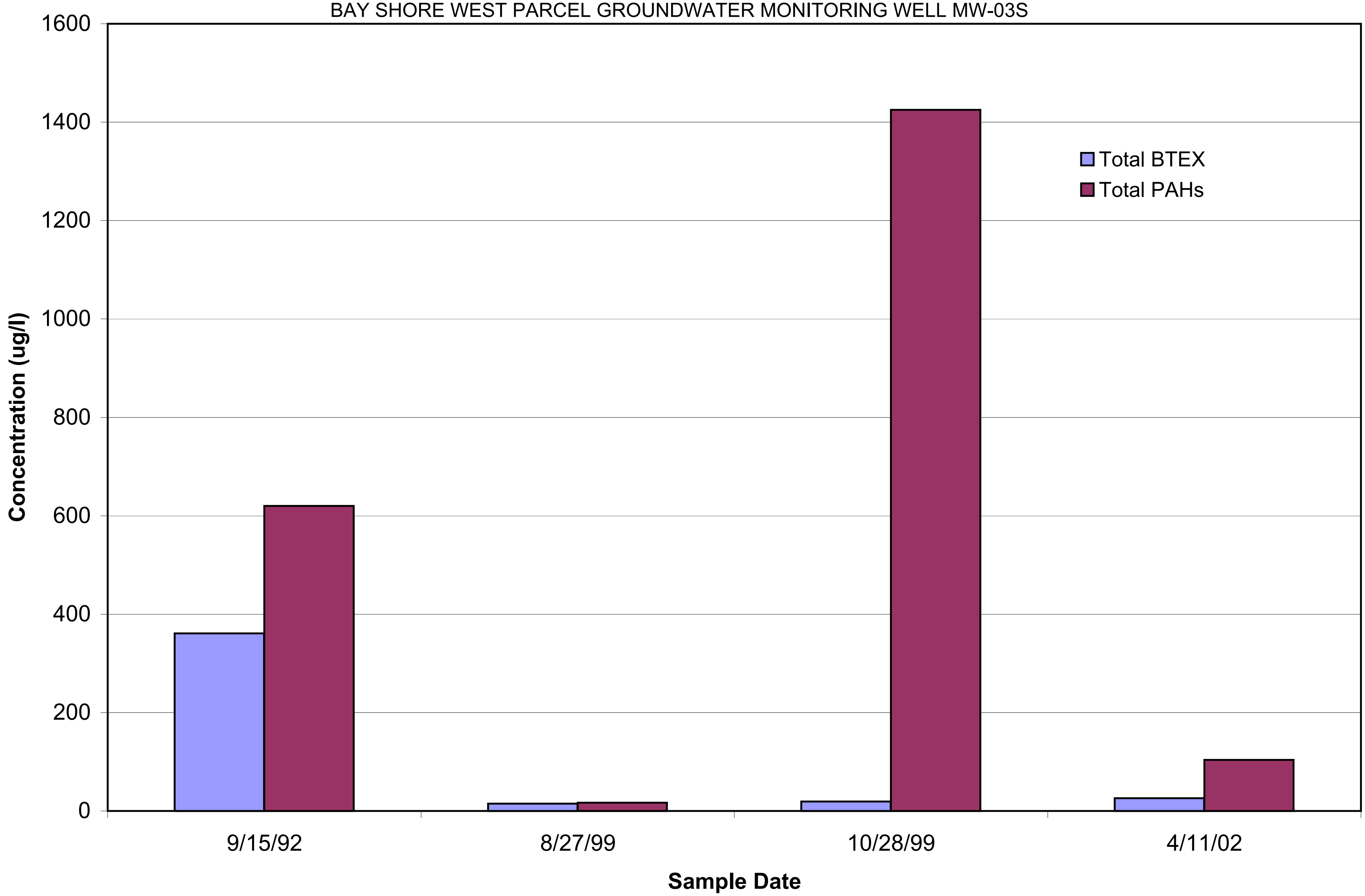
Based on the direction of groundwater flow (refer to **Section 3.3**) and the location of the groundwater samples exhibiting the highest total PAH concentrations, the likely sources of PAH compounds in groundwater at the Bay Shore West Parcel include the former Oil Storage Tanks.

Historical Total BTEX/PAH Concentrations at the Bay Shore West Parcel

Available groundwater data for monitoring well MW-03S, located along the southern property boundary of the Bay Shore West Parcel, is plotted on **Figure 4-23**. The data shown on **Figure 4-23** indicates that total BTEX concentrations have decreased to trace levels since September 1992 and total PAHs have not shown a consistent trend over that same time. As

FIGURE 4-23
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BAY SHORE WEST PARCEL GROUNDWATER MONITORING WELL MW-03S



I:\1620 (KeySpan)\BAY SHORE_BRIGHTWATERS\Supplemental Investigation\SUPPLEMENTAL REPORT\Groundwater Trend Data

indicated on **Figure 4-23**, total BTEX and total PAHs were detected at low concentrations in groundwater samples collected in April 2002.

Petroleum Fingerprint/Specific Gravity/Viscosity Analysis

During the regrading of the Bay Shore West Parcel by KeySpan in the Spring of 2002, several sections of underground piping were removed from the subsurface. Several of the pipes contained a oil/water mixture that were drained, containerized and properly disposed of by KeySpan. Prior to the disposal of this material, a sample was collected for petroleum fingerprint analysis. In addition, the sample was analyzed for specific gravity and viscosity. A report summarizing the results of this analysis is provided in **Appendix D**. Based on the results of this analysis, it was determined that this sample contained pyrogenic and petrogenic substances. Pyrogenic substances are complex mixtures of primarily hydrocarbons produced from organic matter subjected to high temperatures, but with insufficient oxygen for complete combustion. Pyrogenic materials are produced by fires, internal combustion engines, and furnaces. They also are formed when coke or gas are produced from coal or oil. Coal-tar based products, such as roofing, pavement sealers, waterproofing, pesticides, and some shampoos contain pyrogenic materials. Petrogenic substances include crude oil and crude oil derivatives such as gasoline, heating oil, and asphalt. The petrogenic material in this sample eluted as an unresolved complex mixture (UCM or "hump") from approximately octane (C8 - 5 minutes) to nonacosane (C29 - 30 minutes) with a maximum at octadecane (C18 - 19 minutes). Examples of common petroleum products with these features include blended fuels such as No. 4 fuel oil as well as wash oil. The dominance of normal alkanes and the alkane/isoprenoid ratios indicate that this material is relatively unweathered. The combination of the pattern of PAHs, the high MAH concentrations and the petrogenic materials in this sample strongly suggest that this sample contains used wash oil. Wash oils were used in the gas purification process to remove tar volatiles from the gas stream. In addition, analysis of the oil portion of this sample determined the sample had a specific gravity of 0.98 indicating the material was slightly less dense than water. The sample exhibited a kinematic viscosity of 39.2 cSt.

4.2.2.3 - Extent of NAPL

The review of **Figures 4-20** through **4-22**, presented in **Section 4.2.1.4**, which summarize field observations indicates that evidence of NAPL/tar at saturated levels was only observed in shallow subsurface soil at BBSB-69. In addition, several soil borings exhibited NAPL/tar blebs and/or sheens including soil borings BBSB-71, BBSB-72, BBSB-73 and BBSB-80. These borings encompass the general area where BTEX and PAHs were observed in shallow subsurface soil and groundwater. Similar to distribution of total BTEX and total PAH concentrations in shallow soil and groundwater, evidence of NAPL in subsurface soil is minimal below a depth of 12 feet.

4.2.3 Bay Shore West Storage Lot (Operable Unit 3)

4.2.3.1 - Surface Soil

PAHs

Table C-20 summarizes the analytical results for PAHs in surface soil samples collected on the Bay Shore West Storage Lot Parcel. The results show that total PAHs were detected in samples BBSS-34 (0-6") and BBSS-35 (0-6") at respective concentrations of 17.2 mg/kg and 15.8 mg/kg. These relatively low concentrations are typical of surface soil in urban industrial environments such as exists at the Bay Shore West Storage Lot Parcel.

As shown on **Drawing 2A**, surface soil sample BBSS-34 was located along the central portion of the southern boundary of the Bay Shore West Storage Lot Parcel and BBSS-35 was located along the north-central boundary of this parcel.

4.3 Off-site Investigation (Operable Units 1 and 2)

4.3.1 Bay Shore Plume IRM Investigation

The objective of the IRM Investigation in the Bay Shore groundwater plume was to obtain additional stratigraphic, geotechnical and geochemical data within the plume. Similarly, groundwater samples were collected within the plume from both new and existing wells and from new groundwater probe points. The additional stratigraphic and geotechnical data and information were used in **Section 3.0 – Site Geology and Hydrogeology** to refine the model of the subsurface soil with particular emphasis on key aquifer characteristics and the location and configuration of low permeability layers, such as the top of the Upper Magothy Unit.

The soil and groundwater quality discussed below is used to define the vertical distribution of chemical constituents in soil and groundwater in the plume, evaluate the status of the plume (e.g., steady state, decreasing concentrations, etc.) and evaluate overall geochemical conditions in the aquifer. The geochemical data is also used to evaluate the occurrence of biodegradation of BTEX and PAHs in the plume as a potential component of an IRM.

4.3.1.1 - Subsurface Soil

As part of the Bay Shore Plume IRM Investigation, four soil borings, designated BBSB-74 through BBSB-77, were completed down the centerline of the Bay Shore plume in order to obtain additional stratigraphic data from this area. In addition, one sample, designated BBSB-76 (17 to 19 feet), was selected for analysis of BTEX and PAHs due to the presence of a slight hydrocarbon-like odor at this sample interval. The analytical results for BTEX and PAHs are summarized in **Tables C-21** and **C-22**, respectively.

BTEX

With the exception of benzene, BTEX compounds were not detected in soil sample BBSB-76 (17 to 19 feet). Benzene was detected at a concentration of 0.002 mg/kg.

PAHs

With the exception of phenanthrene, PAHs were not detected in subsurface soil sample BBSB-76 (17 to 19 feet). The concentration of phenanthrene was 0.042 mg/kg.

4.3.1.2 - Groundwater

As described in **Section 2.4**, the off-site groundwater investigation included the collection of samples from groundwater probes as well as the sampling of existing monitoring wells and monitoring wells installed as part of the supplemental field program. In addition to the routine MGP analytical parameters of BTEX and PAHs, geochemical parameters were analyzed and field parameters were measured. The analytical results for BTEX and PAHs in groundwater samples collected from monitoring wells are summarized in **Tables C-23** and **C-24**, and for samples collected from groundwater probe points are summarized in **Tables C-25** and **C-26**. The analytical results for geochemical and field parameters for samples collected from monitoring wells are summarized in **Tables C-27** and **C-28** and for samples collected from groundwater probe points are summarized in **Tables C-29** and **C-30**.

The BTEX and PAH data were used to further delineate the vertical and horizontal distribution of the Bay Shore groundwater plume. In addition, concentration of total BTEX/PAHs are used in this section to evaluate changes in concentrations over time. The trend evaluation is based on current and historical groundwater data for select wells. The geochemical parameters and field measurements were used to evaluate the overall geochemical conditions in the aquifer, with specific focus on evaluating the ability of the aquifer to support biodegradation and the effectiveness of biodegradation to reduce the mass of BTEX and PAHs in the Upper Glacial aquifer.

BTEX and PAHs

Table 4-14 summarizes the highest total BTEX and total PAH concentrations detected in the Bay Shore groundwater plume based on data from the supplemental field program. Note that consistent with the operable unit divisions discussed in **Section 1.5**, **Table 4-14** only includes groundwater samples collected from Operable Unit 2 which has Union Boulevard as its northern terminus. The discussion of BTEX and PAHs in groundwater north of Union Boulevard (Operable Unit 1) is presented in **Section 4.2.1.3**. **Table 4-12** summarizes the highest BTEX and PAH concentrations detected on the Bay Shore Site as well as off-site areas as far south as Union Boulevard. Comparison of **Table 4-12** with **Table 4-14** indicates that, in general, BTEX and PAHs are present at higher concentrations immediately downgradient of the Bay Shore Site (Operable Unit 1) compared to groundwater south of Union Boulevard. In addition, shallow groundwater immediately downgradient of the site exhibits the highest concentrations of BTEX and PAHs, whereas south of Union Boulevard the highest concentrations are generally found in the shallow as well as the intermediate groundwater zones.

A review of **Table 4-14** indicates the highest total BTEX concentrations observed in the Bay Shore plume were detected at groundwater probe BBGP-75 located approximately 800 feet downgradient of the Bay Shore Site, with total BTEX concentrations of 7,160 ug/l at 16 to 20 feet, 4,516 ug/l at 64 to 68 feet, and 4,310 ug/l at 32 to 36 feet. The highest total PAH concentration detected south of Union Boulevard (9,720 ug/l) was detected in the intermediate groundwater zone at well cluster BBMW-01 located approximately 550 feet south of the Bay Shore Site. However, the second, third and fourth highest total PAH concentrations in the Bay Shore plume were detected south of Montauk Highway, approximately 2,000 feet south of the Bay Shore Site, including BBGP-79 (32 to 36 feet) at 8,202 ug/l, BBGP-81 (26 to 30 feet) at 9,137 ug/l and BBGP-81 (36 to 40 feet) at 7,756 ug/l.

Using the extensive amount of groundwater quality data collected as part of the initial and supplemental field programs, six groundwater plume maps were prepared. They include shallow, intermediate and deep plume maps for both total BTEX and total PAH concentrations. Groundwater plume maps depicting total BTEX and total PAH concentrations are presented on

TABLE 4-14
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

OFF-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)
BBGP-75 (16-20')	7,160.0	1,959.0	On the corner of Cooper Lane and Clinton Avenue. Approximately 800 ft. downgradient of Bay Shore Site.
BBGP-75 (32-36')	4,310.0	3,954.0	On the corner of Cooper Lane and Clinton Avenue. Approximately 800 ft. downgradient of Bay Shore Site.
BBGP-75 (48-52')	432.0	6,027.0	On the corner of Cooper Lane and Clinton Avenue. Approximately 800 ft. downgradient of Bay Shore Site.
BBGP-75 (64-68')	4,516.0	7,300.0	On the corner of Cooper Lane and Clinton Avenue. Approximately 800 ft. downgradient of Bay Shore Site.
BBGP-76 (32-36')	1,142.0	6,171.0	In vicinity of the Jewish Center of Bay Shore, approximately 1, 200 ft. downgradient of Bay Shore Site.
BBGP-76 (40-44')	214.0	6,428.0	In vicinity of the Jewish Center of Bay Shore, approximately 1, 200 ft. downgradient of Bay Shore Site.
BBGP-76 (56-60')	672.0	6,588.0	In vicinity of the Jewish Center of Bay Shore, approximately 1, 200 ft. downgradient of Bay Shore Site.
BBGP-79 (32-36')	320.0	8,202.0	Within the Town of Islip, south of Montauk Highway. Approximately 1,970 ft. downgradient of Bay Shore Site.
BBGP-81 (26-30')	297.0	9,137.0	Within the Town of Islip, south of Montauk Highway. Approximately 2,250 ft. downgradient of Bay Shore Site.

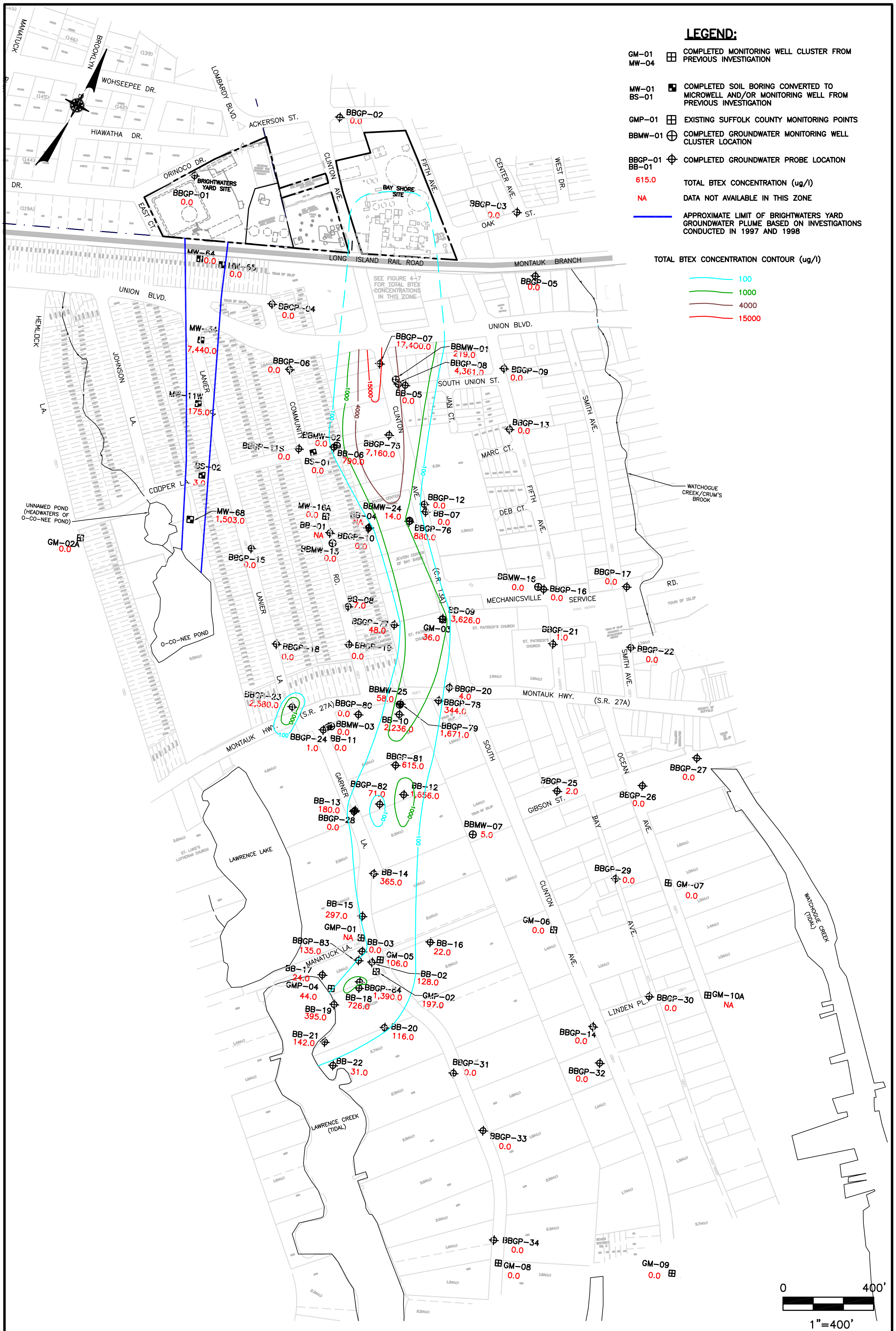
TABLE 4-14 (continued)
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

OFF-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)
BBGP-81 (36-40')	105.0	7,756.0	Within the Town of Islip, south of Montauk Highway. Approximately 2,250 ft. downgradient of Bay Shore Site.
BBGP-82 (36-40')	224.0	6,401.0	Within the Town of Islip, south of Montauk Highway. Approximately 2,420 ft. downgradient of Bay Shore Site.
BBGP-83 (26-30')	236.0	6,171.0	Within the Town of Islip, south of Montauk Highway. Approximately 3,120 ft. downgradient of Bay Shore Site.
BBGP-84 (26-30')	435.0	7,000.0	Within the Town of Islip, south of Montauk Highway. Approximately 3,220 ft. downgradient of Bay Shore Site.
BBMW-01I (32-42')	222.0	9,720.0	In vicinity of Clinton Avenue, aproximately 550 ft. downgradient of Bay Shore Site.
BBMW-24I (32-42')	264.0	6,632.0	In vicinity of the Jewish Center of Bay Shore, approximately 1, 200 ft. downgradient of Bay Shore Site.
BBMW-24D (59.5-69.5')	1,102.0	7,412.0	In vicinity of the Jewish Center of Bay Shore, approximately 1, 200 ft. downgradient of Bay Shore Site.
BBMW-25I (25-35')	1,034.0	7,436.0	Within the Town of Islip, south of Montauk Highway. Approximately 1,970 ft. downgradient of Bay Shore Site.

Figures 4-24 through **4-29**. Both groundwater probe and monitoring well data were used to prepare these maps. The shallow interval is based on data from the water table to approximately 26 feet bgs, the intermediate interval includes data from approximately 26 to 50 feet bgs and the deep interval is approximately 50 feet to the lower limits of the Upper Glacial aquifer, approximately 80 feet bgs. In cases where more than one data point was available for a given location, such as if a monitoring well was installed near a groundwater probe location, the higher of the two concentrations was used to contour the plume in order to provide the most conservative estimate of the plume extent. Due to the highly variable nature of the concentrations found within and immediately downgradient of the site, it was necessary to use a nonlinear concentration contour interval when depicting chemical distribution. The six maps developed to graphically display the data provide an accurate picture of the BTEX and PAH distribution both in areal extent and vertical distribution within the Upper Glacial aquifer. **Drawing 4D** provides a vertical cross section of both the BTEX and PAH plumes with the estimated vertical extent of the plume being defined by the 100 ug/l interval. **Drawing 4D** is provided in the map pocket at the end of this section of the report.

Note that the data used in these graphics was collected during the initial field program as well as the supplemental field program, and as a result, the data set used in the graphics spans several years. However, all newly installed and existing monitoring wells were sampled as part of the supplemental field program, and, all monitoring well data presented on the graphics is from the Spring 2002 sample round. Furthermore, all groundwater samples from BBGP-74 through BBGP-84 were collected during the Winter/Spring of 2002. Therefore, the majority of the data presented in these graphics were collected in early 2002 and provide an accurate picture of total BTEX distribution within the Upper Glacial aquifer. Furthermore, the use of the 100 ug/l total BTEX and total PAH concentrations to define the estimated extent of the plume is not based on a specific regulatory guidance value or cleanup standard. However, we believe the use of the 100 ug/l contour interval is appropriate given upgradient groundwater has been shown to contain detectable levels of BTEX and PAHs from other sources. Additionally, as discussed in the April 2002 RI Report, there have been at least 17 petroleum spills documented as occurring downgradient of the Bay Shore Site between 1988 and 1999. Therefore, it is reasonable to



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

TOTAL BTEX CONCENTRATIONS IN SHALLOW OFF-SITE GROUNDWATER (WATER TABLE TO 26 FEET)

FIGURE 4-24

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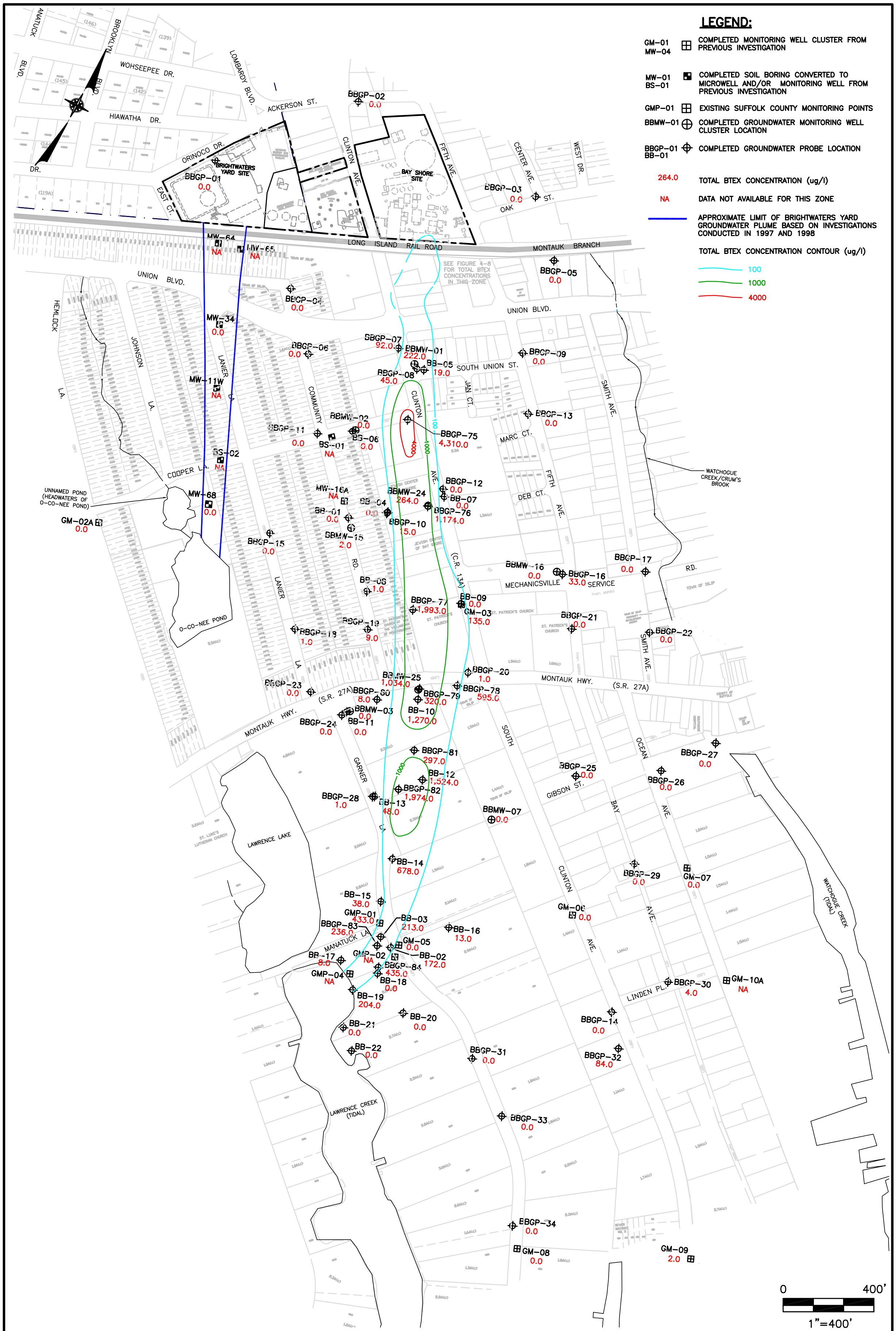

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TOTAL BTEX CONCENTRATIONS IN INTERMEDIATE OFF-SITE GROUNDWATER (26 TO 50 FEET)

FIGURE 4-25

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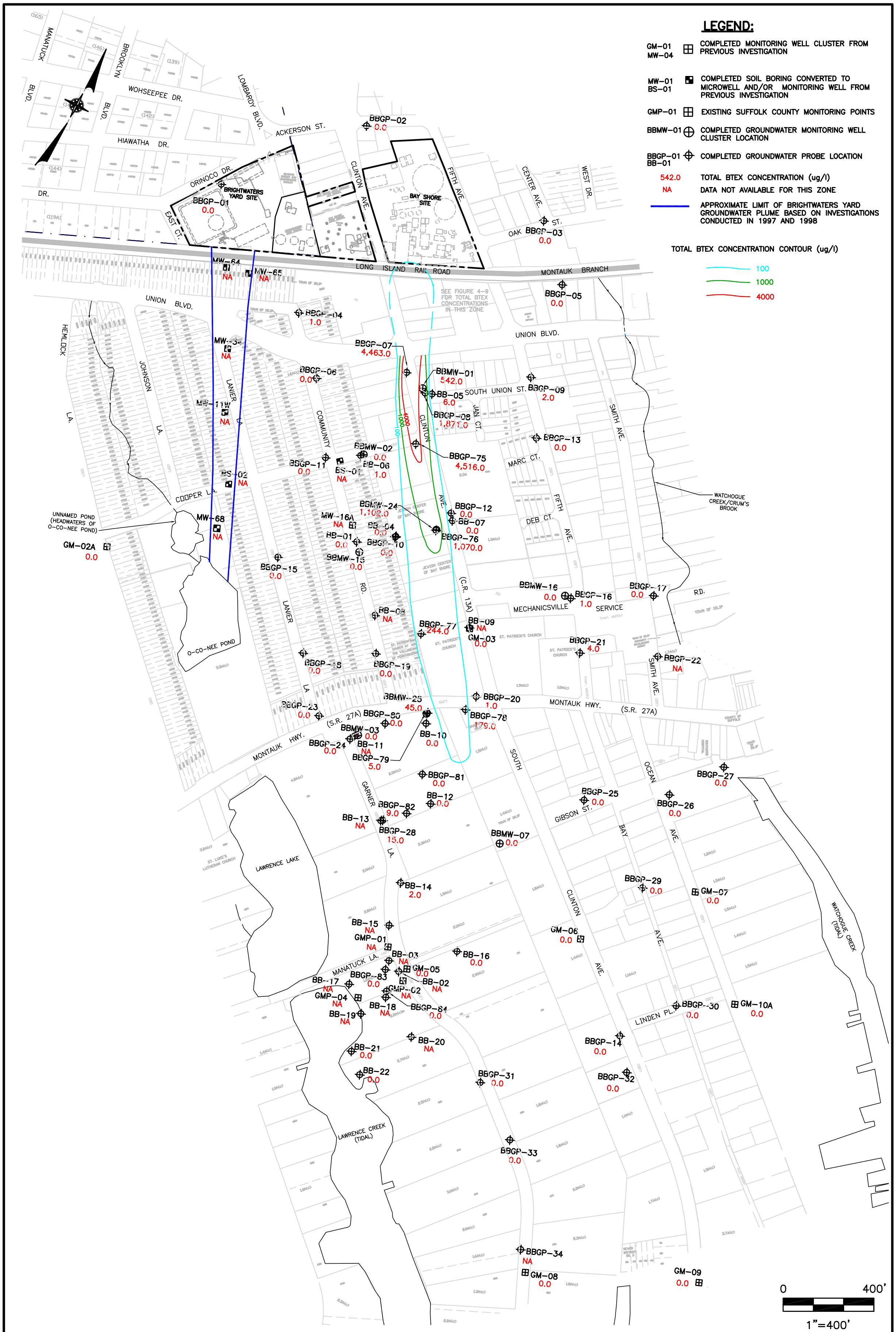

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
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TOTAL BTEX CONCENTRATIONS IN DEEP OFF-SITE GROUNDWATER (50 TO 80 FEET)

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FIGURE 4-26

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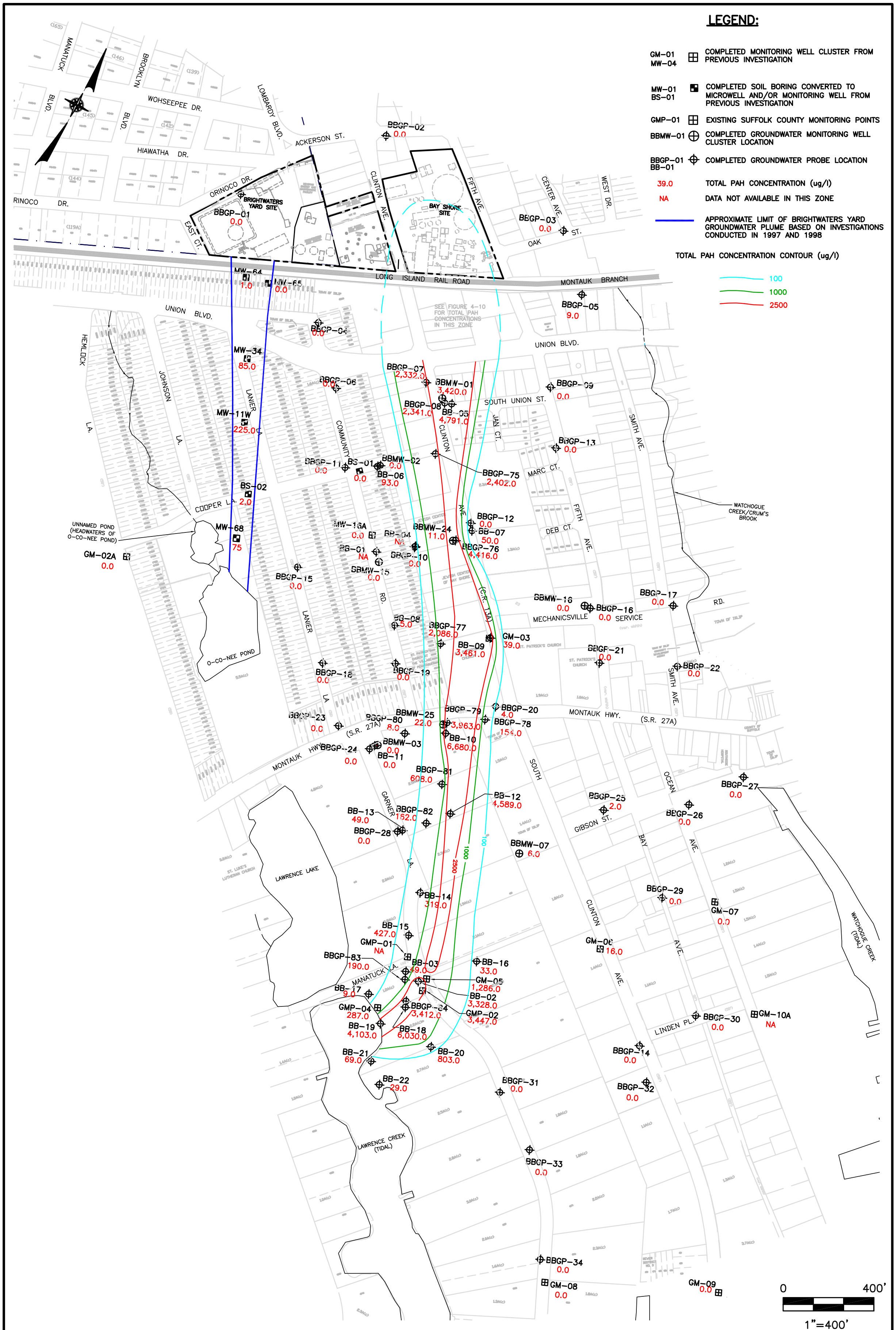

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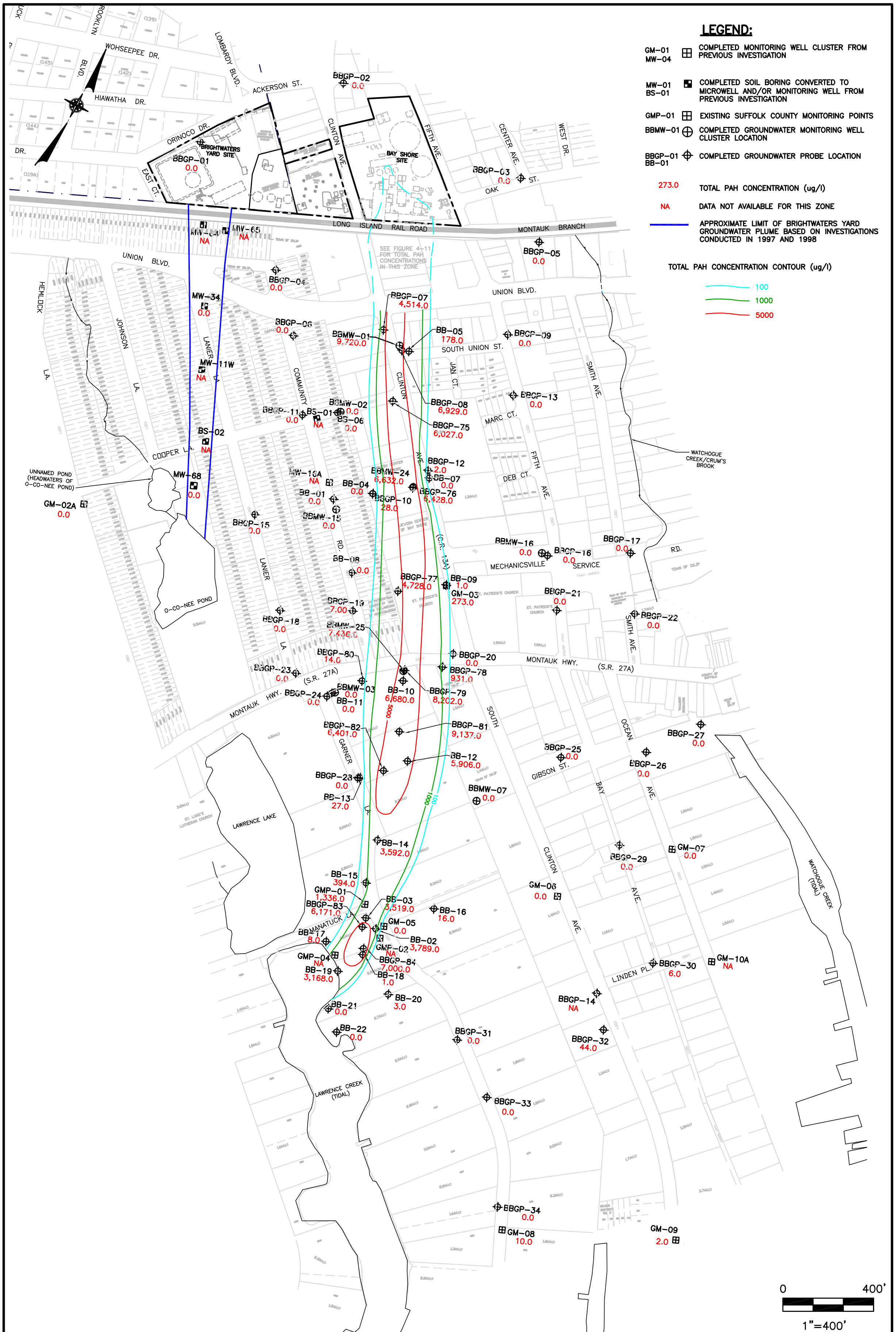
TOTAL PAH CONCENTRATIONS IN SHALLOW OFF-SITE GROUNDWATER (WATER TABLE TO 26 FEET)

FIGURE 4-27

F:\1620B12B\dwg\11X17\FIG-4V.dwg, 01/02/03 01:51:43 PM, PMartorano



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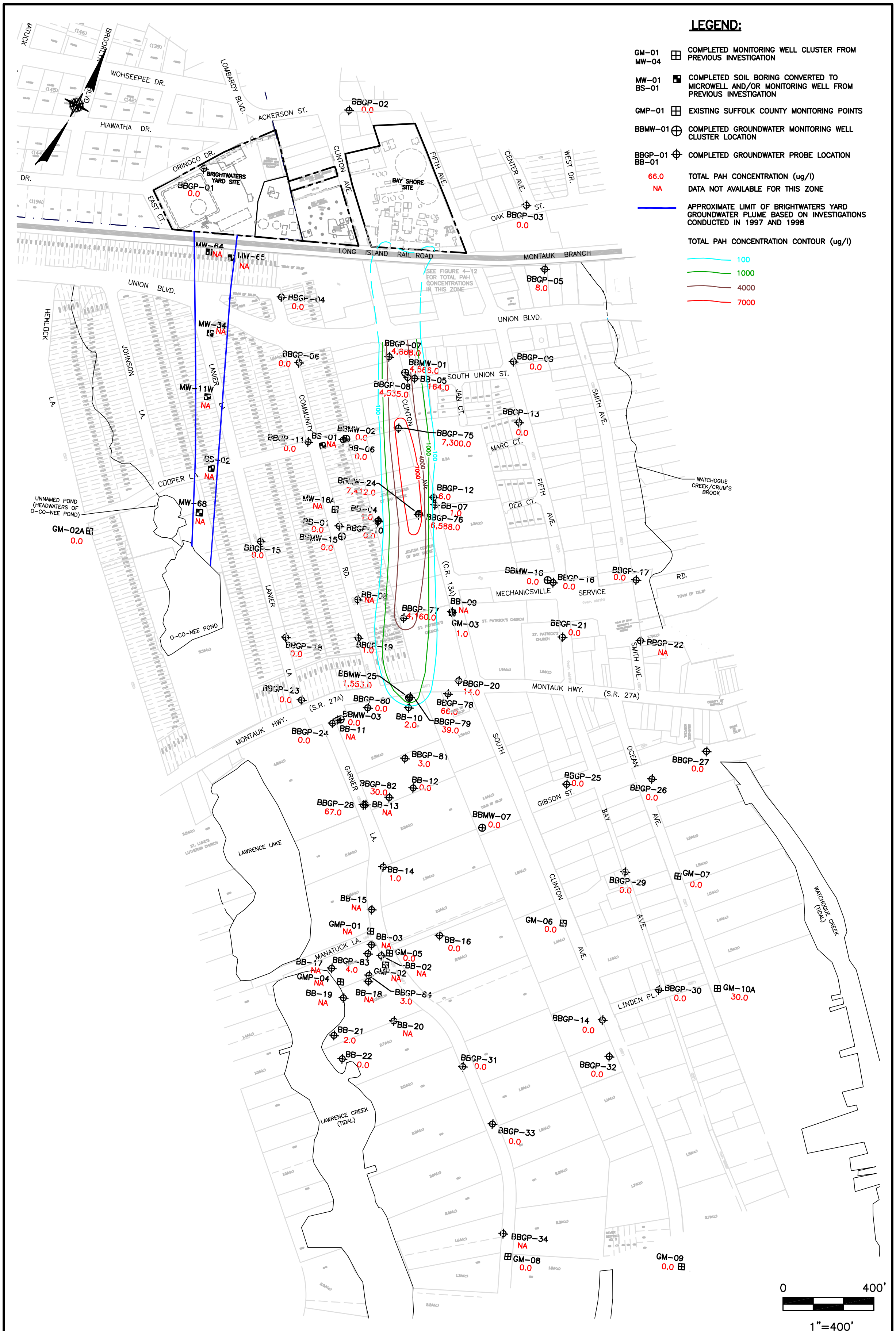
TOTAL PAH CONCENTRATIONS IN INTERMEDIATE OFF-SITE GROUNDWATER (26 TO 50 FEET)

FIGURE 4-28

F:\1620B12B\dwg11X17\FIG-4W.dwg, 01/02/03 01:52:32 PM, PMartorano



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TOTAL PAH CONCENTRATIONS IN DEEP OFF-SITE GROUNDWATER (50 TO 80 FEET)

FIGURE 4-29

F:\1620B12B\dwg\11X17\FIG-4X.dwg, 01/02/03 01:53:18 PM, PMartorano assume that ambient groundwater not influenced by the Bay Shore Site may still exhibit detectable levels of BTEX and PAHs.

Based on the plume maps, the following observations are made with regard to BTEX and PAH concentrations:

1. The off-site plume represents the downgradient extension of the BTEX and PAH plume that originates on-site, as discussed in **Section 4.2.1.3**.

2. Although total BTEX and total PAHs were detected in groundwater samples collected from several downgradient wells and/or groundwater probe points, evidence of NAPL was not observed in any of the samples. Based on this data, the Bay Shore plume is comprised of dissolved phase BTEX and PAH compounds downgradient of Union Boulevard.

3. The highest total BTEX concentrations in the off-site plume were detected in the shallow and intermediate zones of the Upper Glacial Aquifer at groundwater probes BBGP-07 and BBGP-75 located 450 and 800 feet, respectively, downgradient of the site. In addition, the highest total BTEX concentrations detected in the deep groundwater zone were also detected in groundwater samples from these probes. A review of **Figure 4-24** indicates that BTEX compounds are present throughout the shallow groundwater interval along the center line of the plume with total BTEX concentrations ranging from 17,400 ug/l at BBGP-07 to 2,236 ug/l at BB-10, located approximately 50 feet south of Montauk Highway. Farther downgradient from BB-10, total BTEX concentrations decrease significantly within the shallow zone until approaching the plume discharge point located south of Manatuck Lane, where BTEX concentrations increase with a maximum total BTEX concentration of 1,390 ug/l detected at BBGP-84.

4. **Figure 4-27** shows total PAH concentrations down the center line of the Bay Shore plume in the shallow groundwater zone ranging from 2,332 ug/l at BB-07 located 450 feet from the site to a maximum of 6,680 ug/l detected at BB-10, again located 50 feet south of Montauk Highway (approximately 3,000 feet from the site), indicating PAH concentrations actually increase with increasing distance from the site as far downgradient as BB-10. Downgradient of BB-10, PAHs remain in the shallow groundwater zone with total PAH concentrations ranging from 608 ug/l at BBGP-81 to 4,103 ug/l at BB-19, located in the vicinity of the plume discharge point on Lawrence Creek.

5. While **Figures 4-24** and **4-27** indicate that BTEX and PAHs are present throughout much of the shallow groundwater zone, **Drawing 4D**, which consists of a cross-section through the approximate center line of the plume, provides a more detailed view of the vertical distribution of BTEX and PAHs. A review of **Drawing 4D** clearly illustrates the fact that while the shallow groundwater zone does contain levels

of BTEX and PAHs, the highest concentrations are actually observed at least 15 to 20 feet below grade within the plume south of Cooper Lane and, that groundwater samples collected at or near the water table exhibited nondetectable to low levels of BTEX and PAHs, not exceeding 60 ug/l in concentration.

6. As shown on **Figure 4-25**, the concentrations of total BTEX in the intermediate groundwater zone decrease rapidly from a concentration of 4,310 ug/l at groundwater probe point BBGP-75 located near the intersection of Cooper Lane and Clinton Avenue, to a maximum downgradient concentration of 435 ug/l at BBGP-84, which is located immediately upgradient of Lawrence Creek. Although the distribution of the PAHs plume shown on **Figure 4-28** is similar to that of BTEX (**Figure 4-25**), the concentrations of PAHs in the off-site groundwater plume remain elevated along a narrow band that extends the length of the plume, from the site and adjacent off-site areas to the discharge point at Lawrence Creek. As discussed previously, some of the highest total PAH concentrations detected in the Bay Shore plume were observed in the intermediate groundwater zone at groundwater probes BBGP-79 and BBGP-80 located south of Montauk Highway.

7. The BTEX and PAH plumes in the deep groundwater zone, as shown in **Figures 4-26** and **4-29**, respectively, end in the vicinity of Montauk Highway. The off-site concentrations of total BTEX decrease rapidly downgradient from over 4,000 ug/l, at groundwater probe point BBGP-07 located immediately south of Union Boulevard, to less than 200 ug/l south of Montauk highway. As shown on **Figure 4-29**, total PAHs remain along the plume center line in the deep groundwater zone ranging in concentration from a high of 4,868 ug/l at BBGP-07 to a low of 1,553 ug/l at BBMW-25 located on the south side of Montauk Highway. The deep BTEX and PAH Plumes appear to have migrated the least, with the downgradient limit, as defined by the 100 ug/l concentration contour, not extending significantly south of Montauk Highway. Furthermore, **Drawing 4D** illustrates the fact that the majority of the locations where total BTEX and PAHs were detected above 1,000 ug/l occur at the Upper Glacial/Magothy formation interface immediately downgradient of the Bay Shore Site. In addition, the geologic cross-sections provided as part of **Drawing 4D** indicate that the Upper Magothy formation consists primarily of low permeable clays. Due to the low permeable nature of this material, vertical migration of the Bay Shore plume is restricted, and impact to the Magothy aquifer is not expected. Low concentrations of BTEX and PAHs were detected in the initial sample collected from BBMW-05D2, screened below the low permeable clay of the Magothy formation. However, BTEX and PAHs were not detected in subsequent samples collected from this well. Therefore, the minimal impact detected in the initial round was not confirmed by subsequent sampling.

8. **Figure 4-24** depicts an area of BTEX outside of the defined Bay Shore plume centered around groundwater probe BBGP-23. Although groundwater probe sample BBGP-23 (9-13 feet) exhibited a total BTEX concentration of 2,580 ug/l and was generally located downgradient of the Bay Shore Site at the corner of Lanier Lane and Montauk Highway, it is not considered part of the Bay Shore plume. Based on the probe location, the observed distribution of BTEX and PAHs in groundwater

upgradient of this point and the determined groundwater flow directions, it is unlikely that the source of the BTEX observed at this location is associated with the Bay Shore Site. A review of state environmental databases, the findings of which are discussed in the April 2002 RI Report, indicate that a commercial business as well as a gasoline service station, both of which are located at the corner of Lanier Lane and Montauk Highway, have had documented gasoline and petroleum spills as recently as September of 1992.

9. **Figures 4-24** through **4-29** and **Drawing 4D** indicate that the Bay Shore plume is migrating with the natural flow of groundwater and discharging to the tidal portion of Lawrence Creek. The discharge zone appears to be a relatively narrow area along the northeastern shoreline of the tidal creek, roughly bounded by groundwater probe BB-17 to the north and groundwater probe BB-21 to the south, a distance of approximately 300 feet. Also, as discussed in the April 2002 RI Report, based on the analytical results of pore water samples collected from Lawrence Creek, BTEX and PAHs were detected in this relatively narrow portion of the tidal creek. This narrow discharge zone is illustrated on **Drawing 4D**. These findings are consistent with the findings of the SCDHS Lawrence Creek Investigation discussed in the April 2002 RI Report.

10. A review of **Figures 4-24** through **4-29** and **Drawing 4D** indicate that the overall Bay Shore BTEX/PAH plume is approximately 3,400 feet long extending from the southern property boundary of the Bay Shore Site to the discharge area within Lawrence Creek. At the site boundary, it is approximately 500 feet wide. A short distance downgradient, the plume appears to attain its maximum width of approximately 600 feet at or near Union Boulevard. Beyond Union Boulevard, the plume appears to gradually narrow with increasing distance from the site.

In addition, **Drawing 4E** indicates all off-site groundwater sample locations - groundwater probes and monitoring wells - at which groundwater samples were found to contain BTEX or PAH compounds that exceed NYSDEC Class GA groundwater standards. Note that the most recent sampling event was used to evaluate each monitoring well. **Drawing 4E** is provided in the map pocket at the end of this section of the report.

<u>Historical Total BTEX/PAHs in the Bay Shore Groundwater Plume</u>

Changes in total BTEX and total PAH concentrations with time in monitoring well cluster GM-03 (including S, I and D) and monitoring well GM-05S located in the middle and downgradient portions of the off-site Bay Shore groundwater plume, respectively, are shown graphically on **Figures 4-30** through **4-33**. It is noted that the early data (i.e., pre-September

FIGURE 4-30
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BAY SHORE PLUME GROUNDWATER MONITORING WELL GM-03S

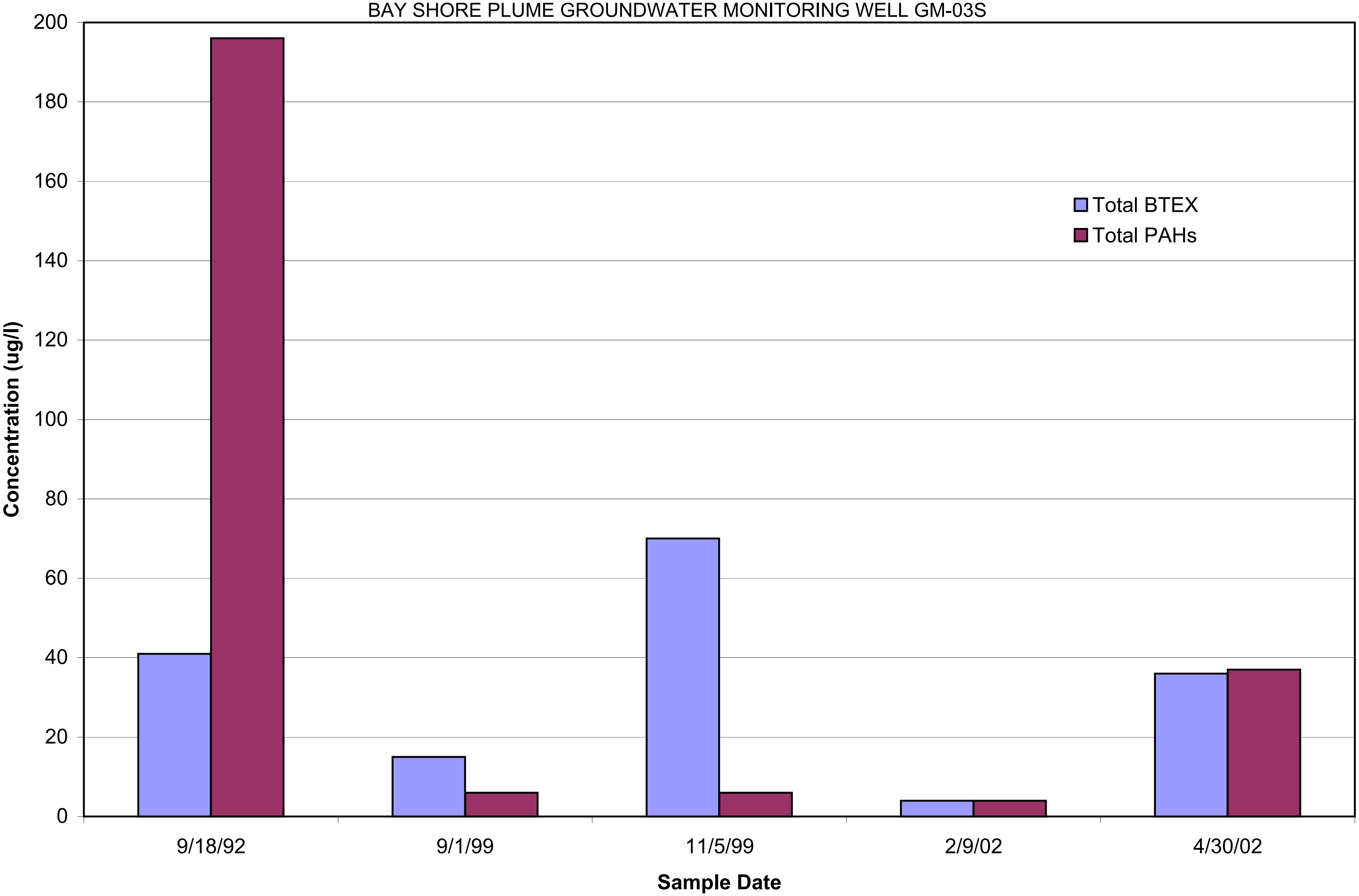

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FIGURE 4-31
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BAY SHORE PLUME GROUNDWATER MONITORING WELL GM-03I

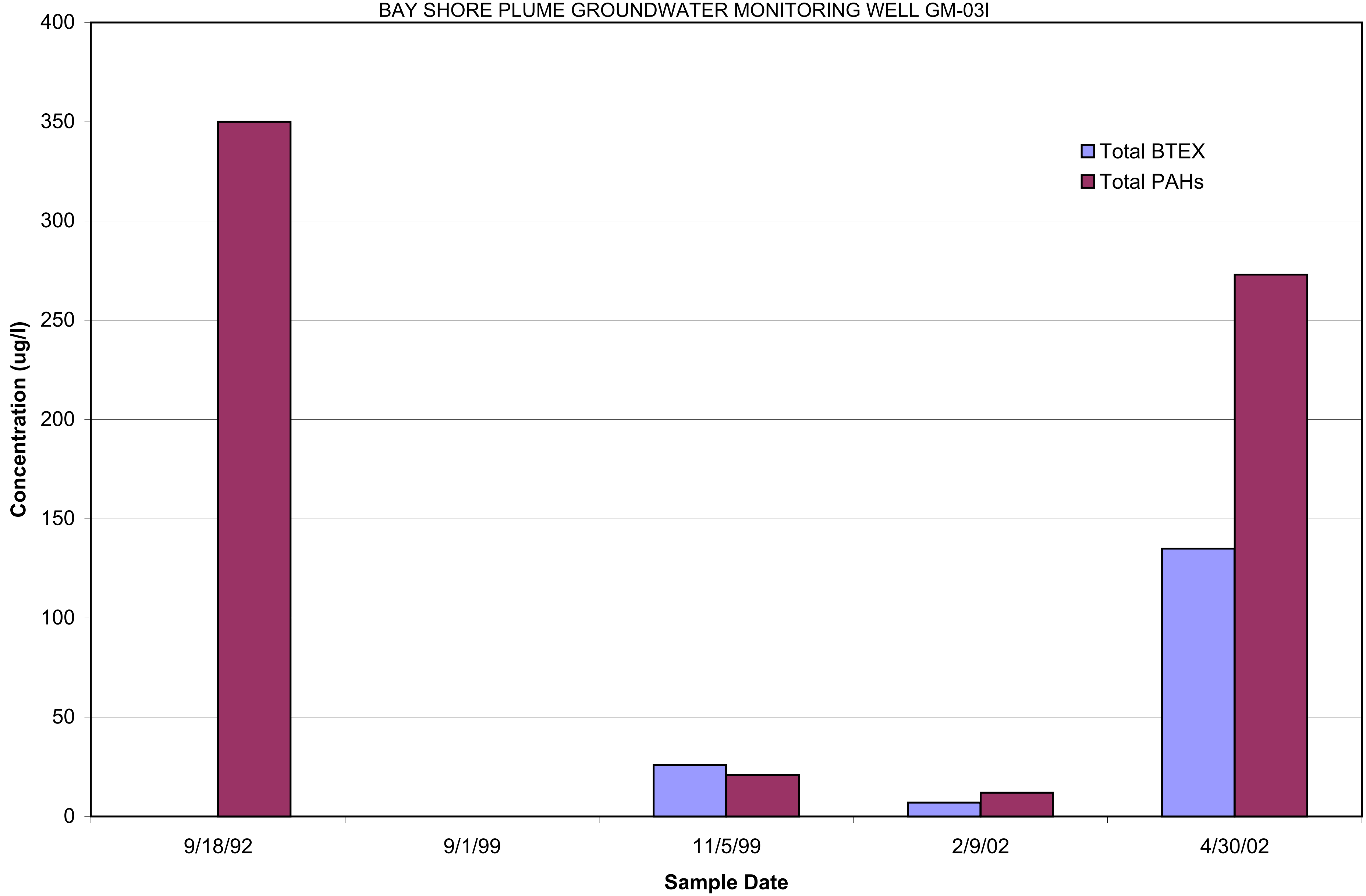

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FIGURE 4-32
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BAY SHORE PLUME GROUNDWATER MONITORING WELL GM-03D

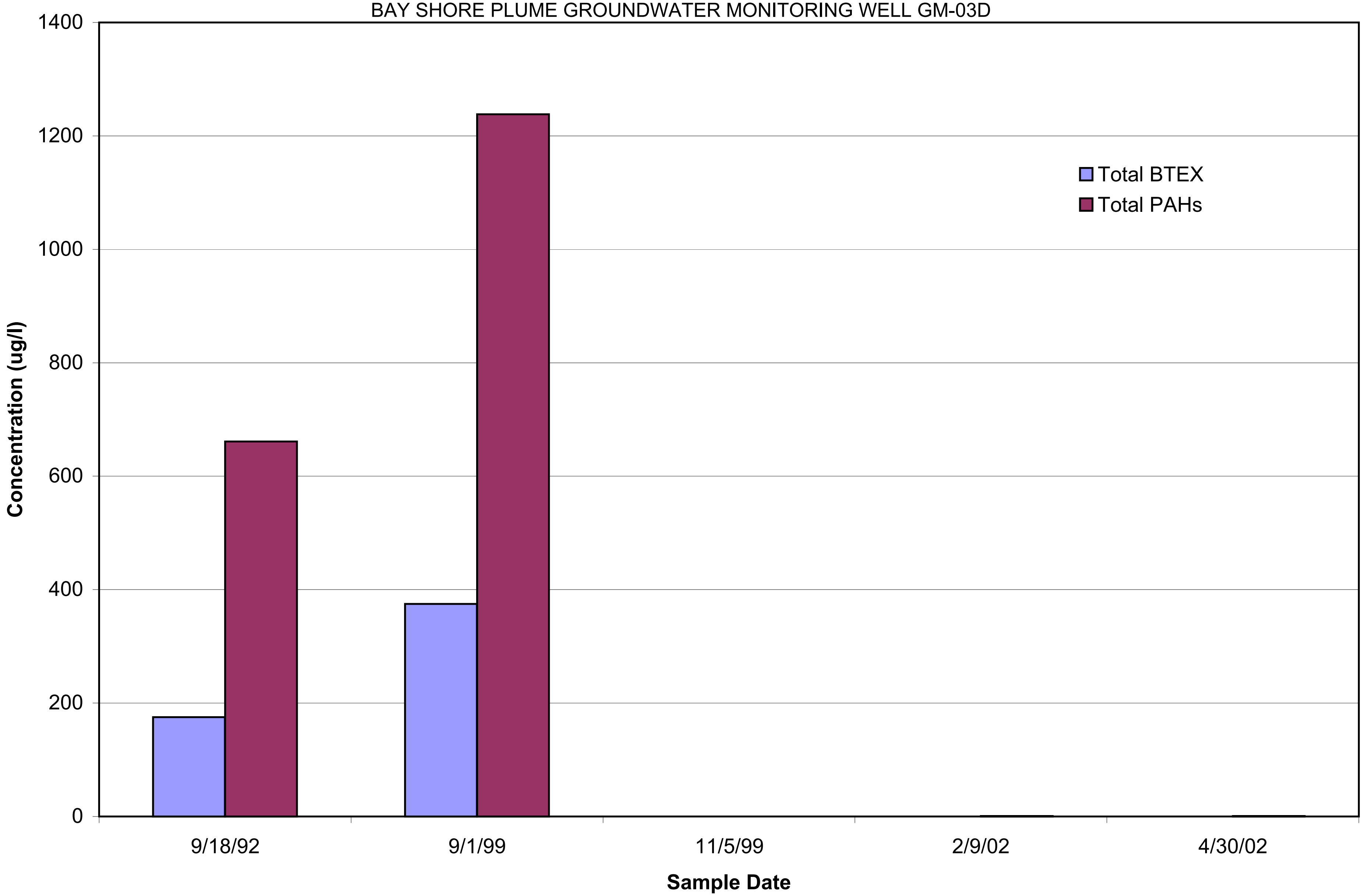

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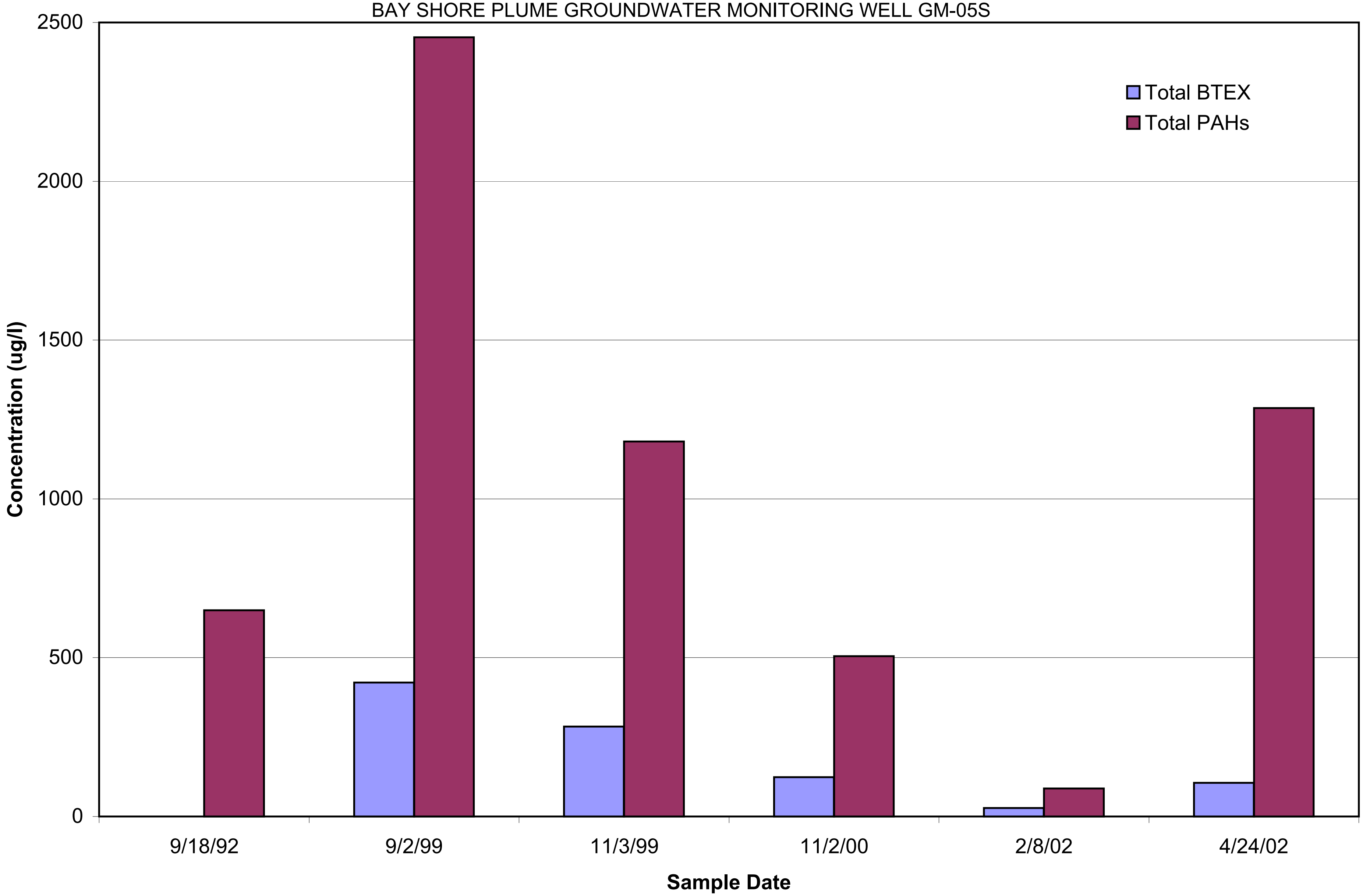
FIGURE 4-33
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BAY SHORE PLUME GROUNDWATER MONITORING WELL GM-05S



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1992) used to develop these figures is based on naphthalene only, as none of the other PAHs were analyzed in groundwater samples collected during the early sampling events. It is also noted that analysis of BTEX was not performed on samples collected from monitoring well GM-03S until September 1992. The wells used to evaluate possible trends in total BTEX and total PAH concentrations were selected based on their location relative to potential source areas, as well as the availability of analytical data from multiple sampling events at each well.

A review of **Figure 4-30** indicates that naphthalene concentrations in monitoring well GM-03S (i.e., in the middle portion of the Bay Shore plume) have decreased from 800 ug/l in August 1978 to 37 ug/l in April 2000. As shown on **Figure 4-30**, analytical results for samples collected since September 1992 show that total BTEX has never been detected at concentrations exceeding 70 ug/l. The relatively minor fluctuations of total BTEX and total PAHs in this well indicate that the water quality in the middle portion of the plume is in a steady state.

A review of **Figures 4-31** and **4-32** for intermediate and deep wells in well cluster GM-03 indicate that, although total PAH concentrations in these wells initially increased, concentrations ultimately decreased to relatively low levels during the most recent sampling event.

The trends of total BTEX and total PAHs in monitoring well GM-05S (**Figure 4-33**) show that total BTEX concentrations in the downgradient area of the Bay Shore plume exhibited a net decrease, and total PAHs have had a period of decreasing concentrations ending with an increase during the most recent sampling round.

Geochemical Parameters and Field Measurements

The analytical results of the geochemical parameters and field measurements in groundwater are summarized in **Tables C-27** through **C-30**. The range of concentrations for each of the key geochemical and field parameters is summarized in **Table 4-15**. Discussions of the geochemical and field parameter analytical results are presented below in order of relevance to assessing the occurrence of biodegradation, followed by discussions of the geochemical

Table 4-15

SUMMARY OF GEOCHEMICAL AND FIELD PARAMETER ANALYTICAL RESULTS

Parameter	Units	Range	Location With Maximum Concentration
Carbon Dioxide	mg/l	ND – 240	BBGP-84 (6-10)
Microbial Plate Count	cfu/ml	ND – 200	BBGP-78 (6-10)
Dissolved Oxygen	mg/l	ND – 2.9	BBMW-03D
Total Iron	ug/l	ND – 53,400	BBGP-82 (26-30)
Ferrous Iron	ug/l	ND – 19,800	GMP-04
Dissolved Iron	ug/l	ND – 29,900	GMP-04
Total Manganese	ug/l	13.7 – 539,000	BBGP-81 (16-20)
Dissolved Manganese	ug/l	15.2 – 24,300	BBGP-77 (60-64)
Oxidation Reduction Potential (ORP)	(mV)	-493 – +77	BBGP-78 (6-10)
Ammonia	mg/l	ND – 3.80	BBGP-83 (16-20)
pH	S.U.	3.95 – 7.11	BBGP-83 (6-10)
Chloride	mg/l	ND – 270	BBGP-76 (16-20)
Chemical Oxygen Demand (COD)	mg/l	ND – 78	BBGP-75 (64-68)
Biochemical Oxygen Demand (BOD)	mg/l	ND – 32	BBGP-75 (16-20)
Orthophosphate	mg/l	ND – 0.78	BBGP-78 (6-10)

parameters that provide a gauge of overall geochemical conditions in the aquifer. The relevance of each geochemical parameter to the occurrence of biodegradation is discussed below as well. The graphs shown on **Figures 4-34** through **4-38** depict variations in geochemical parameter concentrations and/or field measurements relative to total BTEX and PAH concentrations and were developed to identify general correlations between the paired data. Specifically, the parameters shown on the graphs are used to support the evaluation of biodegradation of BTEX and/or PAHs in groundwater.

Heterotrophic Microbial Plate Count

The concentration and distribution of heterotrophic bacteria in groundwater provides an indication as to the relative amount of microbial activity occurring within an aquifer. The results for the plate counts as presented in **Tables C-27** and **C-29** showed that heterotrophic bacteria were detected at low concentrations in 19 of the 63 groundwater samples analyzed. The plate counts ranged from "nondetected" to 200 colony forming units per milliliter (cfu/ml), which was detected in groundwater probe sample BBGP-78 (6 to 10 feet). Total BTEX in this groundwater probe point sample was 42 ug/l. Although the presence and concentrations of total heterotrophic bacteria are lower than would be expected in an aquifer where active biodegradation is occurring, it is noted that these bacteria commonly reside on the aquifer matrix and are less prevalent suspended in groundwater. Accordingly, plate counts of water samples typically yield lower population totals as compared to those in soil samples collected from the saturated zone of the aquifer matrix. However, as discussed below, other geochemical indicators such as carbon dioxide and dissolved oxygen concentrations support the hypothesis that biodegradation of BTEX and PAHs is likely occurring in the Bay Shore groundwater plume.

Carbon Dioxide

Carbon dioxide is the primary byproduct of aerobic biodegradation and the concentration of this compound in groundwater is an indicator as to the relative amount of aerobic biodegradation occurring in an aquifer. As shown in **Tables C-27** and **C-29**, carbon dioxide (CO_2) was detected in 45 of the 60 water samples collected from probe points and nine of the 12

FIGURE 4-34
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

TOTAL BTEX AND CARBON DIOXIDE CONCENTRATIONS VS. OFF-SITE GROUNDWATER SAMPLE LOCATIONS

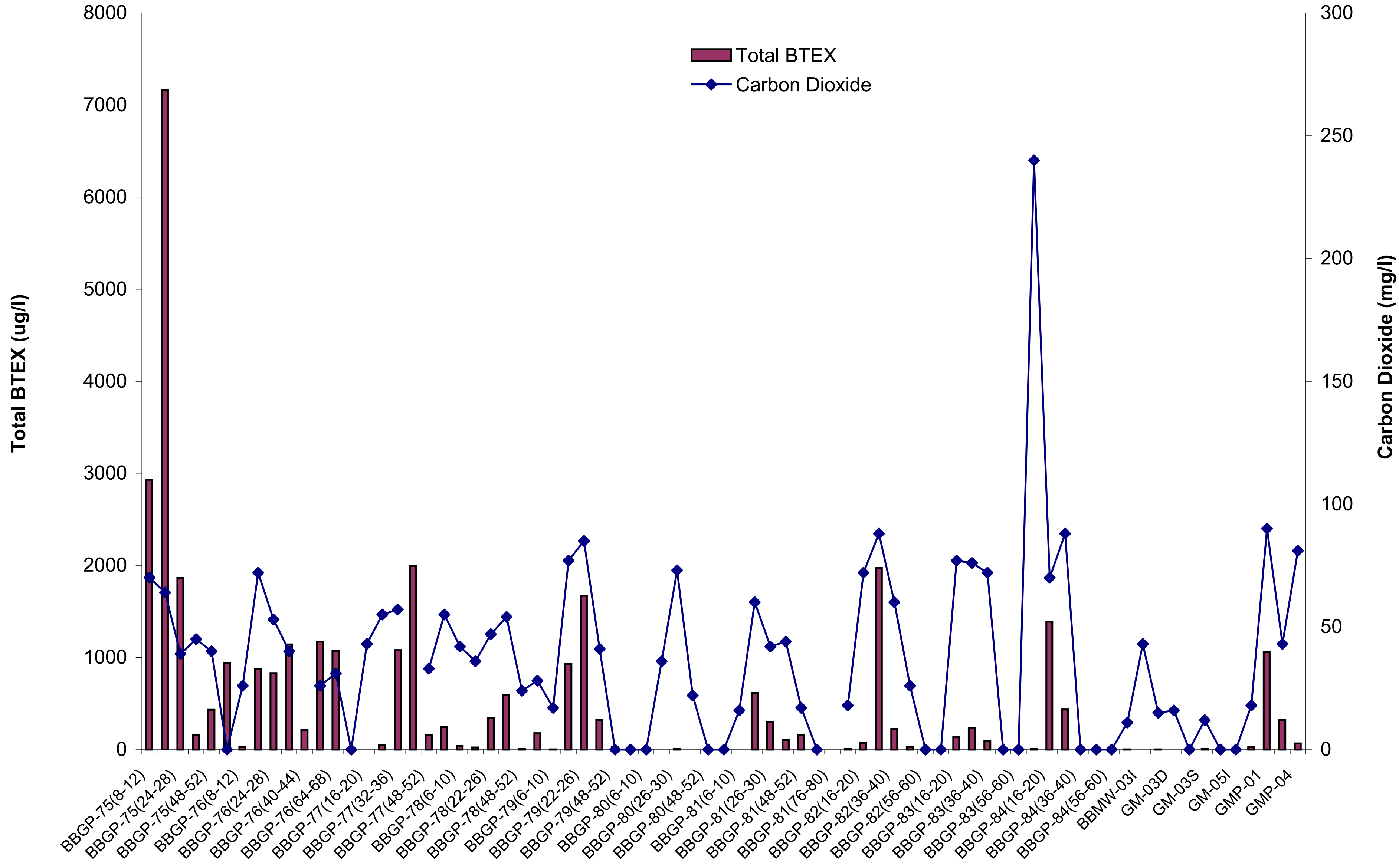

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FIGURE 4-35
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

TOTAL BTEX AND DISSOLVED OXYGEN CONCENTRATIONS VS. OFF-SITE GROUNDWATER SAMPLE LOCATIONS

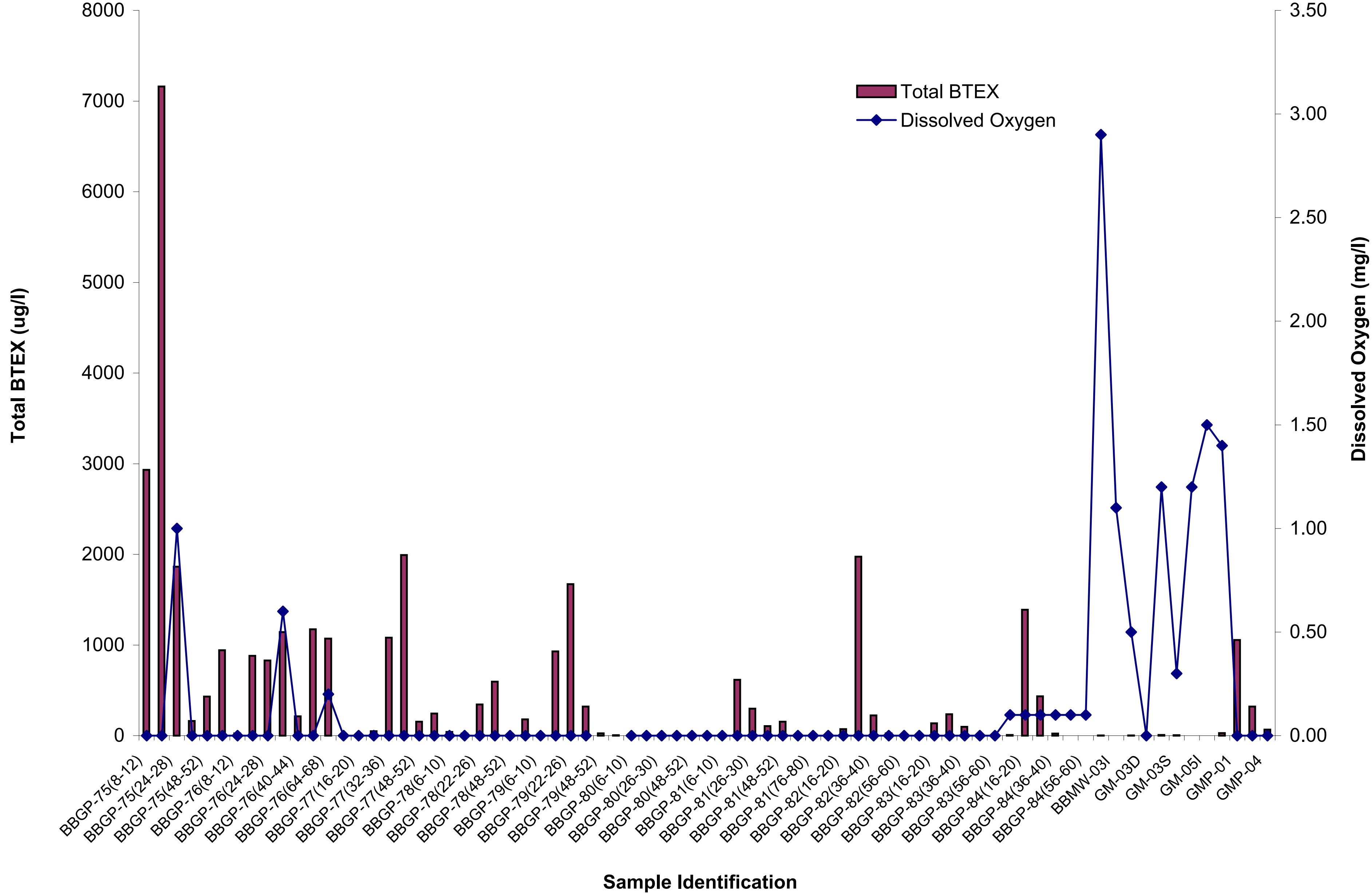

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FIGURE 4-36
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

TOTAL BTEX AND FERROUS IRON CONCENTRATIONS VS. OFF-SITE GROUNDWATER SAMPLE LOCATIONS

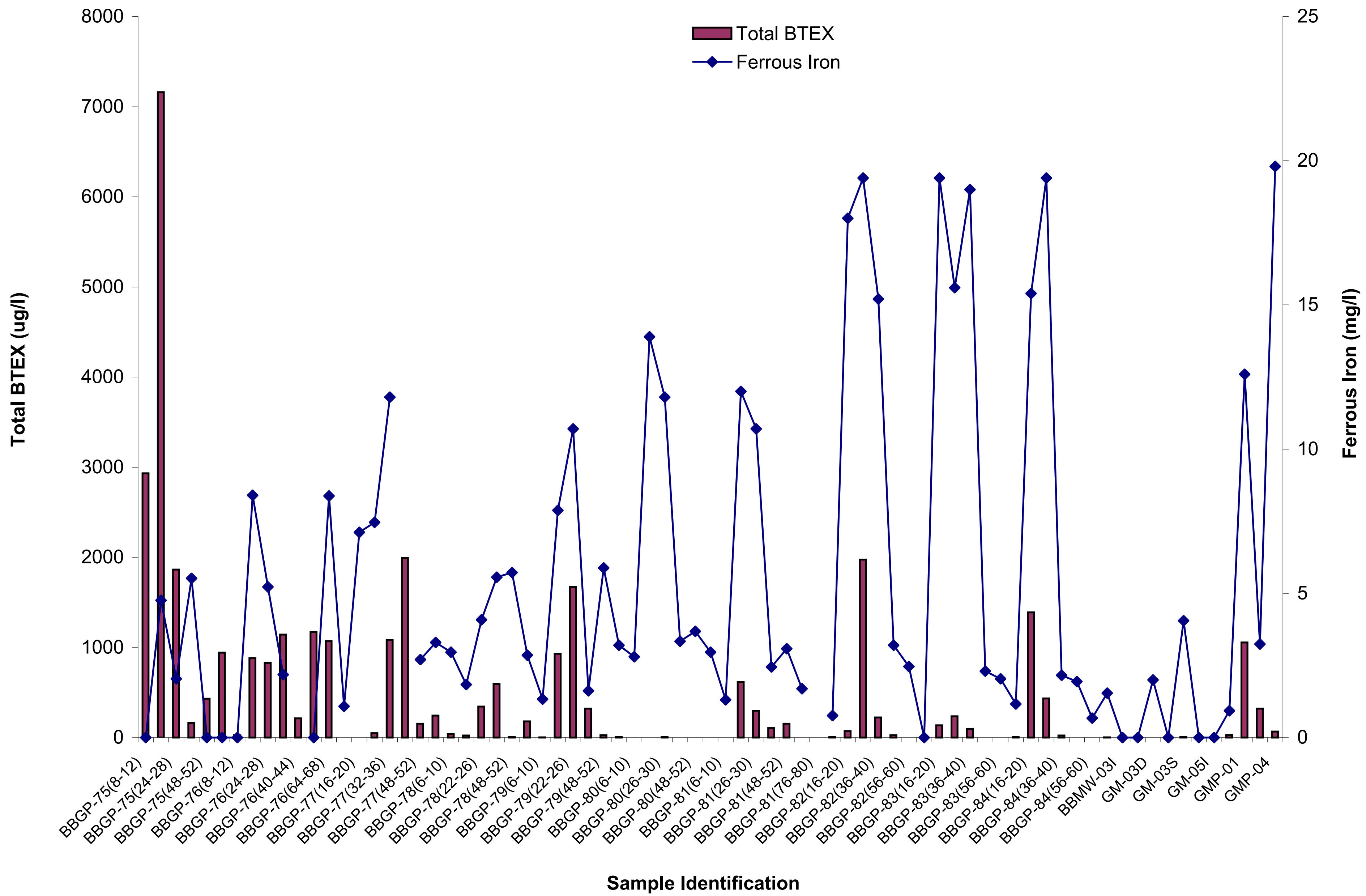

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FIGURE 4-37
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

TOTAL BTEX AND DISSOLVED MANGANESE CONCENTRATIONS VS. OFF-SITE GROUNDWATER SAMPLE LOCATIONS

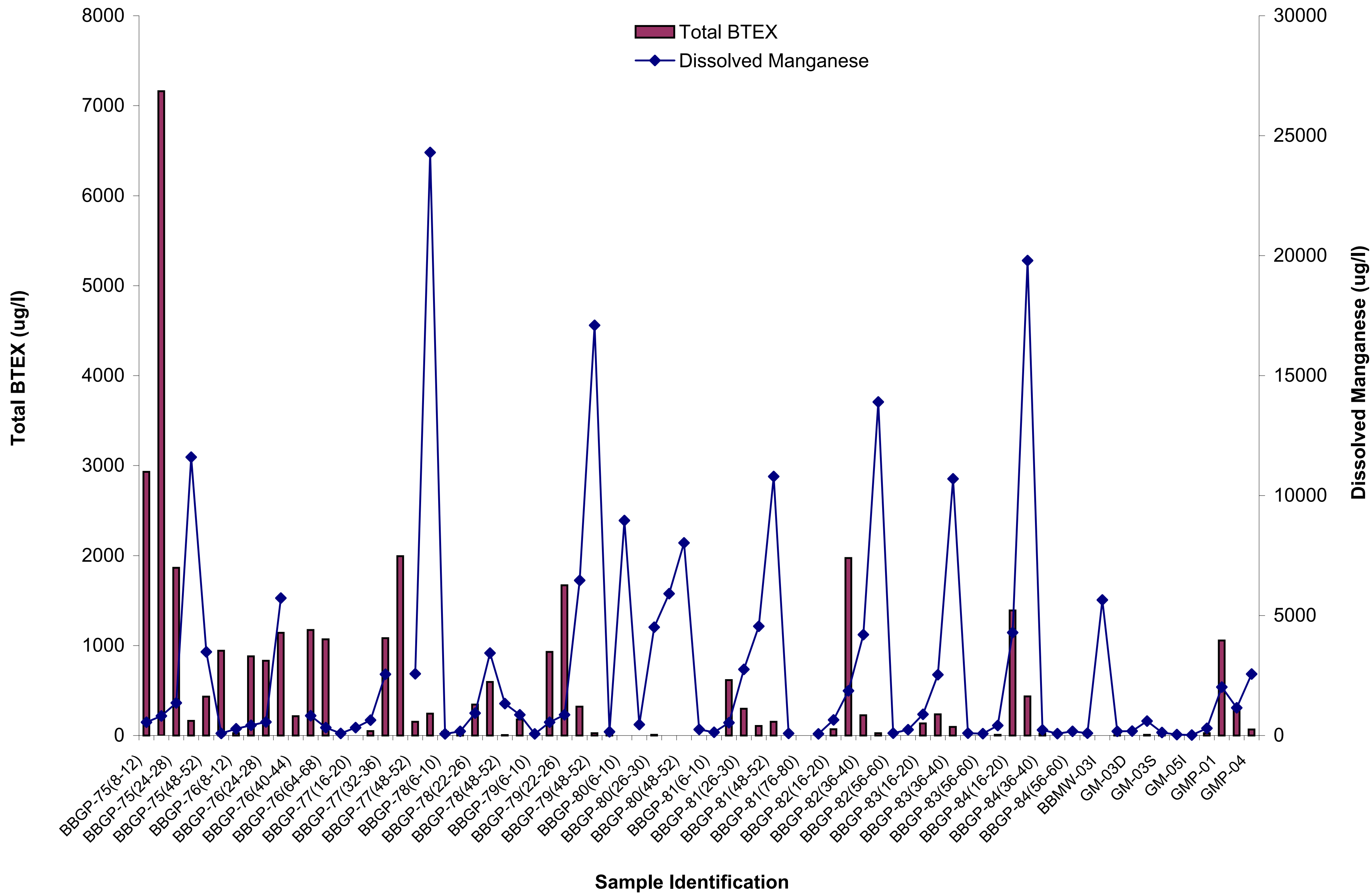

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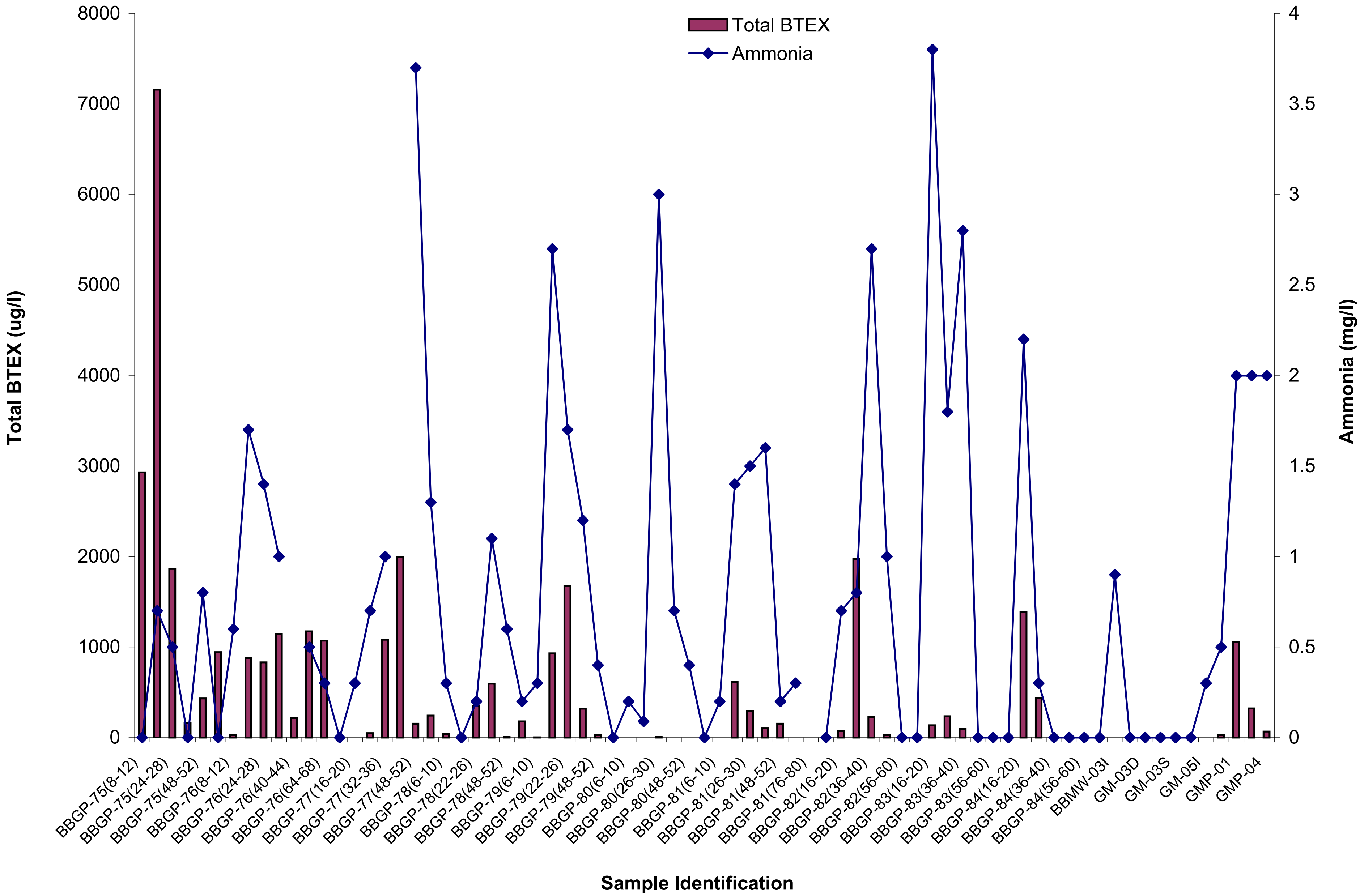
FIGURE 4-38
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

TOTAL BTEX AND AMMONIA CONCENTRATIONS VS. OFF-SITE GROUNDWATER SAMPLE LOCATIONS



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monitoring wells sampled. The concentrations ranged from less than the reported quantitation limit to 240 mg/l, as detected in groundwater probe sample BBGP-84 (6 to 10 feet). Concentrations of carbon dioxide are plotted versus total BTEX on **Figure 4-34**. With the exception of BBGP-75 (64 to 68 feet), carbon dioxide was detected in all samples that contained detectable concentrations of BTEX and or PAHs. Alternatively, no carbon dioxide is detected in samples that did not contain detectable BTEX and or PAHs. These correlations provide evidence that biodegradation of the BTEX and/or PAHs is occurring in the groundwater plume.

Dissolved Oxygen

The level of dissolved oxygen in groundwater provides an indication as to the predominant biological processes which are likely occurring within an aquifer. Concentrations of less than 0.5 mg/l generally indicate anaerobic conditions and concentrations above this generally indicate that aerobic conditions predominate (S. Suthersan). The analytical results presented in **Tables C-27** and **C-29** show that dissolved oxygen was detected in only sixteen of the 72 samples analyzed. Detectable levels of dissolved oxygen ranged from 0.1 mg/l to 2.9 mg/l. The maximum dissolved oxygen concentration of 2.9 mg/l was detected in sample BBMW-03D. At monitoring well cluster BBMW-03D, which is located outside the western plume boundary, concentrations of dissolved oxygen increase with depth. As shown on **Figure 4-35**, the five wells located at the downgradient end of the plume immediately upgradient from Lawrence Creek contained dissolved oxygen concentrations between 1 and 2 mg/l. This indicates that conditions at the leading edge of the plume are mildly aerobic. Dissolved oxygen concentrations in all other wells/probe points were 1.5 mg/l or less. The almost complete absence of dissolved oxygen is attributed to the consumption of oxygen during biodegradation of the BTEX and PAHs present in groundwater. As a result of the biodegradation, groundwater in the plume is predominated by anaerobic processes.

Oxidation - Reduction Potential

Similar to dissolved oxygen levels, oxidation-reduction potential (ORP) measurements provide an indication as to which biological processes predominate in an aquifer with negative

ORP measurements indicating generally anaerobic conditions and positive measurements indicating aerobic conditions. As shown in **Tables C-28** and **C-30**, the measurements of ORP in groundwater samples ranged from –493 millivolts (mV) in sample BBGP-78 (66 to 70 feet) to +77 mV in sample BBGP-78 (6 to 10 feet). The field measurements in **Tables C-28** and **C-30** show that the majority of the ORP measurements are negative, indicating that groundwater conditions in the Bay Shore plume are predominantly reducing and anaerobic.

Iron

Iron is a source of electrons used during biodegradation of organic substrates. During biodegradation iron is reduced to the ferrous, more soluble, form of iron. Ferrous iron is considerably more soluble than the oxidized form, or ferric iron. Accordingly, the presence of dissolved and or ferrous iron, in addition to other geochemical conditions, such as elevated dissolved carbon dioxide and reduced dissolved oxygen concentrations relative to background levels, is consistent with the occurrence of biodegradation. Dissolved iron concentration is used as an estimate or confirmation of ferrous iron.

Dissolved iron ranged from "nondetected" to 29,900 ug/l, which was detected in monitoring well GMP-04. Monitoring well GMP-04 is located at the most downgradient portion of the plume adjacent to Lawrence Creek, the discharge point for the Bay Shore plume. Similarly, analytical results for ferrous iron ranged from "nondetected" to 19,800 ug/l with the maximum concentration also occurring in monitoring well GMP-04. These analytical results from both analytical methods (i.e., for ferrous and dissolved iron) show that the highest concentrations of iron in solution were consistently detected in groundwater at monitoring well GMP-04. Total BTEX concentrations and ferrous iron are plotted by sample location on **Figure 4-36**. This plot indicates that ferrous iron concentrations are covariant with total BTEX concentrations. This means that ferrous iron concentrations are highest in groundwater containing BTEX and/or PAHs, and lowest where these chemical constituents were not detected. These correlations provide good evidence that iron is being used as an alternate electron acceptor to oxygen during anaerobic biodegradation processes. The increase in ferrous iron concentrations, shown as larger "spikes" on **Figure 4-36**, also shows that ferrous iron concentrations are generally higher in the relatively dilute downgradient portions of the plume and lower in the portions of the plume immediately downgradient from the site where BTEX and/or PAH compounds are more prevalent and occur at higher concentrations. As shown in **Tables C-27** and **C-29**, the maximum concentrations of ferrous iron appear to be approximately 20 mg/l, which suggests that the use of iron as an electron acceptor is limited. This may be due to the limited availability of iron in the aquifer.

As indicated in **Table 4-15**, total iron concentrations in the off-site plume ranged from not detected to 53,400 ug/l in groundwater probe sample BBGP-82 (26 to 30 feet). The absence of detectable iron was only observed in monitoring well BBMW-03I. Iron was detected in all other monitoring wells and groundwater probe points.

Manganese

The geochemical behavior of manganese is similar to that of iron, as described above. Accordingly, the reduced form of manganese is more soluble than the oxidized form. During biodegradation, manganese in the aquifer is reduced producing the more soluble manganous form.

Dissolved manganese concentrations ranged from 15.2 ug/l in monitoring well GM-05D to 24,300 ug/l in groundwater probe point BBGP-77 (60 to 64 feet). Monitoring well cluster GM-05 is located in the downgradient end of the plume immediately upgradient from Lawrence Creek. BTEX and PAHs were not detected in this well. Groundwater probe point BBGP-77 was located approximately midway between the site and Lawrence Creek. The concentrations of total BTEX and total PAHs in groundwater sample BBGP-77 (60 to 64 feet) were 244 ug/l and 4,011 ug/l, respectively.

In a parallel manner to iron, manganese is often used as an electron acceptor after the majority of available oxygen has been depleted. Total BTEX and dissolved manganese concentrations are plotted by sample location on **Figure 4-37**. This plot shows that dissolved manganese concentrations correlate directly with BTEX and PAH concentrations, where manganese concentrations are generally highest in groundwater with elevated BTEX and PAH concentrations.

Dissolved manganese was most frequently detected in groundwater with low to moderate concentrations of total BTEX and was present at the highest concentrations in groundwater samples collected from intermediate or deep wells. This increase in concentration with depth would suggest that manganese is utilized in the most reducing portions (i.e., the deepest portions of the aquifer) where total concentrations of total BTEX are moderate to low and dissolved oxygen would be expected to be naturally diminished.

Nutrients

Phosphorous (as orthophosphate) and nitrogen are key nutrients used by microbes in the subsurface to support growth and cell maintenance. Accordingly, these nutrients should be present at sufficient concentrations to support biodegradation of organic substrates.

Orthophosphate

Phosphorous (as orthophosphate) is a key nutrient used by microbes in the subsurface. Orthophosphate concentrations ranged from not detected to 0.78 mg/l, with the maximum concentration occurring in sample BBGP-78 (8 to 10 feet). Review of orthophosphate concentrations in **Tables C-27** and **C-29**, and corresponding total BTEX and/or PAH data in **Tables C-23** through **C-26** indicate that there is no apparent correlation between these chemical constituents and orthophosphate. According to Durant, et al. (1995), the ability to obtain and interpret the effect of phosphate concentrations on biodegradation rates or capacity is difficult, as it can readily complex with cations in the aquifer, such as calcium and iron. However, based on the absence of dissolved oxygen and the presence of metabolic by-products such as carbon dioxide, reduced forms of iron and manganese, the ability of the aquifer to support biodegradation does not appear to be limited by the relatively low phosphate concentrations in groundwater in the Bay Shore plume.

Ammonia

Ammonia is a reduced form of nitrogen that is produced in moderate to low pH and anaerobic conditions. During biodegradation, nitrate, a common component of groundwater, is used as an alternate electron acceptor. Therefore, relatively high concentrations of ammonia in groundwater is further evidence of anaerobic conditions.

Ammonia concentrations ranged from nondetected to 3.8 mg/l. In order to evaluate the behavior of ammonia in the plume, the concentrations of ammonia and total BTEX were plotted on **Figure 4-38** relative to sample locations. The plot indicates that ammonia concentrations, in general, are directly related to total BTEX concentrations. Without exception, ammonia concentrations are elevated in samples containing detected BTEX. This suggests that nitrogen, likely in the form of nitrate, is being used as an electron acceptor during anaerobic biodegradation of BTEX and PAHs in the aquifer. The reduced nitrogen resulting from this process is reacting with hydrogen to produce ammonia. The direct correlation of ammonia production with total BTEX concentrations indicates that sufficient nitrogen (likely as nitrate) is present in the aquifer to support biodegradation.

pH

As shown in **Tables C-28** and **C-30**, and as summarized in **Table 4-15**, values of pH ranged from 3.95 standard units (s.u.) to 7.11 s.u. According to Wiedemeir, et al. (1995), bacteria that typically degrade petroleum hydrocarbon compounds, such as BTEX and PAHs, prefer pHs from approximately 6 to 8 s.u.

Chloride

Chloride provides evidence of dechlorination of chlorinated hydrocarbons present in groundwater but may be also associated with road salting activities. As shown in **Tables C-27** and **C-29**, and as summarized in **Table 4-15**, where detected, chloride concentrations ranged from 11 mg/l in groundwater probe sample BBGP-78 (48 to 52 feet) to 270 mg/l in groundwater probe sample BBGP-76 (16 to 20 feet).

Chemical Oxygen Demand

Chemical Oxygen Demand (COD) is a measure of the portion of organic matter (including BTEX and PAHs) that can be readily oxidized by a strong oxidant. The concentrations of COD in groundwater samples collected in the plume, as shown in **Tables C-27** and **C-29**, and summarized in **Table 4-15**, ranged from not detected to a maximum of 78 mg/l in sample BBGP-75 (64 to 68 feet). Although COD was only detected in 24 of the 60 samples analyzed, the reported detection limit for this parameter was 30 mg/l, therefore, it is likely that COD is also present at concentrations below 30 mg/l in most, if not all, of the remaining samples analyzed. It is noted that the majority of the COD is attributed to naturally occurring organic materials with only minor contributions from the chemical constituents related to MGP residual materials in the subsurface.

Biochemical Oxygen Demand

Biochemical oxygen demand (BOD) is defined as the mass of oxygen required by bacteria to metabolize decomposable organic compounds (including BTEX and PAHs) in a water or wastewater under aerobic conditions. The concentrations of BOD in groundwater, as shown in **Tables C-27** and **C-29**, and as summarized in **Table 4-15**, ranged from not detected to 32 mg/l, which was detected in sample BBGP-75 (16 to 20 feet). Biochemical oxygen demand is used here as an indication of the empirical maximum amount of oxygen that may be consumed by biochemical activity in groundwater. Specifically, in determining the necessary concentration of oxygen necessary to promote biochemical oxidation of target organic chemicals, such as BTEX, sufficient oxygen would be necessary to ensure that all forms of readily oxidizable organic materials are accommodated.

4.3.2 O-Co-Nee Pond Investigation (Operable Unit 3)

Investigations downgradient of the Brightwaters Yard conducted as part of the initial field program as well as prior work had defined a BTEX/PAH groundwater plume downgradient of the site. While the vertical and horizontal extent of the plume was sufficiently defined, additional data was needed to determine if the plume was discharging to a small surface water body called O-Co-Nee Pond located approximately 1,400 feet south of the site. Therefore, as part of the supplemental field program, additional surface water, surface water sediment and pore water samples were collected from this surface water body.

It should be noted that KeySpan is currently performing an Interim Remedial Measure (IRM) at the Brightwaters Yard. This IRM involves the mitigation of BTEX and PAHs present in the plume source area as well as in the off-site groundwater plume. The IRM includes the use of in-situ chemical oxidation technology and oxygen injection. The specific chemical oxidation process applied was the In-situ Oxidative Technologies, Inc. ISOTEC process. This IRM is one phase of the overall environmental improvements being implemented at the Bay Shore/Brightwaters former MGP site.

As part of this IRM, two series of oxygen injection wells were installed in September 2000. One system is located on the Brightwaters Yard property line adjacent to and parallel with the Long Island Railroad Right-of-Way. The other system is located off-site, perpendicular to the groundwater plume along the southern shoulder of Union Boulevard. The location of this system, relative to the plume, is depicted on **Figure 4-39**. The on-site system was installed for future use, and the off-site Union Boulevard system has been operational since its installation and is showing positive impacts at least 350 feet downgradient of the system. The system is still operational and is monitored on a monthly basis. Downgradient wells in the area are sampled quarterly and the status of the system is reported with this data to the NYSDEC.

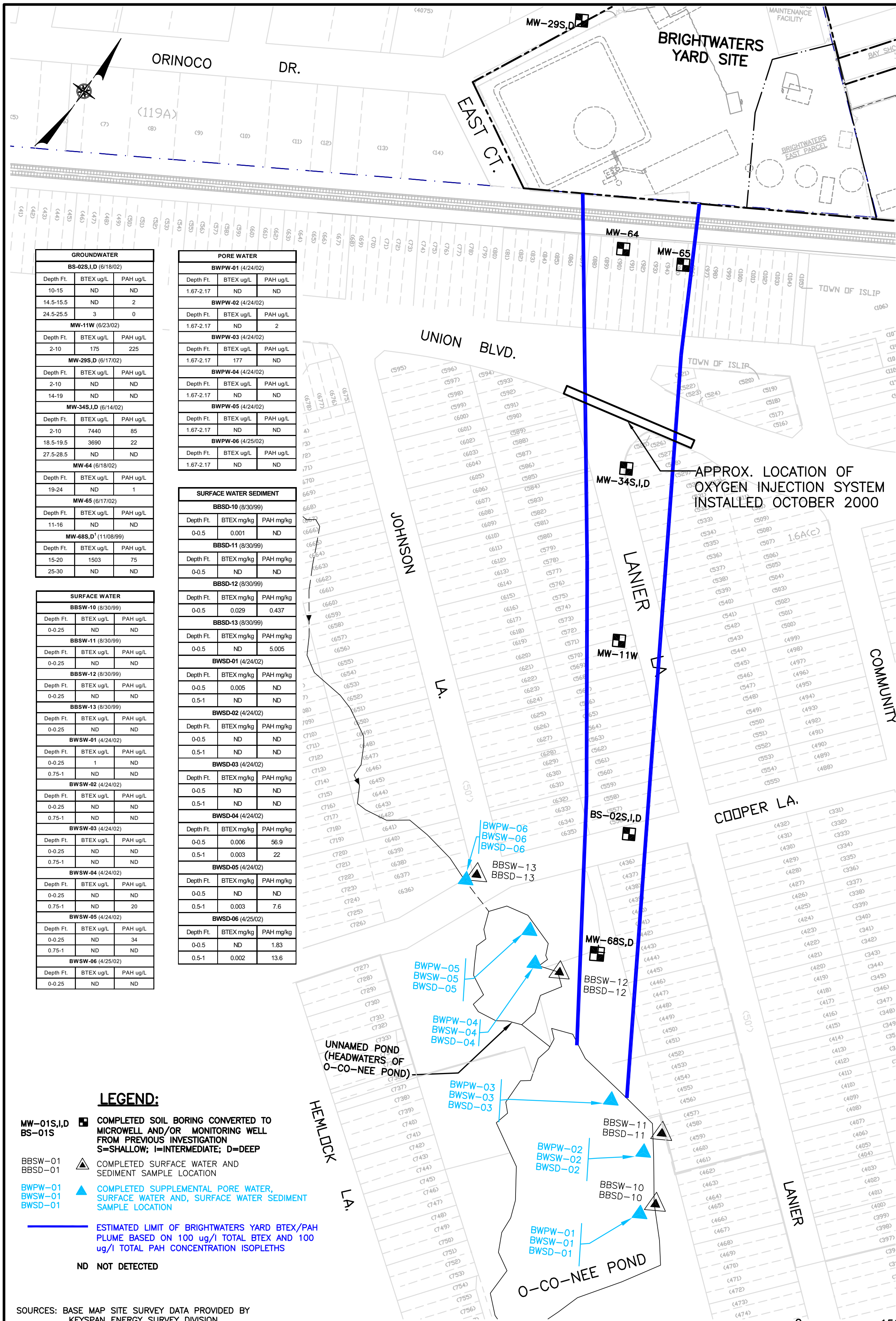
To address the plume source areas, this IRM also included two large scale series of ISOTEC injections in the Brightwaters Yard and along the LIRR Right-of-Way. The injections were completed in May and September of 2001. On-site and downgradient well monitoring took

GROUNDWATER		
BS-02S,I,D (6/18/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
10-15	ND	ND
14.5-15.5	ND	2
24.5-25.5	3	0
MW-11W (6/23/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
2-10	175	225
MW-29S,D (6/17/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
2-10	ND	ND
14-19	ND	ND
MW-34S,I,D (6/14/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
2-10	7440	85
18.5-19.5	3690	22
27.5-28.5	ND	ND
MW-64 (6/18/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
19-24	ND	1
MW-65 (6/17/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
11-16	ND	ND
MW-68S,D[1] (11/08/99)		
Depth Ft.	BTEX ug/L	PAH ug/L
15-20	1503	75
25-30	ND	ND

SURFACE WATER		
BBSW-10 (8/30/99)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
BBSW-11 (8/30/99)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
BBSW-12 (8/30/99)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
BBSW-13 (8/30/99)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
BWSW-01 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	1	ND
0.75-1	ND	ND
BWSW-02 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
0.75-1	ND	ND
BWSW-03 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
0.75-1	ND	ND
BWSW-04 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND
0.75-1	ND	20
BWSW-05 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	34
0.75-1	ND	ND
BWSW-06 (4/25/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
0-0.25	ND	ND

PORE WATER		
BWPW-01 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
1.67-2.17	ND	ND
BWPW-02 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
1.67-2.17	ND	2
BWPW-03 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
1.67-2.17	177	ND
BWPW-04 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
1.67-2.17	ND	ND
BWPW-05 (4/24/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
1.67-2.17	ND	ND
BWPW-06 (4/25/02)		
Depth Ft.	BTEX ug/L	PAH ug/L
1.67-2.17	ND	ND

SURFACE WATER SEDIMENT		
BBSD-10 (8/30/99)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	0.001	ND
BBSD-11 (8/30/99)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	ND	ND
BBSD-12 (8/30/99)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	0.029	0.437
BBSD-13 (8/30/99)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	ND	5.005
BWSD-01 (4/24/02)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	0.005	ND
0.5-1	ND	ND
BWSD-02 (4/24/02)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	ND	ND
0.5-1	ND	ND
BWSD-03 (4/24/02)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	ND	ND
0.5-1	ND	ND
BWSD-04 (4/24/02)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	0.006	56.9
0.5-1	0.003	22
BWSD-05 (4/24/02)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	ND	ND
0.5-1	0.003	7.6
BWSD-06 (4/25/02)		
Depth Ft.	BTEX mg/kg	PAH mg/kg
0-0.5	ND	1.83
0.5-1	0.002	13.6



LEGEND:

MW-01S,I,D
BS-01S — COMPLETED SOIL BORING CONVERTED TO MICROWELL AND/OR MONITORING WELL FROM PREVIOUS INVESTIGATION S=SHALLOW; I=INTERMEDIATE; D=DEEP

BBSW-01
BBSD-01 — COMPLETED SURFACE WATER AND SEDIMENT SAMPLE LOCATION

BWPW-01
BWSW-01
BWSD-01 — COMPLETED SUPPLEMENTAL PORE WATER, SURFACE WATER AND, SURFACE WATER SEDIMENT SAMPLE LOCATION

ESTIMATED LIMIT OF BRIGHTWATERS YARD BTEX/PAH PLUME BASED ON 100 ug/l TOTAL BTEX AND 100 ug/l TOTAL PAH CONCENTRATION ISOPLETHS

ND — NOT DETECTED

SOURCES: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.

NOTE: SITE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS.
1 – CURRENT DATA NOT AVAILABLE DUE TO WELL LOCATION IN INACCESSIBLE AREA

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

Dvirka and Bartilucci
CONSULTING ENGINEERS
A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

TOTAL BTEX AND PAH CONCENTRATIONS IN GROUNDWATER, SURFACE WATER, PORE WATER AND SURFACE WATER SEDIMENT FOR BRIGHTWATERS YARD PLUME AND O-CO-NEE POND

FIGURE 4-39

place at least monthly from the beginning of the IRM until January 2002. Groundwater monitoring has taken place quarterly from January 2002 until present, and is still ongoing. A supplemental investigation was performed in August 2002 in accordance with the "Supplemental Investigation Work Plan, Brightwaters Yard Groundwater Plume IRM," dated June 2002, that was approved by the NYSDEC. The purpose of the investigation was to:

- Better define the extent of BTEX and PAHs remaining in the Brightwaters Yard after completing the IRM;
- Provide a more definitive "before and after" BTEX/PAH concentration comparison for evaluating the IRM performance;
- Summarize the data collected to date on the IRM; and
- Recommend a course of action for additional remedial measures for the Brightwaters Yard.

A Supplemental IRM Investigation Report will be submitted to the NYSDEC in the first quarter of 2003 to document the results of this investigation and address the first three bulleted items mentioned above.

A Recommendations Report will immediately follow the Supplemental IRM Investigation to identify the extent of BTEX/PAHs remaining at the site and propose a conceptual plan detailing how these residual BTEX/PAHs will be mitigated. This document will begin a dialogue with the NYSDEC that will culminate with the development of a formal IRM Work Plan Addendum to remediate the remaining BTEX/PAHs identified at the Brightwaters Yard. While this process takes place, previously planned operations and maintenance will continue. These activities include: quarterly sampling of monitoring wells located within the Brightwaters Yard and downgradient throughout the groundwater plume, and monthly operation and maintenance of the Union Boulevard oxygen injection system.

As specified in the original IRM Work Plan dated June 2001, a Summary IRM Report will be prepared at the conclusion of the IRM project. The Report will be P.E. certified and stamped, attesting that the IRM was conducted in accordance with the IRM Work Plan. The report will include interim reports in the form of attachments, the results of field measurements and laboratory analyses, records pertinent to the performance and completion of the IRM project such as well abandonment records, summary evaluations of the components of the IRM, and project findings. The success of the IRM relative to the project objectives will be addressed in the summary report. Consideration will be given to the need for additional action as part of the overall site remedial program required under the Order on Consent.

4.3.2.1 - Groundwater

As discussed above, prior investigations had defined a groundwater plume downgradient of the Brightwaters Yard. The plume consists of dissolved-phase BTEX and PAH compounds originating from a source area located in the southwest corner of the site. This source area is associated with a petroleum-based MGP feedstock historically stored in this portion of the site. The plume has been determined to be approximately 200 feet wide at the site boundary and approximately 1,400 feet long.

Starting in March of 1999, KeySpan began routinely monitoring the Brightwaters Yard plume on a quarterly basis using a number of monitoring well clusters located down the plume centerline. **Figure 4-39** shows the location of each well cluster used in the monitoring program and the most recent BTEX/PAH concentration for each well, the majority being from the June 2002 sample round. In order to develop an understanding of changes in concentration of total BTEX/PAHs in groundwater over time, historical and current data were also evaluated as discussed below.

Changes in total BTEX and total PAH concentrations with time in monitoring wells MW-64, MW-65, MW-34S, MW-11W, BS-02S and MW-68S, which are located within the defined Brightwaters Yard groundwater plume, are shown graphically on **Figures 4-40** through **4-45**, respectively. The plots for monitoring wells MW-64 and MW-65 are used to show trends in water quality immediately downgradient from the Brightwaters Yard. The plots for monitoring wells MW-34S and MW-11W are used to show trends in water quality in the middle portion of the plume. The plots for monitoring wells MW-68S and BS-02S are used to show trends in water

FIGURE 4-40
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BRIGHTWATERS YARD PLUME GROUNDWATER MONITORING WELL MW-64

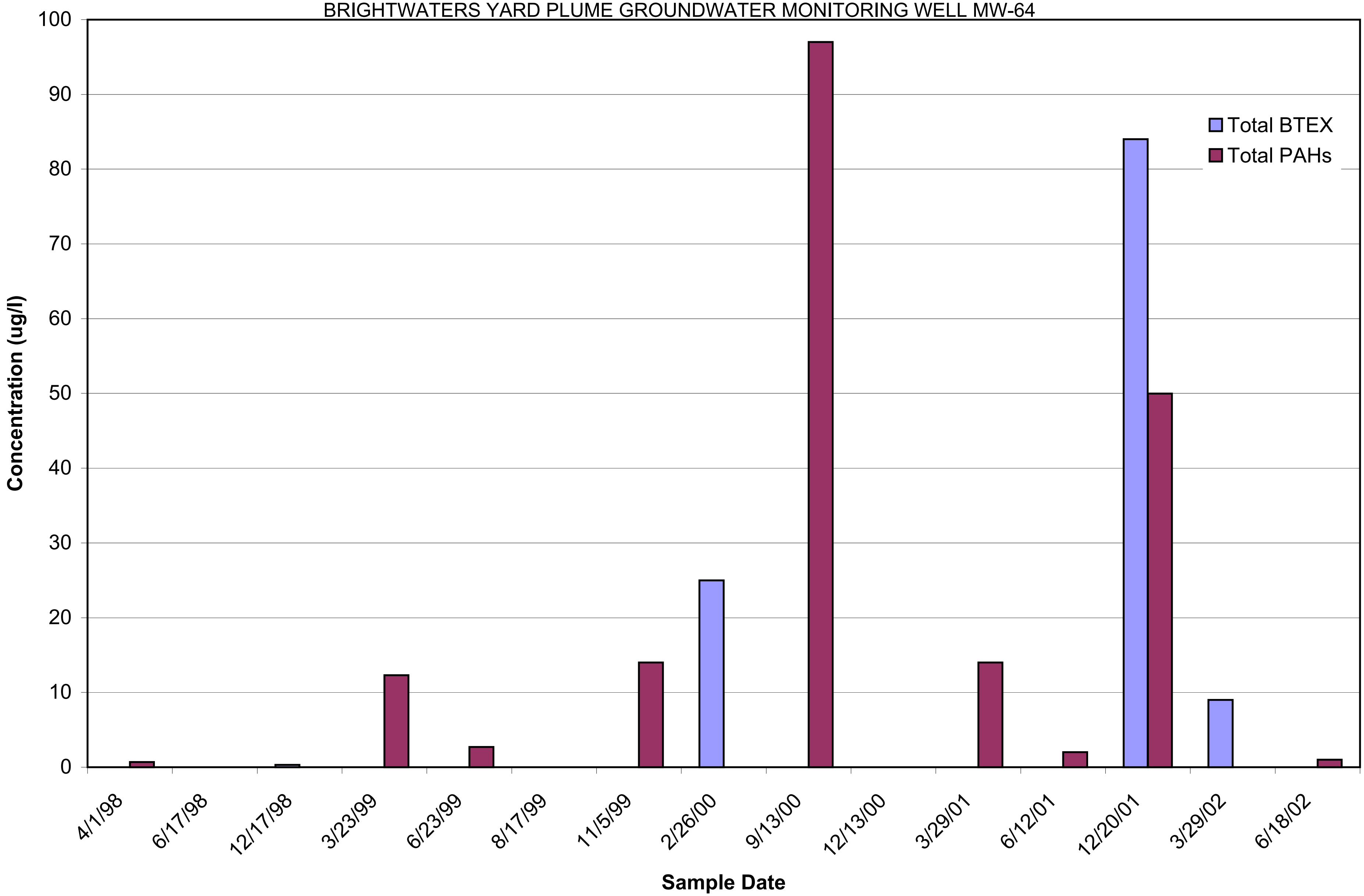


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FIGURE 4-41
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BRIGHTWATERS YARD PLUME GROUNDWATER MONITORING WELL MW-65

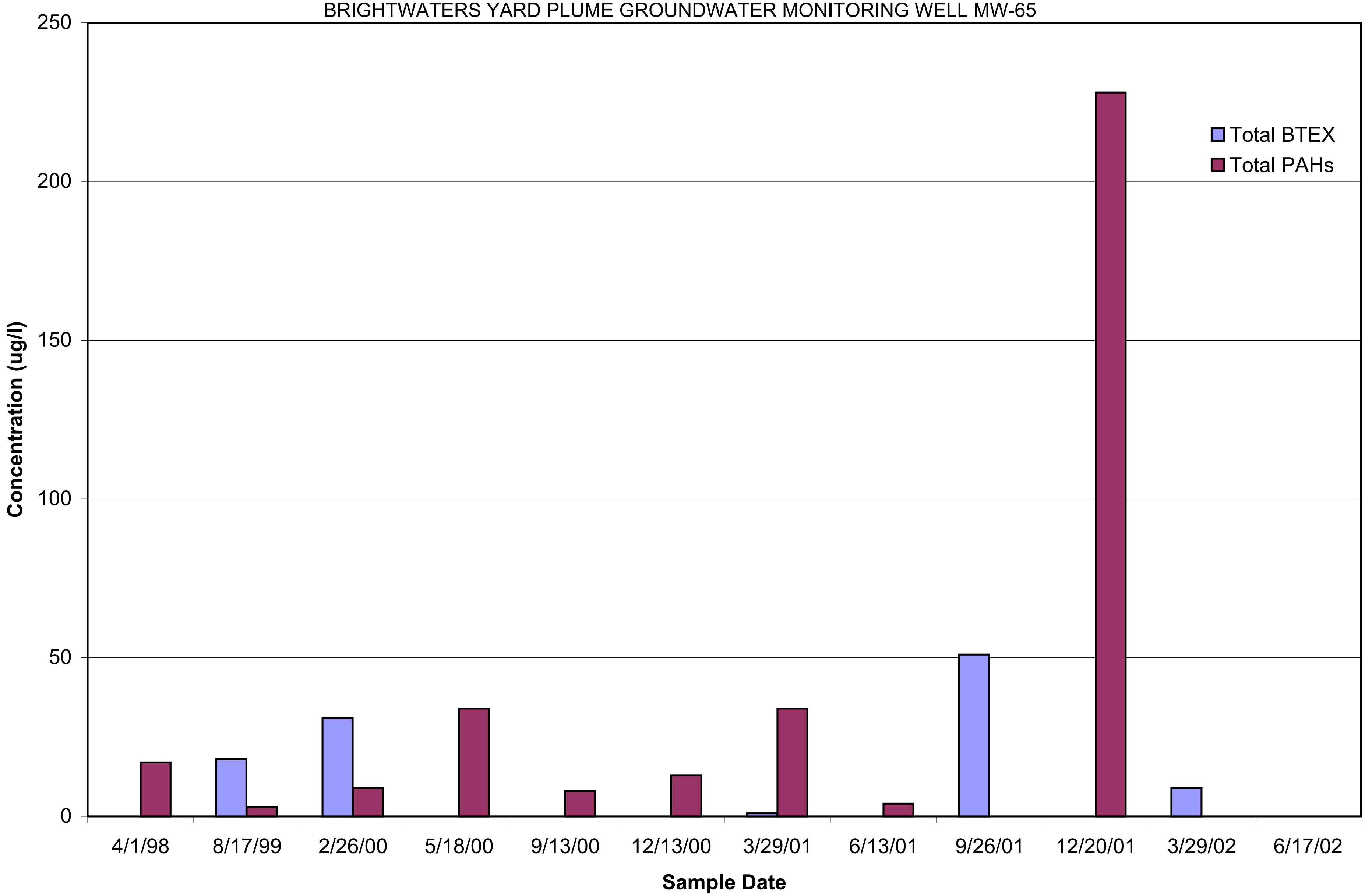

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FIGURE 4-42
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN BRIGHTWATERS YARD PLUME GROUNDWATER MONITORING WELL MW-34S

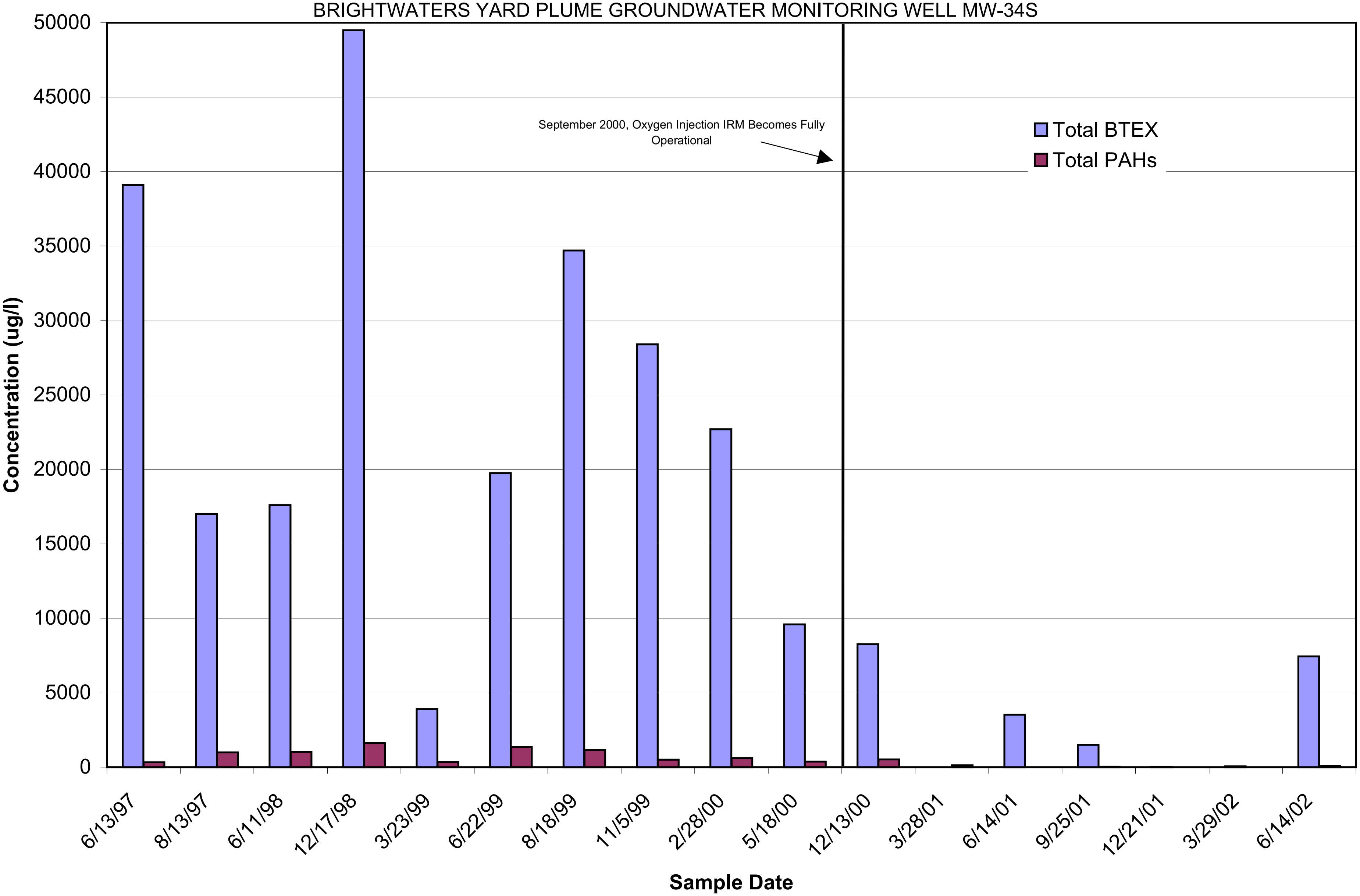

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FIGURE 4-43
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BRIGHTWATERS YARD PLUME GROUNDWATER MONITORING WELL MW-11W

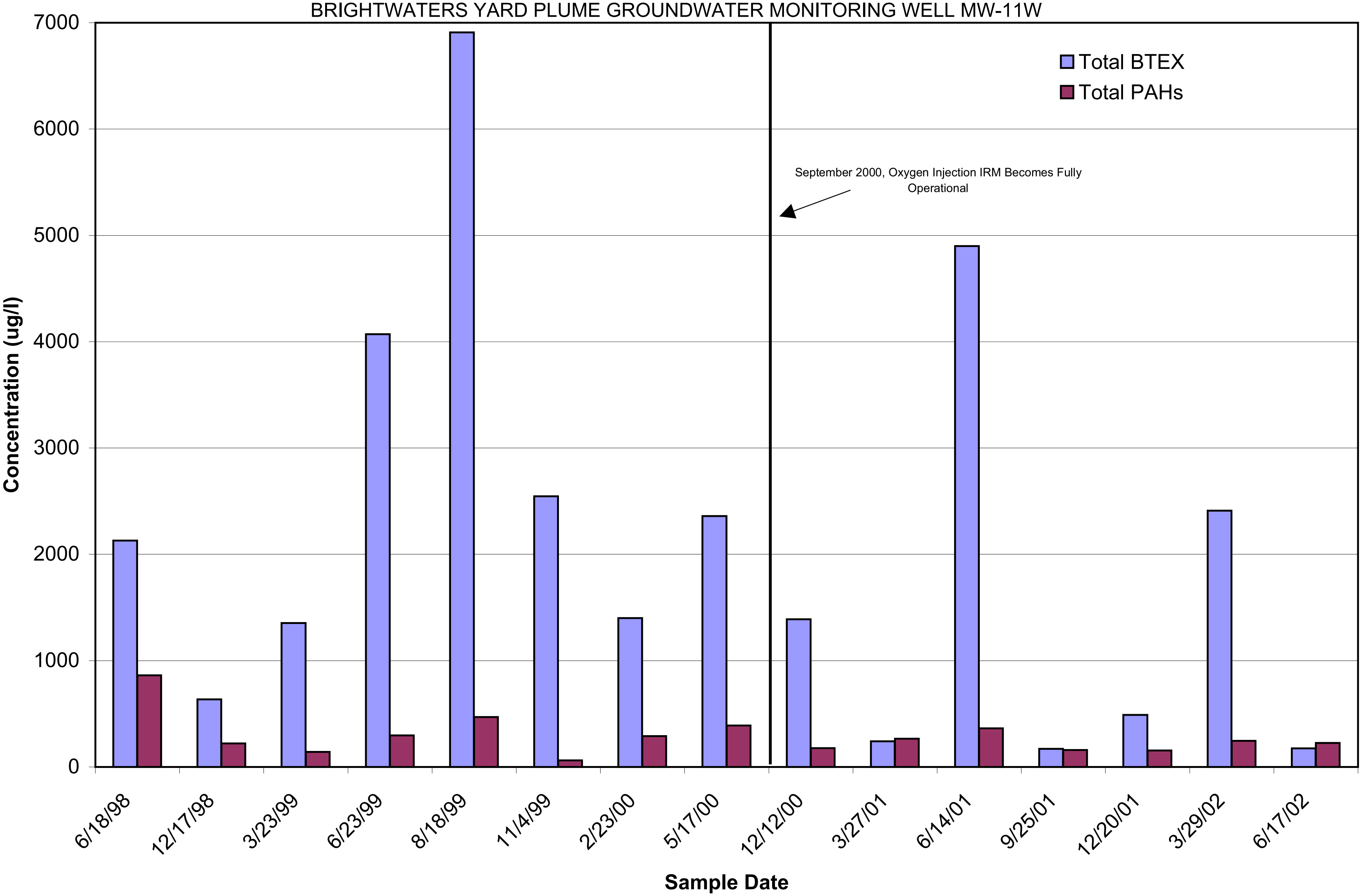

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FIGURE 4-44
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BRIGHTWATERS YARD PLUME GROUNDWATER MONITORING WELL BS-02S

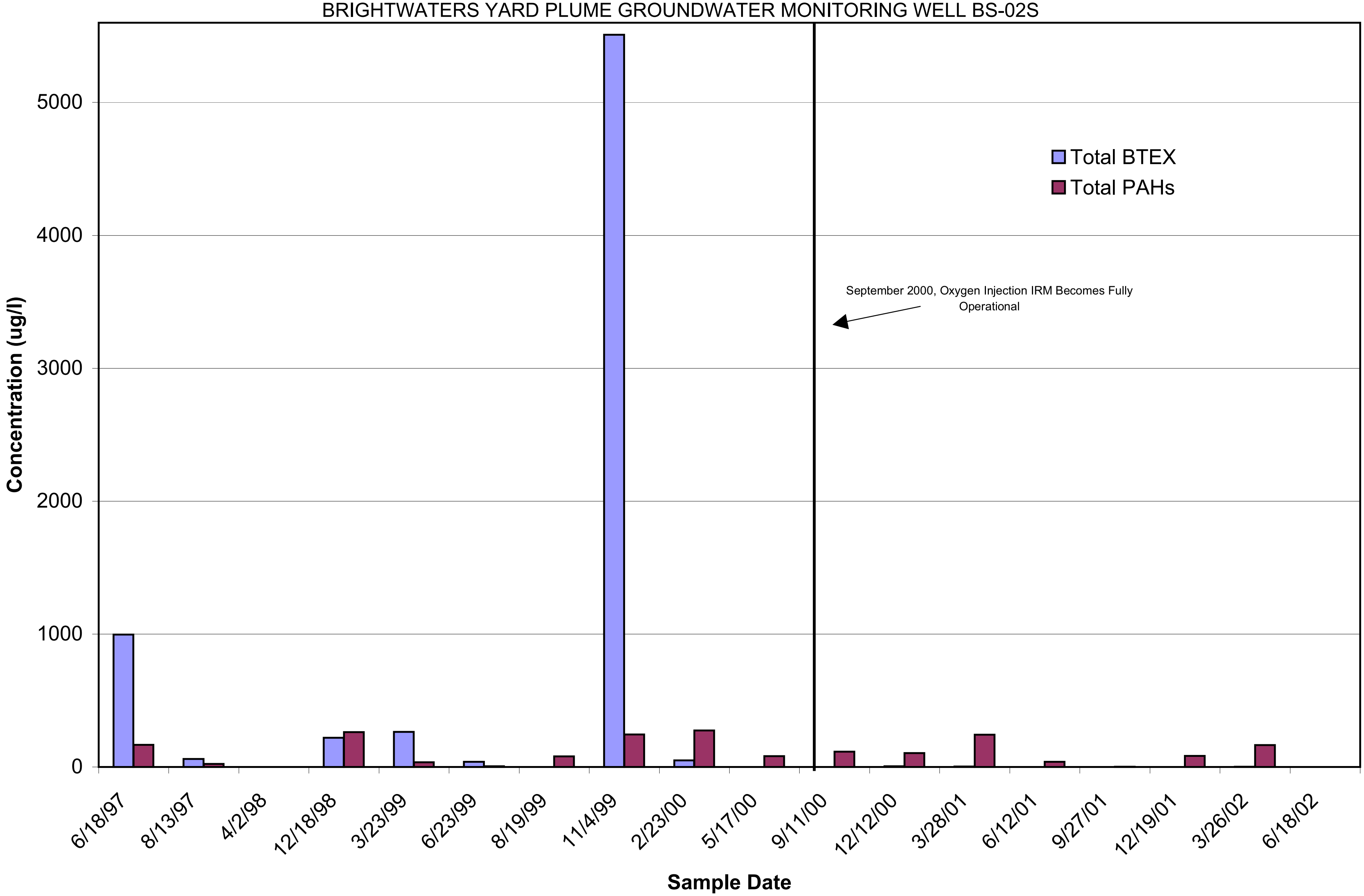

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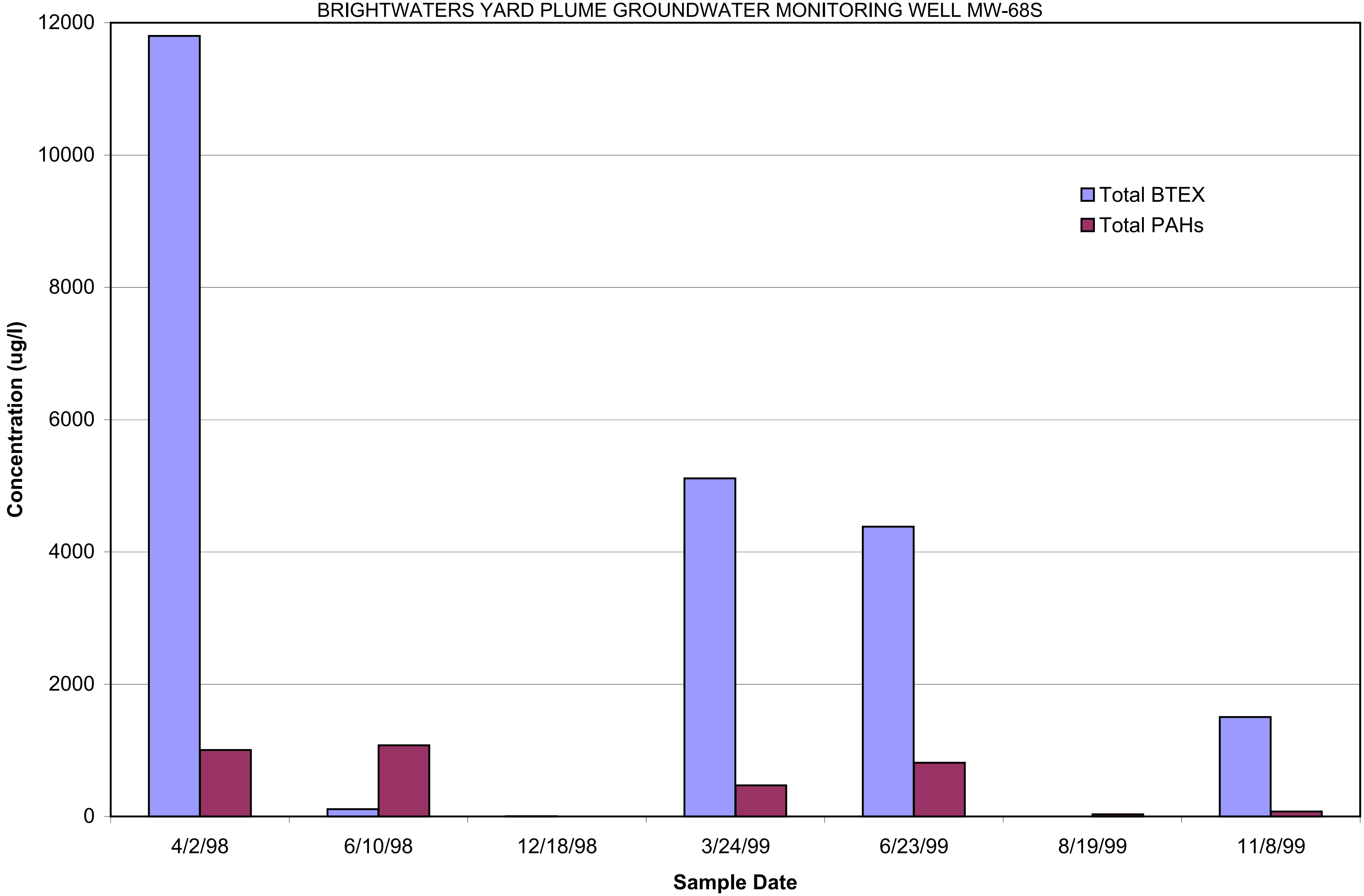
FIGURE 4-45
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

CHANGES OF TOTAL BTEX AND TOTAL PAH CONCENTRATIONS OVER TIME IN
BRIGHTWATERS YARD PLUME GROUNDWATER MONITORING WELL MW-68S



I:\1620 (KeySpan)\BAY SHORE_BRIGHTWATERS\Supplemental Investigation\SUPPLEMENTAL REPORT\Groundwater Trend Data

quality in downgradient areas of the plume. The wells used to evaluate the historical trend of total BTEX and total PAHs were selected based on their location relative to the source area and downgradient discharge point, as well as the availability of analytical data from multiple sampling events at each well. Where appropriate, data from all wells in a monitoring well cluster were evaluated. Note that a bold vertical line has been added to the figures, where appropriate, marking September 2000, the month in which the oxygen injection IRM discussed above became operational. Since monitoring wells MW-64 and MW-65 are located upgradient of the oxygen injection points, a bold vertical line has not been added to **Figures 4-40** and **4-41**. The line has also not been added to **Figure 4-45**, as monitoring well MW-68S has not been sampled since November 1999.

A review of **Figures 4-40** and **4-41** shows that total BTEX and total PAHs in the shallow groundwater at monitoring wells MW-64 and MW-65 have been detected at low concentrations intermittently since 1998. There is no predominant trend of increasing or decreasing concentrations. The graphs also show that concentrations of total BTEX and total PAHs for samples collected during 2002 from monitoring well MW-64 are near historical lows and that no BTEX or PAHs were detected in samples collected during the most recent sampling event in June 2002. Based on the trends presented, the concentrations of BTEX and PAHs in the plume immediately downgradient from the Brightwaters Yard site are not increasing and the plume is in an apparent steady state at this location.

A review of **Figures 4-42** and **4-43** shows that concentrations of total BTEX and total PAHs in the shallow groundwater in the middle portion of the plume, at monitoring wells MW-34S and MW-11W, respectively, exhibit an overall decreasing trend. As shown on **Figure 4-42**, since the oxygen injection IRM began operation in September 2000 immediately upgradient from monitoring well MW-34S, BTEX and PAH compounds decreased to relatively low concentrations until June 2002 when the concentration of total BTEX increased. Total PAHs in monitoring well MW-34S (**Figure 4-42**) have decreased to a concentration of 85 ug/l since oxygen injection was initiated and have remained at this low concentration. Due to its location approximately 350 feet downgradient from the injection transect, the concentrations of total BTEX and total PAHs in monitoring well MW-11W (**Figure 4-43**) showed a minimal response, if any, to the oxygen amendments. Despite its downgradient location, the concentration of BTEX and PAHs have decreased overall, with only two peaks of increased concentrations detected in samples collected during June 2001 and March 2002, respectively. It is noted that analytical results for the most recent sampling of the intermediate well MW-34I showed that total BTEX was detected at an elevated concentration of 3,690 ug/l. This is the first time that BTEX was detected in this well since August 1997. No BTEX has been detected in the deep well MW-34D since August 1997. With few exceptions since December 2000, PAHs have been either not detected or detected at trace concentrations in the wells of the MW-34 cluster.

A review of **Figures 4-44** and **4-45** shows that concentrations of total BTEX and total PAHs detected in the shallow groundwater at downgradient monitoring wells BS-02S and MW-68S have been sporadic since the first monitoring events at these locations, but have decreased overall.

4.3.2.2 - Pore Water

A total of six pore water samples were collected from the O-Co-Nee Pond within the suspected discharge area of the Brightwaters Yard groundwater plume. As discussed in **Section 2.4.2**, the pore water samples were collected immediately beneath the pond bottom using a 6-inch long stainless steel well screen. Each sample was analyzed for BTEX and PAHs. The BTEX results are summarized in **Table C-31** and the PAH results are summarized in **Table C-32**. The pore water sample locations are provided on **Drawing 2B,** as well as **Figure 4-39**.

BTEX

Analytical results for the BTEX compounds in pore water are summarized on **Figure 4-39**. The results show that BTEX was detected in one of the six pore water samples that were collected and analyzed. Total BTEX was detected in sample BWPW-03 at a concentration of 177 ug/l and consisted almost entirely of benzene, which was detected at a concentration of 170 ug/l.

PAHs

Of the PAHs analyzed, only naphthalene was detected in pore water sample BWPW-02 at a concentration of 2 ug/l. No other PAHs were detected in any of the other pore water samples.

4.3.2.3 - Surface Water

As discussed in **Section 2.4.2**, a total of 11 surface water samples were collected from O-Co-Nee Pond at six different locations with one sample collected immediately off the pond bottom and the second one approximately 12 inches off the pond bottom. Note that only one sample was collected from sample location BWSW-06 given the water was less than 6 inches deep at this location. All samples were analyzed for BTEX and PAHs with the results summarized in **Tables C-33** and **C-34**, respectively. Additionally, the total BTEX and total PAH concentrations are summarized on **Figure 4-39**.

BTEX

With the exception of xylene detected at a concentration of 1 ug/l in BWSW-01 (Bottom), BTEX compounds were not detected in the surface water samples.

PAHs

PAHs were detected in two of the 11 surface water samples. Concentrations for total PAHs were 20 ug/l in sample BWSW-04 (Bottom +12 inches) and 34 ug/l in sample BWSW-05 (bottom). The low concentrations of PAHs are typical for a surface water body that receives storm water from roadways and surrounding commercial and light industrial areas.

4.3.2.4 - Surface Water Sediment

As discussed in **Section 2.4.2**, a total of 12 sediment samples were collected from O-Co-Nee Pond at six locations with one sample collected from 0 to 6 inches below the pond bottom and one sample collected from 6 to 12 inches below the pond bottom. All samples were analyzed for BTEX, PAHs and total organic carbon (TOC), the results of which are summarized in **Tables C-35**, **C-36** and **C-37**, respectively.

BTEX

Trace concentrations of xylene were detected in 5 of the 12 surface water sediment samples ranging from 0.002 mg/kg in sample BWSD-06 (6 to 12 inches) to 0.006 mg/kg in sample BWSD-04 (0 to 6 inches). No other BTEX compounds were detected in any of the other surface water sediment samples.

PAHs

Relatively low concentrations of phenanthrene and/or pyrene were detected in five of the 12 surface water sediment samples. Concentrations of total PAHs, where detected, ranged from 1.8 mg/kg in sample BWSD-06 (0 to 6 inches) to 56.9 mg/kg in sample BWSD-04 (0 to 6 inches). PAHs were not detected in any of the other surface water sediment samples.

Total Organic Carbon

Total organic carbon was detected in all surface water sediments and ranged in concentration from 0.3 percent weight in sample BWSD-02 (6 to 12 inches) to 79 percent in sample BWSD-01 (0 to 6 inches). With the exception of samples from sample locations BWSD-02 and BWSD-03, which all had TOC less than 1.5 percent, all TOC was detected at concentrations greater than 10 percent. As shown on **Figure 4-39**, sample location BWSD-02 is located outside the discharge area and BWSD-03 was located in the area of O-Co-Nee Pond where the plume of dissolved chemical constituents from the Brightwaters site discharges. Due to the relatively low TOC concentrations in samples collected at BWSD-03, it is anticipated that the effect of organic carbon in the surface water sediments on the attenuation of the dissolved BTEX and or PAHs in the groundwater plume will be minor.

4.3.3 Watchogue Creek/Crum's Brook Investigation (Operable Unit 4)

As part of the initial field program, the headwaters of Watchogue Creek/Crum's Brook were investigated to evaluate potential migration of MGP-related materials from the Bay Shore Site to the headwaters area of Watchogue Creek. A former Cesspool located at the headwaters of Watchogue Creek was the historical discharge point for treated wastewater generated at the former MGP. Wastewater discharged to the creek flowed south to a small pond area, which was subsequently backfilled. Currently, the creek headwaters start immediately south of the LIRR property, located approximately 500 feet east of the former MGP site. The creek flows south under Union Boulevard, eventually discharging to the Great South Bay. The results of the initial field program indicated that soil, groundwater and surface water sediments contained detectable levels of BTEX and PAHs. In general, BTEX and PAH concentrations decreased rapidly with increasing depth. However, at several soil borings completed in the vicinity of the former Cesspool, the detectable concentrations of PAHs persisted at depths well below the water table. In these soil borings field observations of recovered soil included staining, sporadic blebs of NAPL and/or hydrocarbon and naphthalene odors. Additionally, groundwater samples collected in the vicinity of the borings that exhibited these conditions also contained detectable concentrations of BTEX and/or PAHs. It was determined that additional data was needed to advance the proposed IRM of the former cesspool area.

In addition, BTEX and PAHs were identified in shallow subsurface soil within the vicinity of a former pond located south of the former Cesspool. Based on the results of the initial field program, it was determined that additional data is necessary to advance the proposed IRM of the former pond area.

It should be noted that an IRM was performed from September to November of 2000 on the southern portion of Operable Unit 4, south of the former pond area, between Union

Boulevard and Mechanicsville Service Road. The objectives of this IRM were to remove sediments potentially containing MGP residual materials and to enhance the existing brook channel by improving its flow characteristics and aesthetics.

Specifically, Crum's Brook was improved over the approximate 1,400 feet long span between Union Boulevard and Mechanicsville Service Road (identified in green on **Figure 1-3**). The restoration provides a uniform, non-eroding stream cross section. Prior to improvement, a minimum of one (1) foot of sediment was excavated from the brook bed throughout the stream's width (as it existed at the time of remedial activities). To improve the flow characteristics of the brook, a nominal three (3) inch diameter stone lining underlain by filter fabric was installed in the brook invert to convey low flow conditions. The banks were cut to a consistent 2:1 slope and were overlain with erosion control matting and temporary winter rye grass to stabilize the banks during high flow events. Because the channel restoration work was completed in late fall (a non-optimum planting season) and construction activities were still scheduled to take place in support of the adjacent South Wind Village Development, no final landscaping was installed at the end of the field activities. Shrubs were installed during the fourth quarter of 2001, and a wildflower seed mix was determined unnecessary during the second quarter of 2002 due to the growth of natural vegetation already taking place. The "Final Summary Report for Crum's Brook Restoration, Area C Interim Remedial Measure in the Town of Islip, New York (OU-4B)" was submitted to the NYSDEC, NYSDOH and SCDHS on November 15, 2002.

The construction has improved the brook's flow characteristics and enhanced its aesthetics. The restored brook banks and adjacent upland area will provide an improved natural amenity that will be an asset to the community. The project has improved the quality of the habitat surrounding the brook, thereby supporting a more diverse mixture of plants and wildlife. KeySpan commenced with this aspect of the OU-4 remediation first, because proceeding with the restoration project as soon as possible met an important community goal in the construction of the adjacent South Wind Village Development.

4.3.3.1 - Surface Soil

BTEX and PAHs

One surface soil sample, designated WC-SOP, was collected adjacent to the former Standard Oil property located west of the former Cesspool. Analytical results for BTEX and PAHs in this sample are summarized in **Tables C-38** and **C-39**, respectively. The concentration of total BTEX detected in surface soil sample WC-SOP was 0.024 mg/kg and for total PAHs was 62.7 mg/kg.

Petroleum Fingerprint/TPH

TPH was detected at a concentration of 1,500.0 mg/kg in surface soil sample WC-SOP.

Metals

Metals were not detected above background concentrations in surface soil sample WC-SOP.

4.3.3.2 - Subsurface Soil

As part of the supplemental field program, a total of 14 soil borings were completed within the vicinity of the former Cesspool and 3 borings were completed within the former pond area, south of the LIRR tracks. A total of 66 subsurface soil samples were selected for analysis including BTEX and PAHs, the results of which are summarized in **Tables C-42** and **C-43**, respectively. Total BTEX and total PAH results are also summarized on **Figure 4-46**. In addition, three samples were selected for Petroleum Fingerprint/TPH analysis, summarized in **Table C-44**.

Table 4-16 summarizes data related to subsurface soil samples collected as part of the Watchogue Creek Investigation, which exhibited the highest total BTEX and total PAH

INITIAL RI

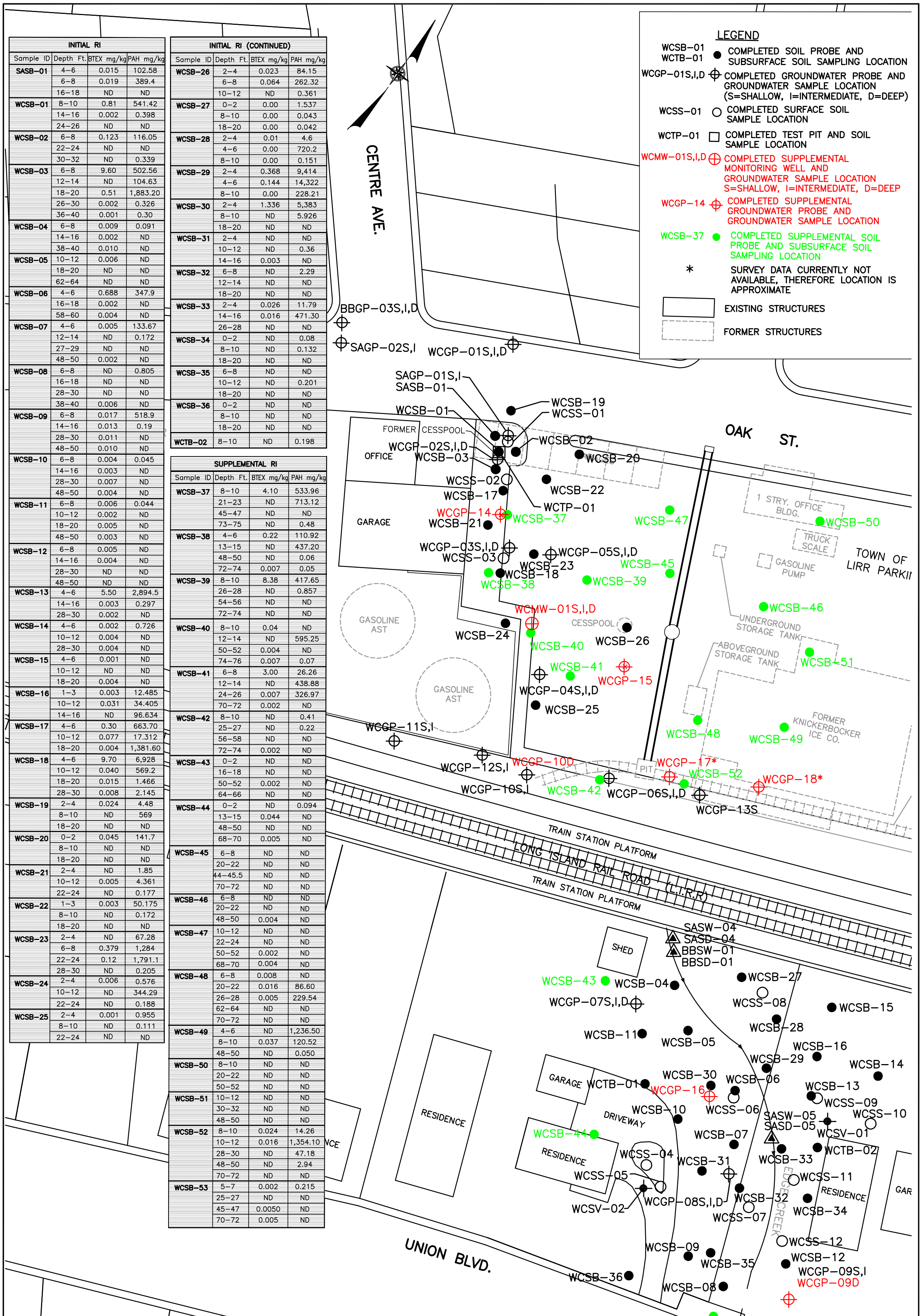
Sample ID	Depth Ft.	BTEX mg/kg	PAH mg/kg
SASB-01	4-6	0.015	102.58
	6-8	0.019	389.4
	16-18	ND	ND
WCSB-01	8-10	0.81	541.42
	14-16	0.002	0.398
	24-26	ND	ND
WCSB-02	6-8	0.123	116.05
	22-24	ND	ND
	30-32	ND	0.339
WCSB-03	6-8	9.60	502.56
	12-14	ND	104.63
	18-20	0.51	1,883.20
	26-30	0.002	0.326
	36-40	0.001	0.30
WCSB-04	6-8	0.009	0.091
	14-16	0.002	ND
	38-40	0.010	ND
WCSB-05	10-12	0.006	ND
	18-20	ND	ND
	62-64	ND	ND
WCSB-06	4-6	0.688	347.9
	16-18	0.002	ND
	58-60	0.004	ND
WCSB-07	4-6	0.005	133.67
	12-14	ND	0.172
	27-29	ND	ND
	48-50	0.002	ND
WCSB-08	6-8	ND	0.805
	16-18	ND	ND
	28-30	ND	ND
	38-40	0.006	ND
WCSB-09	6-8	0.017	518.9
	14-16	0.013	0.19
	28-30	0.011	ND
	48-50	0.010	ND
WCSB-10	6-8	0.004	0.045
	14-16	0.003	ND
	28-30	0.007	ND
	48-50	0.004	ND
WCSB-11	6-8	0.006	0.044
	10-12	0.002	ND
	18-20	0.005	ND
	48-50	0.003	ND
WCSB-12	6-8	0.005	ND
	14-16	0.004	ND
	28-30	ND	ND
	48-50	ND	ND
WCSB-13	4-6	5.50	2,894.5
	14-16	0.003	0.297
	28-30	0.002	ND
WCSB-14	4-6	0.002	0.726
	10-12	0.004	ND
	28-30	0.004	ND
WCSB-15	4-6	0.001	ND
	10-12	ND	ND
	18-20	0.004	ND
WCSB-16	1-3	0.003	12.485
	10-12	0.031	34.405
	14-16	ND	96.634
WCSB-17	4-6	0.30	663.70
	10-12	0.077	17.312
	18-20	0.004	1,381.60
WCSB-18	4-6	9.70	6,928
	10-12	0.040	569.2
	18-20	0.015	1.466
	28-30	0.008	2.145
WCSB-19	2-4	0.024	4.48
	8-10	ND	569
	18-20	ND	ND
WCSB-20	0-2	0.045	141.7
	8-10	ND	ND
	18-20	ND	ND
WCSB-21	2-4	ND	1.85
	10-12	0.005	4.361
	22-24	ND	0.177
WCSB-22	1-3	0.003	50.175
	8-10	ND	0.172
	18-20	ND	ND
WCSB-23	2-4	ND	67.28
	6-8	0.379	1,284
	22-24	0.12	1,791.1
	28-30	ND	0.205
WCSB-24	2-4	0.006	0.576
	10-12	ND	344.29
	22-24	ND	0.188
WCSB-25	2-4	0.001	0.955
	8-10	ND	0.111
	22-24	ND	ND

INITIAL RI (CONTINUED)

Sample ID	Depth Ft.	BTEX mg/kg	PAH mg/kg
WCSB-26	2-4	0.023	84.15
	6-8	0.064	262.32
	10-12	ND	0.361
WCSB-27	0-2	0.00	1.537
	8-10	0.00	0.043
	18-20	0.00	0.042
WCSB-28	2-4	0.01	4.6
	4-6	0.00	720.2
	8-10	0.00	0.151
WCSB-29	2-4	0.368	9,414
	4-6	0.144	14,322
	8-10	0.00	228.21
WCSB-30	2-4	1.336	5,383
	8-10	ND	5.926
	18-20	ND	ND
WCSB-31	2-4	ND	ND
	10-12	ND	0.36
	14-16	0.003	ND
WCSB-32	6-8	ND	2.29
	12-14	ND	ND
	18-20	ND	ND
WCSB-33	2-4	0.026	11.79
	14-16	0.016	471.30
	26-28	ND	ND
WCSB-34	0-2	ND	0.08
	8-10	ND	0.132
	18-20	ND	ND
WCSB-35	6-8	ND	ND
	10-12	ND	0.201
	18-20	ND	ND
WCSB-36	0-2	ND	ND
	8-10	ND	ND
	18-20	ND	ND
WCTB-02	8-10	ND	0.198

SUPPLEMENTAL RI

Sample ID	Depth Ft.	BTEX mg/kg	PAH mg/kg
WCSB-37	8-10	4.10	533.96
	21-23	ND	713.12
	45-47	ND	ND
	73-75	ND	0.48
WCSB-38	4-6	0.22	110.92
	13-15	ND	437.20
	48-50	ND	0.06
	72-74	0.007	0.05
WCSB-39	8-10	8.38	417.65
	26-28	ND	0.857
	54-56	ND	ND
	72-74	ND	ND
WCSB-40	8-10	0.04	ND
	12-14	ND	595.25
	50-52	0.004	ND
	74-76	0.007	0.07
WCSB-41	6-8	3.00	26.26
	12-14	ND	438.88
	24-26	0.007	326.97
	70-72	0.002	ND
WCSB-42	8-10	ND	0.41
	25-27	ND	0.22
	56-58	ND	ND
	72-74	0.002	ND
WCSB-43	0-2	ND	ND
	16-18	ND	ND
	50-52	0.002	ND
	64-66	ND	ND
WCSB-44	0-2	ND	0.094
	13-15	0.044	ND
	48-50	ND	ND
	68-70	0.005	ND
WCSB-45	6-8	ND	ND
	20-22	ND	ND
	44-45.5	ND	ND
	70-72	ND	ND
WCSB-46	6-8	ND	ND
	20-22	ND	ND
	48-50	0.004	ND
WCSB-47	10-12	ND	ND
	22-24	ND	ND
	50-52	0.002	ND
	68-70	0.004	ND
WCSB-48	6-8	0.008	ND
	20-22	0.016	86.60
	26-28	0.005	229.54
	62-64	ND	ND
	70-72	ND	ND
WCSB-49	4-6	ND	1,236.50
	8-10	0.037	120.52
	48-50	ND	0.050
WCSB-50	8-10	ND	ND
	20-22	ND	ND
	50-52	ND	ND
WCSB-51	10-12	ND	ND
	30-32	ND	ND
	48-50	ND	ND
WCSB-52	8-10	0.024	14.26
	10-12	0.016	1,354.10
	28-30	ND	47.18
	48-50	ND	2.94
	70-72	ND	ND
WCSB-53	5-7	0.002	0.215
	25-27	ND	ND
	45-47	0.0050	ND
	70-72	0.005	ND



SOURCES: TOWN OF ISLIP ENGINEERING DEPARTMENT, DATED MAY 1965
LONG ISLAND LIGHTING CO., DATED DECEMBER 1947
LONG ISLAND LIGHTING CO., REV. DATED APRIL 1973
INTERPRETATION OF AN APRIL 4, 1994 AERIAL PHOTOGRAPH

NOTE: SITE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS.

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

WATCHOGUE CREEK/CRUM'S BROOK IRM/INVESTIGATION
BTEX AND PAH CONCENTRATIONS IN SOIL

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE 4-46

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TABLE 4-16

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

WATCHOGUE CREEK/CRUM'S BROOK SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (ppm)	Field Description of Recovered Sample
WCSB-37 (8-10')	4.1	534.0	Approximately 30 feet Downgradient of Former Cesspool.	12.1	Saturated w/NAPL, sheen, strong hydrocarbon-like odor
WCSB-37 (21-23')	0.0	713.1	Approximately 30 feet Downgradient of Former Cesspool.	0.3	Staining, sheen, slight hydrocarbon-like odor
WCSB-39 (8-10')	8.4	447.7	Approximately 85 feet Downgradient of Former Cesspool.	31.0	Tar staining and hydrocarbon-like odor
WCSB-40 (12-14')	0.0	595.3	Approximately 95 feet Downgradient of Former Cesspool.	6.0	Tar lenses at 12.7' and 13',
WCSB-49 (4-6')	0.0	1,236.5	Within Former Knickerbocker Ice Company. Downgradient of Truck Scale and Gas Pump	0.0	None
WCSB-52 (10-12')	0.0	1,354.1	Downgradient of Former Knickerbocker Ice Company and Above Ground Storage Tank	18.0	Tar staining and hydrocarbon-like odor from 9.5-11.5', sheen

concentrations along with the approximate location of each sample with respect to former MGP structures/features where appropriate. The table also includes PID measurements and lists any significant field observations noted for the samples.

Former Cesspool Area

As **Table 4-16** indicates, the maximum total BTEX concentration of 8.4 mg/kg was detected at WCSB-39 (8 to 10 feet) located approximately 80 feet downgradient of the former Cesspool. The maximum total BTEX concentration observed during the initial field program of 9.6 mg/kg was identified in BBSB-03 (6 to 8 feet), also located downgradient of the former Cesspool. Consistent with the initial field program findings, BTEX compounds were only detected at concentrations greater than 1.0 mg/kg in shallow subsurface soil no greater than 10 feet in depth. Below this depth, BTEX concentrations were found to be nondetectable or at trace concentrations of 0.05 mg/kg or less. The maximum total PAH concentrations detected in subsurface soil were observed in shallow subsurface soil within the vicinity of the former Knickerbocker Ice Company facility, including at WCSB-49 (4 to 6 feet) and WCSB-52 (10 to 12 feet) with total PAH concentrations of 1,236.5 mg/kg and 1,354.1 mg/kg, respectively. Petroleum fingerprint analysis indicates that the hydrocarbons present in the WCSB-49 (8 to 10 feet) sample were most characteristic of diesel fuel and motor oil. Similar to the initial field program findings, PAHs appear to be present up to 30 feet below grade in several locations with total PAHs up to 327.0 mg/kg. However, below this depth PAHs decrease in concentration with total PAHs not exceeding 3.0 mg/kg.

Former Pond Area and Watchogue Creek/Crum's Brook Headwaters

Three soil borings were completed in the former pond area in order to delineate the areal extent of BTEX/PAHs identified in this area as part of the initial field program. As shown on **Figure 4-46**, BTEX and PAHs did not exceed 0.25 mg/kg at all sample intervals selected for analysis.

4.3.3.3 - Groundwater

As part of the supplemental field program, five groundwater probes and one monitoring well cluster was installed within the former cesspool area. In addition, two groundwater probes and one monitoring well cluster were installed within the former pond area. A total of 43 groundwater samples were analyzed for BTEX and PAHs with the results for the monitoring wells presented in **Tables C-45** and **C-46**, and for groundwater probes in **Tables C-47** and **C-48**. In addition, total BTEX and PAH results are summarized on **Figure 4-47**.

Table 4-17 summarizes groundwater samples that exhibited the highest total BTEX and total PAH concentrations along with the approximate locations of these samples in relation to former MGP structures/features. The table also indicates any significant field observations noted in these samples.

Former Cesspool Area

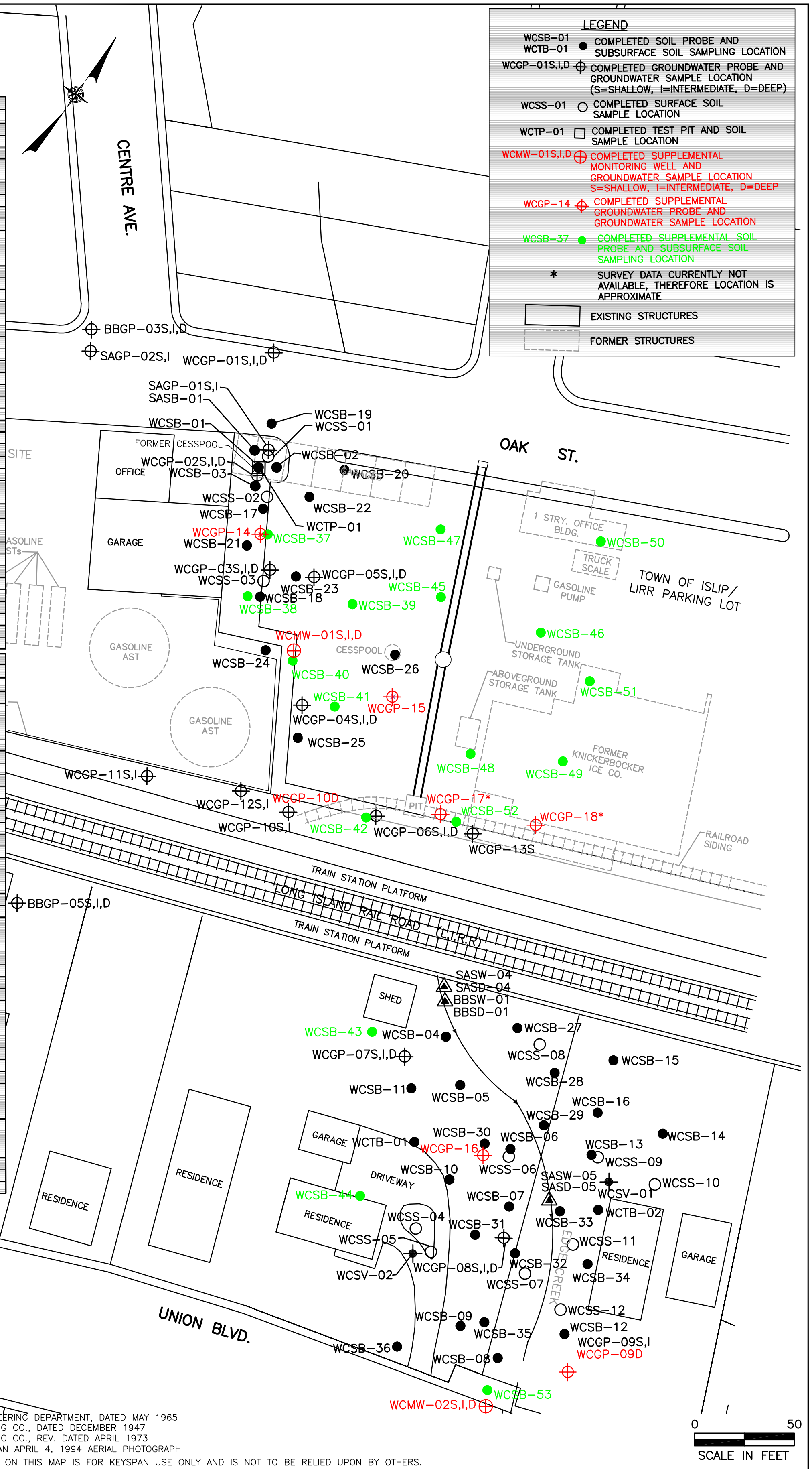
BTEX and PAH groundwater data is generally consistent with soil data with the highest BTEX and PAH concentrations observed within the former Cesspool and immediately downgradient in shallow groundwater. The maximum total BTEX and total PAH concentrations observed in this area were 911 ug/l and 3,015 ug/l, respectively, detected at WCGP-14 (4.5 to 8.5 feet). While the data does identify groundwater containing BTEX and PAH compounds immediately downgradient of the former Cesspool, concentrations decrease rapidly at most sample locations.

Former Pond Area and Watchogue Creek/Crum's Brook Headwaters

BTEX concentrations were below detection limits in 13 of the 15 groundwater samples. The remaining two samples exhibited total BTEX concentrations ranging from 5 ug/l to 16 ug/l. PAH compounds were detected in six of the 15 samples. Total PAH concentrations ranged from 22 ug/l to 740 ug/l. Based on these results, subsurface soil within the former pond area appears to be a minor source of BTEX and PAH compounds to groundwater.

INITIAL RI			
Sample ID	Depth Ft.	BTEX ug/l	PAH ug/l
WCGP-01	6-10	ND	54
	26-30	ND	ND
	64-68	ND	12
WCGP-02	6-10	55	2,765
	26-30	ND	57
	67-71	ND	185
WCGP-03	6-10	116	1,713
	26-30	ND	1,239
	67-71	3	1,652
WCGP-04	6-10	46	1,051
	26-30	ND	165
	67-71	ND	227
WCGP-05	6-10	ND	1
	26-30	ND	219
	67-71	ND	107
WCGP-06	6-10	29	209
	26-30	ND	40
	67-71	ND	1
WCGP-07	6-10	ND	ND
	26-30	ND	87
	67-71	ND	ND
WCGP-08	6-10	8	595
	26-30	ND	39
	67-71	6	683
WCGP-09	6-10	11	29
	40-43	ND	ND
WCGP-10	3-7	ND	ND
	23-27	2	1
WCGP-11	3-7	ND	6
	23-27	2	1
WCGP-12	3-7	ND	ND
	23-27	ND	3
WCGP-13	3-7	1	ND
SAGP-01	6-10	1	1,233
	26-30	ND	2
SAGP-02	8-12	ND	12
	28-32	ND	ND
	26-30	ND	ND
SAGP-03	9-13	ND	ND
	31-35	ND	ND
	63-68	ND	ND
SAGP-05	9-13	ND	9
	31-35	ND	ND
	67-71	ND	8

SUPPLEMENTAL RI			
Sample ID	Depth Ft.	BTEX ug/l	PAH ug/l
WCGP-09D	2-6	ND	ND
	12-16	ND	22
	26-30	ND	ND
	36-40	ND	ND
	48-52	ND	ND
	65-69	ND	ND
WCGP-10D	5-9	69	847
	36-40	ND	ND
	52-56	ND	1
	71-75	ND	4
WCGP-14	4.5-8.5	911	3,015
	18-22	0.90	300
	30-34	ND	32
	56-60	1	14
	72-76	ND	34
WCGP-15	4-8	30	1,542
	18-22	ND	941
	30-34	ND	280
	56-60	ND	213
	70-74	ND	234
WCGP-16	2-6	16	740
	12-16	ND	14
	26-30	ND	ND
	36-40	ND	ND
	48-52	ND	21
	65-69	ND	77
WCGP-17	4-8	2	67
	8-12	1	67
	18-22	ND	225
	28-32	1	803
	42-46	2	26
	67-71	1	81
WCGP-18	4-8	3	ND
	8-12	3	ND
	18-22	ND	ND
	28-32	7	ND
	67-71	ND	ND
WCMW-01 S,I,D	2-12	5	33
	35-45	ND	2
	64-74	ND	45
WCMW-02 S,I,D	3-13	6	79
	34.5-44.5	ND	ND
	62-72	ND	ND



SOURCES: TOWN OF ISLIP ENGINEERING DEPARTMENT, DATED MAY 1965
LONG ISLAND LIGHTING CO., DATED DECEMBER 1947
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BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

WATCHOGUE CREEK/CRUM'S BROOK IRM/INVESTIGATION
BTEX AND PAH CONCENTRATIONS IN GROUNDWATER

Dvirka and Bartilucci
Consulting Engineers
A Division of William F. Cosulich Associates, P.C.

FIGURE 4-47

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TABLE 4-17

BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

WATCHOGUE CREEK/CRUM'S BROOK GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe No. and Sample Depth)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
WCGP-10D (5-9')	69.0	847.0	In vicinity of Raiilroad Siding and the southern most Gasoline AST.	None
WCGP-14 (4.5-8.5')	911.0	3,015.0	In vicinity of Garage and Office. Downgradient of Former Cesspool.	None
WCGP-15 (4-8')	30.0	1,542.0	In vicinity of Cesspool and Above Ground Storage Tank. Downgradient of Cesspool.	Oily, dark gray-black, odor
WCGP-15 (18-22')	0.0	941.0	In vicinity of Cesspool and Above Ground Storage Tank. Downgradient of Cesspool.	Sheen, hydrocarbon-like odor
WCGP-16 (2-6')	16.0	740.0	In vicinity of Driveway, south of the Railroad Tracks.	None
WCGP-17 (28-32')	1.0	803.0	Within Railroad Siding and downgradient of Above Ground Storage Tank.	sheen, mild hydrocarbon-like odor

4.3.4 Air and Private Well Sampling (Operable Units 2 and 3)

Since January 1999, KeySpan has collected air samples for chemical analysis from residential and commercial properties located downgradient of the Bay Shore/Brightwaters former MGP site. Analytical results for collected air samples are provided in **Table C-49**. In addition, two private wells identified downgradient of the former MGP site, based on the completed private well and basement survey (discussed under **Section 2.4.4**), were sampled. The analytical results of the samples are presented in **Table C-50** and **Table C-51**. Locations of properties in which air samples and private well samples were collected are shown on **Figure 2-2**.

4.3.4.1 - Air

Air sampling was conducted at 16 off-site locations during the remedial investigation. At one location, two rounds of sampling were conducted and at another location, three rounds of sampling were conducted. A total of 67 samples were collected and each sample was analyzed for 61 volatile organic compounds. Of these 67 samples, 27 were collected from inside homes/businesses, 23 were collected from basement/crawl spaces, and 17 were collected outside. The results, including frequency of detection, and the minimum and maximum detected concentrations for each compound, are summarized in **Tables 4-18**, **4-19** and **4-20**, for ambient air, basement/crawl space air and indoor (living/working space) air, respectively. The majority of the volatile organic compounds for which analysis was performed were not detected. Additionally, naphthalene, the compound most commonly associated with potential MGP impacts, was not detected in any of the samples. The analytical results obtained were reviewed by the NYSDOH and the detected compounds were found to be at acceptable levels.

4.3.4.2 - Private Well Groundwater

As discussed in **Section 2.4.6**, two private wells were identified and sampled downgradient of the Bay Shore/Brightwaters former MGP site. Groundwater samples were collected from the two wells and analyzed for VOCs and SVOCs. Sample PW-1 was collected

TABLE 4-18
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CONCENTRATIONS DETECTED IN OFF-SITE AMBIENT AIR SAMPLES

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration
1,2,4-Trimethylbenzene	1/17	--	7.4
1,3,5-Trimethylbenzene	1/17	--	8.4
1,4-Dioxane	2/17	20.9	90.1
2-Butanone	7/17	13.3	94.4
2-Propanol	2/17	*	12.0
Acetone	14/17	6.2	57.0
Benzene	1/17	--	6.7
Carbon Disulfide	1/17	--	21.2
Chloromethane	5/17	2.0	2.9
Ethanol	10/17	7.7	180.9
Ethylbenzene	1/17	--	4.3
Freon 12	1/17	--	5.4
m,p-Xylenes	4/17	4.2	18.7
Methylene Chloride	8/17	4.2	7.6
Propylene	1/17	--	9.1
Tetrachloroethene	2/17	17.6	28.5
Tetrahydrofuran	1/17	--	10.9
Toluene	7/17	3.8	13.6
Trichloroethene	2/17	5.2	5.3

All units are in ug/m^3.
* Results essentially identical for each detected concentration.

TABLE 4-19
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

SUMMARY OF CONCENTRATIONS DETECTED IN OFF-SITE BASEMENT/CRAWL SPACE AIR SAMPLES

Analyte	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration
1,1,1-Trichloroethane	1/23	--	7.1
1,2,4-Trimethylbenzene	4/23	3.6	12.3
1,2-Dichloropropane	1/23	--	4.6
2-Butanone	6/23	8.3	124
2-Propanol	7/23	9.3	3441
Acetone	21/23	8.1	570
Benzene	4/23	3.2	7.0
Carbon Disulfide	2/23	10.0	15.6
Chloroethane	3/23	2.6	22.4
Chloromethane	5/23	2.1	2.9
Ethanol	21/23	6.8	119
Ethylbenzene	2/23	4.3	6.1
Freon 11	2/23	21.4	25.8
Freon 12	6/23	3.3	59.3
Hexane	3/23	18.0	81.1
m,p-Xylenes	6/23	4.8	23.4
Methyl tert-butyl ehter	3/23	14.4	112
Methylene Chloride	15/23	3.5	25.4
o-Xylene	3/23	4.3	8.3
Styrene	1/23	--	3.1
Tetrachloroethene	8/23	8.1	16.3
Tetrahydrofuran	1/23	--	17.1
Toluene	16/23	3.5	41.4

All units are in ug/m^3.

TABLE 4-20
BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION

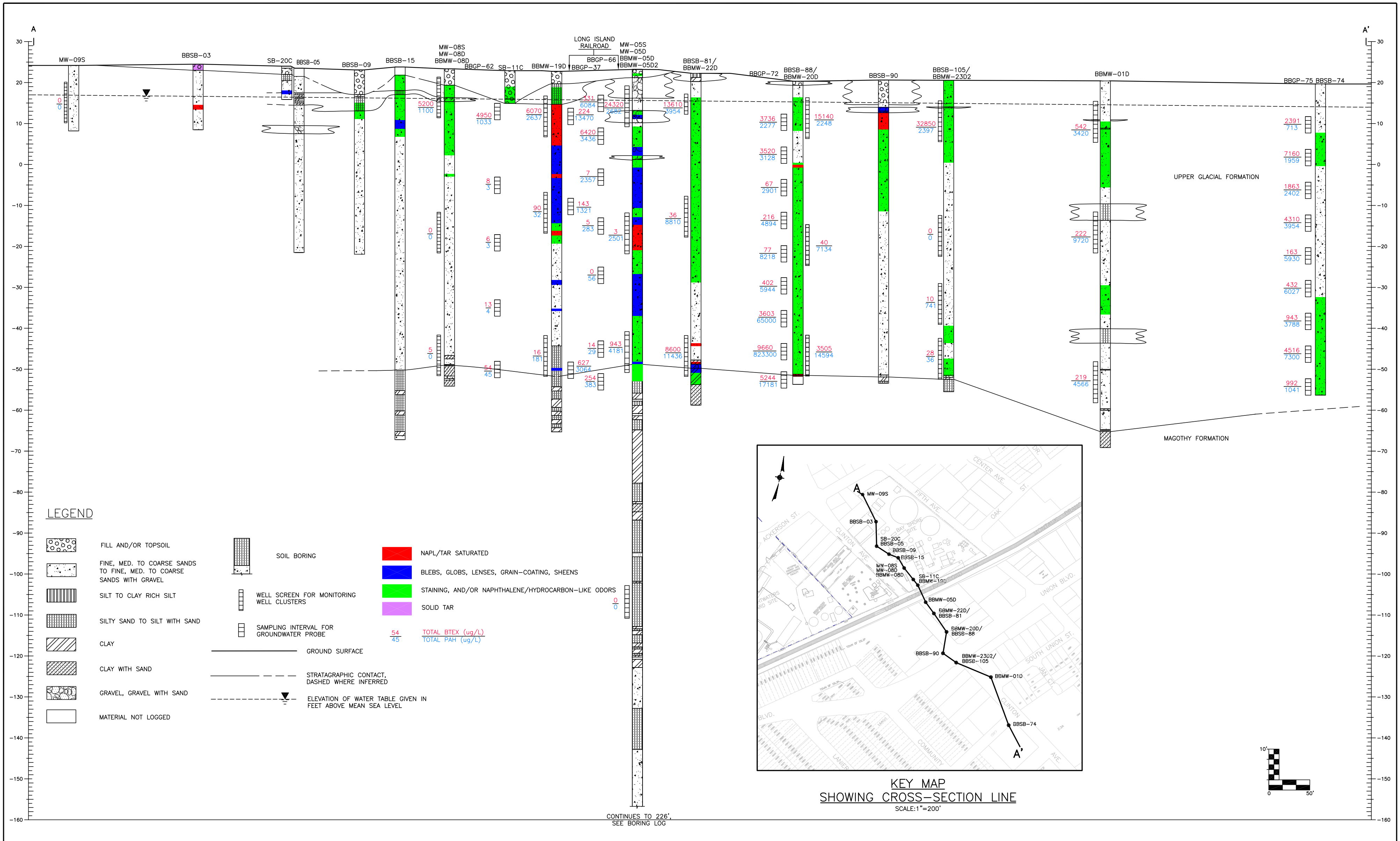
SUMMARY OF CONCENTRATIONS DETECTED IN OFF-SITE INDOOR (LIVING/WORKING SPACE) AIR SAMPLES

Analyte	Frequency of Detection *	Minimum Detected Concentration	Maximum Detected Concentration
1,2,4-Trimethylbenzene	4/27	4.9	12.3
1,2-Dichloropropane	1/27	--	3.3
1,4-Dioxane	1/27	--	15.1
2-Butanone	6/27	9.4	265
2-Propanol	15/27	7.6	4915
Acetone	26/27	10.2	474.8
Benzene	7/27	3.0	7.3
Carbon Disulfide	1/27	--	16.5
Chloroethane	2/27	4.5	8.7
Chloroform	1/27	--	4.3
Chloromethane	7/27	1.9	4.7
Ethanol	27/27	12.6	1583
Freon 11	4/27	6.7	43.3
Freon 12	5/27	4.2	109
Heptane	1/27	--	34.0
Hexane	1/27	--	24.3
m,p-Xylenes	9/27	4.3	10.4
Methyl tert-butyl ehter	1/27	--	18.7
Methylene Chloride	16/27	3.0	11.8
o-Xylene	1/27	--	4.8
Styrene	1/27	--	20.4
Tetrachloroethene	10/27	9.5	81.4
Toluene	23/27	2.8	26.8
Trichloroethene	1/27	--	5.9

All units are in ug/m^3.
*Total includes duplicate sample.

from the well located between O-Co-Nee Pond and the Bay Shore plume approximately 1,400 feet south of the site. Sample PW-2 was collected from the well located within the Brightwaters Yard plume boundary approximately 950 feet south of the Brightwaters Yard.

VOCs and SVOCs were not detected in sample PW-1, with the exception of methyl tert butyl ether (MTBE), at a concentration of 2 ug/l. MTBE is a common additive to gasoline. PW-1 was collected from a well that is currently used for irrigation purposes. A number of VOCs were detected in sample PW-2, with ethylbenzene exhibiting the highest concentration of 100 ug/l. SVOCs were detected as well, with naphthalene exhibiting the highest concentration of 23 ug/l. PW-2 was collected from a well that is currently not used as a source of water for any purpose and the pump and associated piping is currently inoperable.



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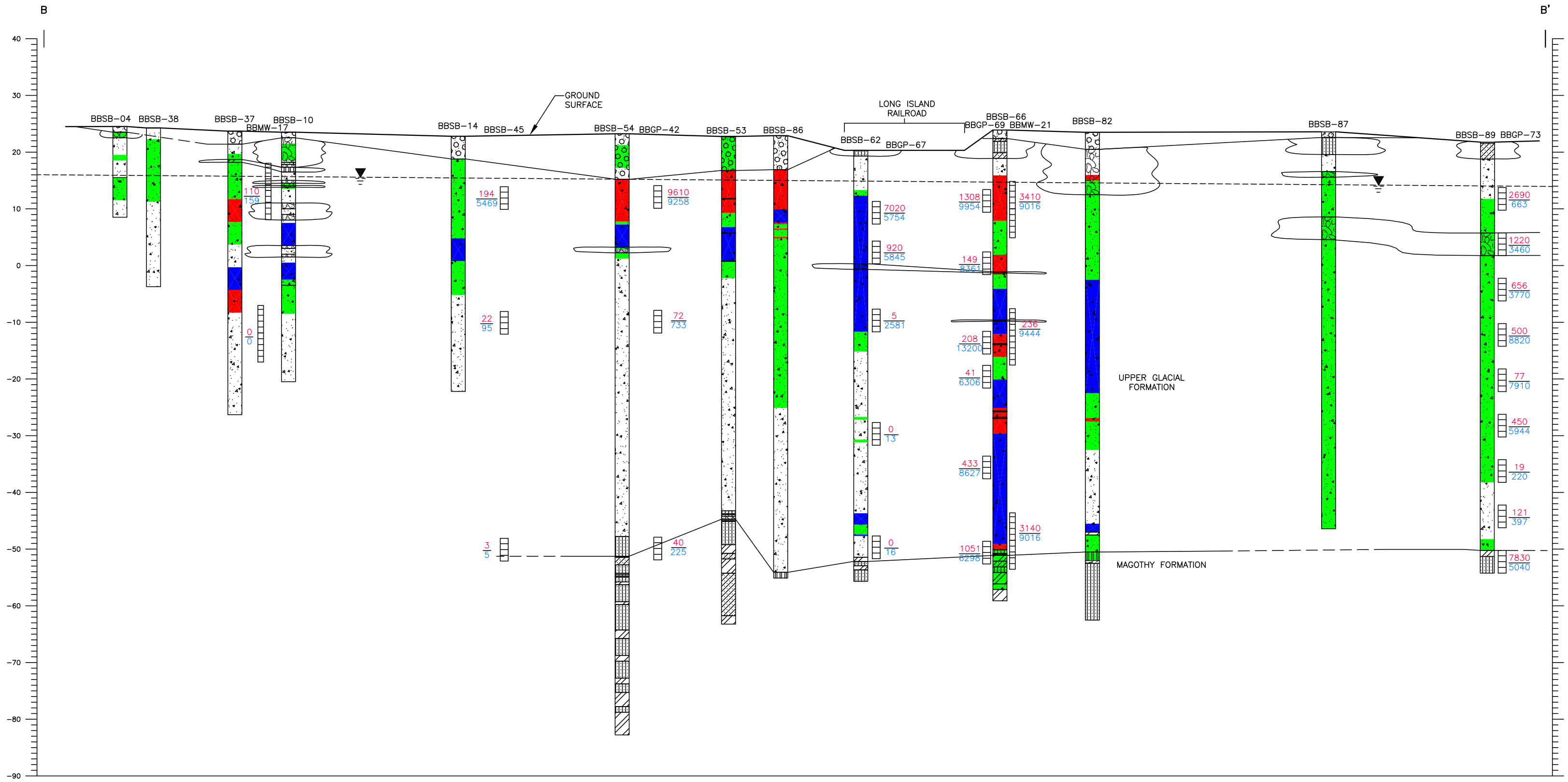
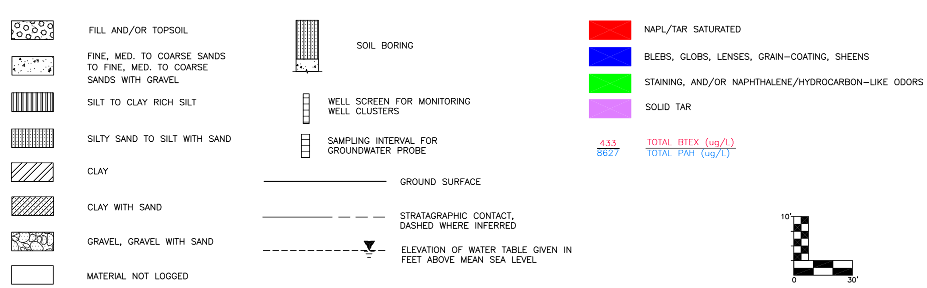
BAY SHORE/BRIGHTWATERS
FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

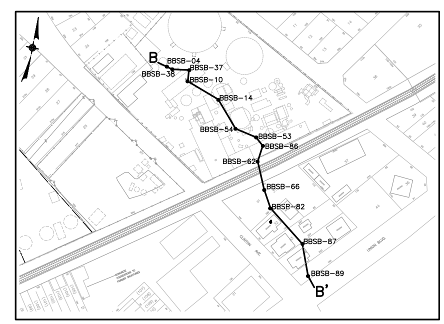
FIELD OBSERVATIONS OF SUBSURFACE SOIL DEPICTED VERTICALLY IN EXTENDED GEOLOGIC CROSS-SECTION A–A'

PROJECT NO. 1620-B12C
DATE: JANUARY 2003
SCALE: AS SHOWN
DRAWING NO. 4A



LEGEND





KEY MAP
SHOWING CROSS-SECTION LINE
SCALE:1"=150'

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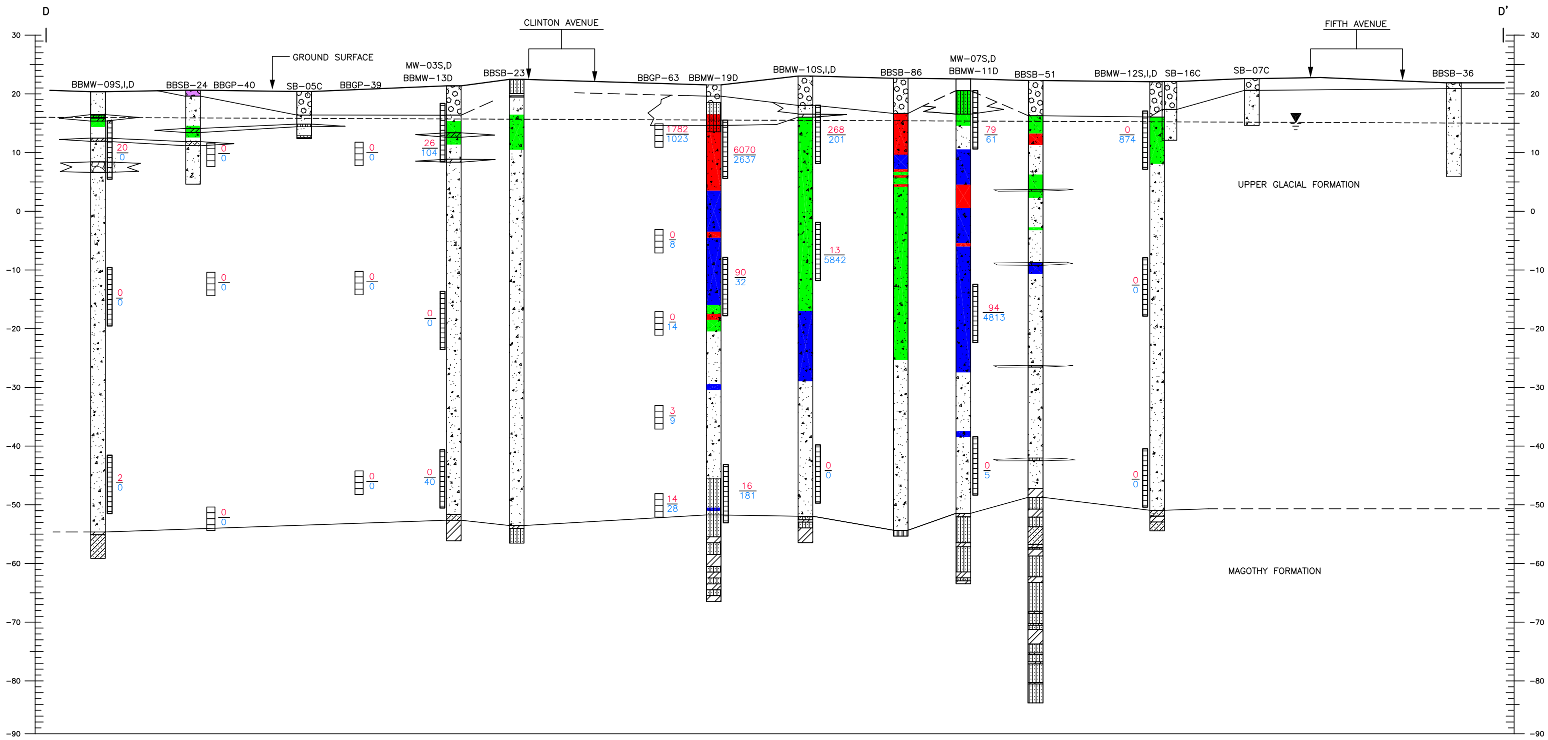
BAY SHORE/BRIGHTWATERS
FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

FIELD OBSERVATIONS OF SUBSURFACE SOIL DEPICTED VERTICALLY IN GEOLOGIC CROSS-SECTION B-B'

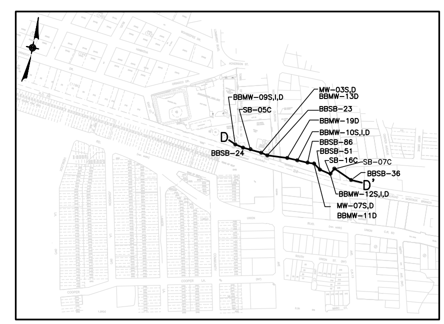
PROJECT NO. 1620-B12C
DATE: JANUARY 2003
SCALE: AS SHOWN
DRAWING NO. 4B



LEGEND

- FILL AND/OR TOPSOIL
- FINE, MED. TO COARSE SANDS TO FINE, MED. TO COARSE SANDS WITH GRAVEL
- SILT TO CLAY RICH SILT
- SILTY SAND TO SILT WITH SAND
- CLAY
- CLAY WITH SAND
- GRAVEL, GRAVEL WITH SAND
- MATERIAL NOT LOGGED
- SOIL BORING
- WELL SCREEN FOR MONITORING WELL CLUSTERS
- SAMPLING INTERVAL FOR GROUNDWATER PROBE
- GROUND SURFACE
- STRATAGRAPHIC CONTACT, DASHED WHERE INFERRED
- ELEVATION OF WATER TABLE GIVEN IN FEET ABOVE MEAN SEA LEVEL
- NAPL/TAR SATURATED
- BLEBS, GLOBS, LENSES, GRAIN-COATING, SHEENS
- STAINING, AND/OR NAPHTHALENE/HYDROCARBON-LIKE ODORS
- SOLID TAR
- 79 / 61 — TOTAL BTEX (ug/L) / TOTAL PAH (ug/L)

10'
0
40'



KEY MAP
SHOWING CROSS-SECTION LINE
SCALE:1"=400'

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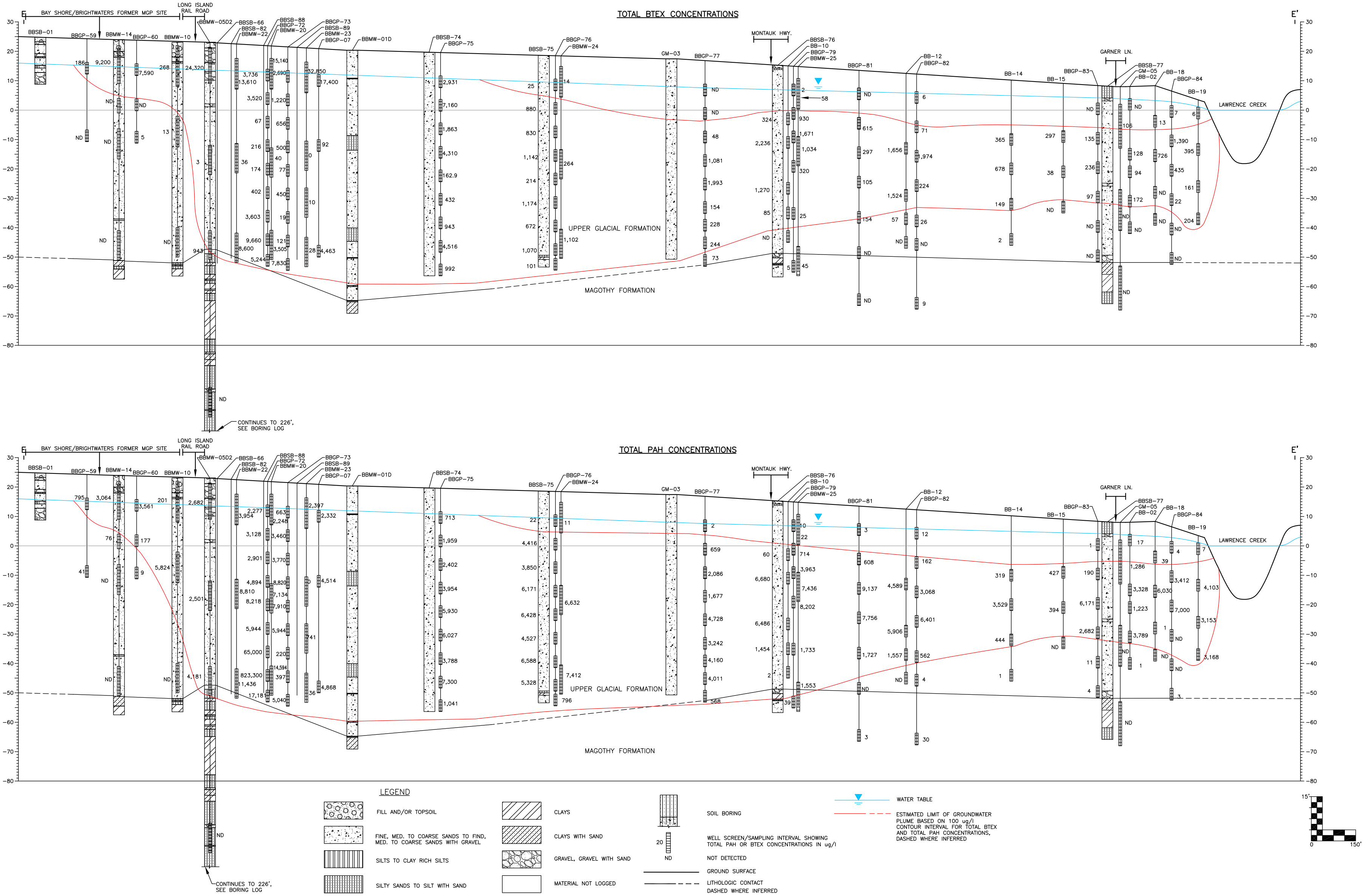
BAY SHORE/BRIGHTWATERS
FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

FIELD OBSERVATIONS OF SUBSURFACE SOIL DEPICTED VERTICALLY IN GEOLOGIC CROSS-SECTION D-D'

PROJECT NO. 1620-B12C
DATE: JANUARY 2003
SCALE: AS SHOWN
DRAWING NO. 4C



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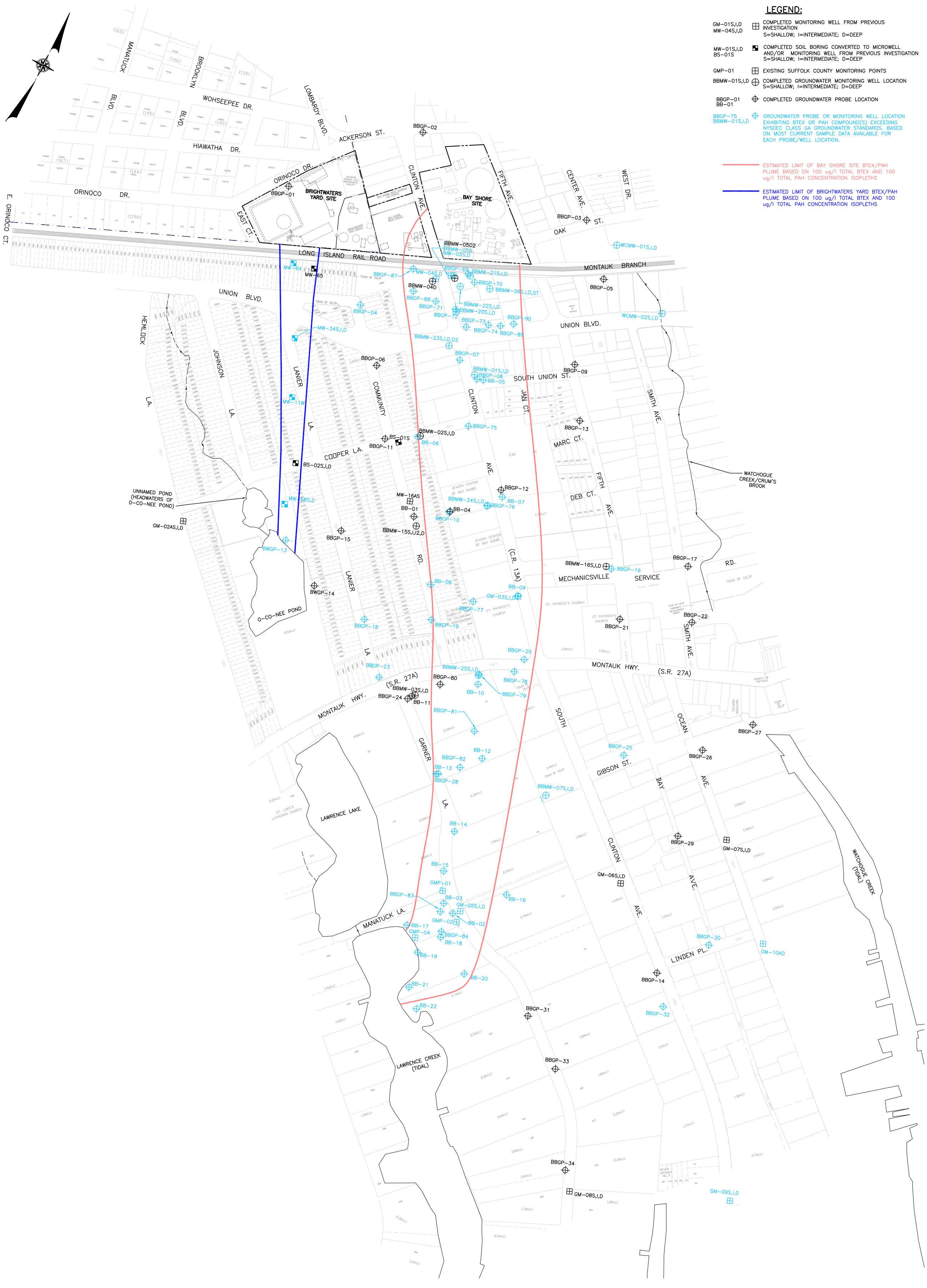
BAY SHORE/BRIGHTWATERS
FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

TOTAL BTEX AND PAH CONCENTRATIONS IN GROUNDWATER THROUGH BAY SHORE PLUME CENTERLINE PLOTTED ON NORTH–SOUTH GEOLOGIC CROSS–SECTION E–E'

PROJECT NO. 1620-B
DATE: JANUARY 2003
SCALE: AS SHOWN
DRAWING NO. 4D



SOURCE: BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.

NOTE: SITE SURVEY DATA SHOWN ON THIS MAP IS FOR KEYSPAN USE ONLY AND IS NOT TO BE RELIED UPON BY OTHERS

DVIRKA AND BARTILUCCI CONSULTING ENGINEERS A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.	BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION BAY SHORE, NEW YORK	OFF-SITE GROUNDWATER SAMPLE LOCATIONS EXCEEDING NYSDEC CLASS GA GROUNDWATER STANDARDS FOR BTEX AND/OR PAHS	1620-B12C DATE: JANUARY 2003 SCALE: AS SHOWN	DRAWING NO. 4E

5.0 CONCLUSIONS

This section presents the conclusions with regard to the nature and extent of chemical constituents and other MGP residuals identified in on-site and off-site areas based on the results of the supplemental field program. Where appropriate, data from the initial field program, as well as historical data has been used in conjunction with data from this field program to develop the conclusions presented in this section. This section also presents the conclusions of the Qualitative Human Exposure Assessment, as well as the findings associated with the private well and basement survey. **Appendix F** presents the detailed findings of the Qualitative Human Exposure Assessment, as well as the private well and basement survey. **Appendix F** also includes a Fish and Wildlife Resources Impact Analysis (FWRIA).

5.1 Bay Shore Site and Adjacent Off-site Locations (Operable Unit 1)

Surface Soil

- As part of the initial field program, the PCB Aroclor-1260 was detected in surface soil sample BBSS-09 at 43 mg/kg, located in the southwest corner of the Bay Shore site. Historically, several electric transformers were known to have been located in this area. PCB analysis of subsurface soil samples collected as part of the supplemental field program in the vicinity of BBSS-09 indicated the presence of Aroclor-1260 ranging in concentration of 0.01 mg/kg to 4.7 mg/kg. Sample BBSS-09 was collected from a lens of surficial soil no more than 10 inches in thickness overlying the top of the concrete foundation associated with the former Office Store and Wash Room. Based on these findings, surface soil containing elevated levels of PCBs is limited to an area no greater than 100 square feet and approximately 10 inches in thickness located in the southwest corner of the Bay Shore site.

Subsurface Soil

- With the exception of the former industrial cesspool area located immediately southwest of the former Main Gas Holder, the northern third of the Bay Shore Site does not exhibit elevated levels of BTEX, PAHs or NAPL/Tar at saturated levels. In addition, it appears that the southeastern portion of the Bay Shore Site is free of these MGP-related constituents.

- The highest concentrations of BTEX and PAHs in subsurface soil are found in shallow subsurface soil not exceeding 12 feet in depth, southwest of the former Relief

Holder and within the general vicinity of a former Naphthalene Scrubber. This area extends south to the former locations of the Effluent Water Treatment Facilities, Tar Separators and Tar Settling and Holding Tanks. A second area of elevated BTEX and PAHs in subsurface soil is located in the vicinity of the Tar and Drip Oil Collecting Pits and the former Tar Well located within the southwest corner of the site.

- Immediately downgradient of the site, BTEX and PAHs are present in deeper subsurface soil at a depth of greater than 32 feet below ground surface (bgs). The off-site BTEX and PAH concentrations observed at depths greater than 32 feet are consistent with field observations that indicate tar staining, as well as NAPL/tar at saturated levels within deep subsurface soil immediately downgradient of the Bay Shore site.

- Where detected, saturated NAPL/tar observed in subsurface soil in the central third of the site is generally limited to approximately 20 to 30 feet bgs. The sources of this relatively shallow NAPL/tar are former MGP structures. The occurrence of saturated NAPL/tar in soil at depths greater than 30 feet bgs is generally limited to the southern third of the site and immediately adjacent downgradient areas.

- The observed distribution of NAPL/tar in subsurface soil indicates a southerly migration of this material from on-site source areas primarily located in the southernmost third of the site to downgradient areas. NAPL/tar migration appears to be predominantly horizontal in nature at and below the water table. However, in the vicinity of the southern property boundary, a significant downward vertical migration component appears to have been present. As a result, there appears to be a deep NAPL/tar zone located above the Glacial/Magothy formation interface from the property boundary to as far south as BBSB-88 located approximately 250 feet from the site boundary.

- LNAPL was not observed within shallow monitoring wells or test pits completed within the Bay Shore site. In addition, LNAPL was not observed in shallow monitoring wells located immediately downgradient of the site.

- Based on the results of BTEX/PAH analytical data in subsurface soil and visual observations of recovered soil samples collected from within the Bay Shore Site, the following former structures and/or subsurface soil surrounding these structures are considered source areas of BTEX and PAH compounds:

    – The Relief Holder
    – Naphthalene Scrubber/Oil Separation Tank and Surge Tank located west of the Relief Holder
    – The 54,000 Cubic Foot Gas Holder/Heavy Oil Tank
    – Tar/Oil Separators and Storage Tanks, located in the southern portion of the site
    – Effluent Water Treatment Facilities, located in the southern portion of the site
    – The Cesspool located southwest of the Main Holder
    – Tar/Drip Oil Collection Pit

All of these structures were demolished many years ago, and the aboveground elements removed from the site.

Groundwater

- Consistent with subsurface soil, groundwater data indicates that the northern third of the Bay Shore site is relatively free of elevated BTEX and PAH concentrations in shallow groundwater with total BTEX concentrations not exceeding 100 ug/l and 200 ug/l, respectively at the majority of sample locations. In addition, samples collected from the southeast corner of the site also indicate this area does not exhibit BTEX and PAHs above 10 ug/l.

- Consistent with the initial field program findings, shallow groundwater in the southern half of the Bay Shore site exhibits BTEX and PAHs with the highest concentrations observed southwest of the former Relief Holder, downgradient of the former Tar Separators/Effluent Treatment House, the 54,000 Cubic Foot Gas Holder/Heavy Oil Tank and downgradient of the former Tar and Drip Oil Collection Pit. In addition, BTEX and PAH compounds are present downgradient of the former Tar Well located in the southwestern portion of the site. While the former industrial Cesspool located southwest of the former Gas Holder contains levels of BTEX and PAHs in subsurface soil, groundwater data from BBMW-17S indicates relatively low BTEX and PAHs in groundwater downgradient of this area with total BTEX and PAH concentrations of 110.0 ug/l and 159.0 ug/l, respectively.

- On-site deep groundwater at a depth greater than 50 feet bgs was found to exhibit nondetectable to trace levels of BTEX and PAHs, with total BTEX concentrations not exceeding 5 ug/l and total PAH concentrations not exceeding 50 ug/l. However, samples collected along the southern property boundary contained higher levels of BTEX and PAH. This area also exhibited elevated levels of these compounds in subsurface soil as well as tar staining and tar/NAPL at saturated levels.

- Review of historical and recent data for total BTEX/PAHs in groundwater in wells MW-07S and MW-08S, located on-site, indicates that since the initial monitoring, the concentrations of these chemicals have decreased significantly from elevated concentrations to less than 100 ug/l and 200 ug/l, respectively. This observation reflects that the source areas have weathered and are continuing to degrade. Total BTEX/PAH concentrations in the adjacent off-site areas have fluctuated over time, but exhibit no net increase. Concentrations of total PAHs in deep well MW-07D fluctuated sporadically since initial monitoring of this well. It is noted that NAPL was detected in deep subsurface soil at monitoring well MW-07D. Based on the trends observed, the groundwater at the site is considered to be in a steady state.

- A measurable layer of DNAPL was detected in on-site monitoring well MW-07D and off-site monitoring wells BBMW-20D, BBMW-21D and BBMW-22D. The three off-site wells are located immediately downgradient of the Bay Shore site and are screened immediately above the Glacial/Magothy formation interface. DNAPL thicknesses ranged from a minimum of 2.5 feet detected in MW-07D to a maximum of 7.0 feet detected in BBMW-21D and BBMW-22D. The four monitoring wells are located within the general area described above as containing a NAPL/tar-saturated soil zone at the Glacial/Magothy formation interface described above.

Qualitative Human Exposure Assessment

- The potentially exposed populations under current site conditions at the Bay Shore Site are on-site trespassers who may be exposed to surface soil via ingestion and dermal contact; on-site KeySpan workers who may be exposed to surface soil via ingestion and dermal contact, and inhalation of vapors in indoor air; and adult nearby off-site utility workers who may be exposed to site-related chemicals of potential concern (COPCs) in surface and subsurface soil via ingestion and dermal contact and groundwater via dermal contact. Potential exposures for nearby off-site utility workers are possible because of the presence of subsurface sewer, telephone, gas, water and railroad lines/facilities in the areas immediately adjacent to the site. Additionally, a portion of the residential area to the immediate south of the Bay Shore Site is included as part of the Bay Shore Site Operable Unit 1 (OU-1). The potential exposures for these off-site residents are discussed in **Section 5.4** below.

- Under potential future site use conditions, potentially exposed human populations include on-site and off-site construction workers and on-site adult commercial workers, adult and child visitors, and on-site adult and child residents. Exposure for the construction worker is possible because virtually any site redevelopment would involve some kind of construction activity. Potential on-site exposure media for the construction worker include surface soil (via ingestion and dermal contact), subsurface soil (via ingestion and dermal contact) and groundwater (via dermal contact).

- Because the Bay Shore Site is suited for commercial/light industrial redevelopment, exposures for adult commercial workers and adult and child visitors to future commercial properties are possible. Commercial worker and site visitor exposures are limited to indoor air because this is the exposure route most likely to occur, absent appropriate remediation, and present the greatest potential risk. It is expected that future land use of the on-site property may be deed restricted to prevent residential redevelopment; however, because deed restrictions are not yet in place, a future on-site residential scenario is included in this assessment. Potential on-site exposure media for these future on-site residents include surface and subsurface soil (via ingestion and dermal contact), groundwater (via dermal contact) and inhalation of vapors in indoor air.

5.2 Bay Shore West Parcel (Operable Unit 1)

Subsurface Soil

- Sampling conducted in the Bay Shore West Parcel identified an area of subsurface soil exhibiting BTEX with total BTEX concentrations ranging up to 495 mg/kg. Based on available data, this area is approximately 400 square feet in areal extent and appears to be centered at the locations of two former Oil Storage Tanks. This area of BTEX appears to be relatively shallow with concentrations of total BTEX not exceeding 0.1 mg/kg below a depth of 12 feet. NAPL/tar at saturated levels was not observed within the Bay Shore West Parcel with the exception of BBSB-69 located within the area exhibiting BTEX described above. In addition, shallow soil collected from several soil borings completed in this area exhibited NAPL/tar blebs and/or sheens. Similar to BTEX concentrations, these conditions were not observed below a depth of 12 feet.

Groundwater

- BTEX compounds were detected in shallow groundwater along the southern property boundary with total concentrations ranging up to 21,500.0 ug/l. Groundwater sample locations collected off-site and immediately downgradient of the Bay Shore West Parcel also exhibited total BTEX concentrations in shallow groundwater of between 353.0 ug/l and 4,500.0 ug/l. BTEX compounds were not detected above 81.0 ug/l in groundwater deeper than 26 feet bgs.

- PAHs were not detected above 732 ug/l in groundwater samples collected from the Bay Shore West Parcel.

- Historical trends of total BTEX/PAH concentrations in shallow groundwater in monitoring well MW-03S located on the Bay Shore West Parcel but east of the area of BTEX discussed above indicate that total BTEX concentrations have decreased to trace levels since September 1992 and total PAH concentrations have been detected at elevated levels since that time. However, it is noted that total BTEX and total PAHs in the recent sampling were detected at low concentrations. It is believed that the BTEX and PAHs observed in MW-03S are actually associated with source areas located on the southwestern portion of the Bay Shore site.

- Based on the southerly flow of groundwater and the location of sample points, the likely source of the BTEX present in shallow groundwater is subsurface soil located in the vicinity of the former Oil Tanks described above.

Qualitative Human Exposure Assessment

- Like the Bay Shore Site, the potentially exposed populations under current site conditions at the Bay Shore West Parcel are on-site trespassers who may be exposed to surface soil via ingestion and dermal contact; on-site KeySpan workers who may be exposed to surface soil via ingestion and dermal contact, and inhalation of vapors in indoor air; and adult nearby off-site utility workers who may be exposed to site-related COPCs in surface and subsurface soil via ingestion and dermal contact and groundwater via dermal contact. Potential exposures for nearby off-site utility workers are possible because of the presence of subsurface sewer, telephone, gas, water and railroad lines/facilities in the areas immediately adjacent to the site.

- Potential future use scenarios for the Bay Shore West Parcel are the same as those for the Bay Shore Site. Consequently, the potential exposure populations include construction workers, commercial workers and visitors to those commercial establishments, absent appropriate remediation. In the absence of deed restrictions precluding residential use, potential future on-site exposure populations include adult and child residents. The potential exposure pathways for these receptor populations are identical to those for the Bay Shore Site.

5.3 Bay Shore West Storage Lot (Operable Unit 3)

Surface Soil

- As part of the supplemental field program, two surface soil samples were collected from this parcel for analysis of PAHs. Total PAHs ranged from 15.8 mg/kg to 17.2 mg/kg. Based on the results of this data along with existing surface soil data, PAHs do not appear to be a concern in this portion of the study area.

Qualitative Human Exposure Assessment

- Potentially exposed human populations under current site conditions at the Bay Shore West Storage Lot Parcel include on-site trespassers and adult on-site KeySpan workers. On-site trespassers may be exposed to site-related COPCs in surface soil via ingestion and dermal contact. Potential exposures for the on-site KeySpan worker include surface soil (via ingestion and dermal contact) and inhalation of vapors in indoor air.

- Like the Bay Shore West Parcel, potential future use scenarios for the Bay Shore West Storage Lot Parcel are the same as those for the Bay Shore Site. Consequently, the potential exposure populations include construction workers, commercial workers and visitors to those commercial establishments, absent appropriate remediation. In the absence of deed restrictions precluding residential use, potential future on-site exposure populations include adult and child residents. The potential exposure pathways for these receptor populations are identical to those for the Bay Shore Site.

5.4 Bay Shore Plume (Operable Units 1 and 2)

Groundwater

- Based on a south to southeast direction of groundwater flow, the sources of BTEX and PAH compounds in off-site groundwater appear to be primarily located within the central and southern portions of the Bay Shore Site. The Bay Shore West Parcel appears to be a minor contributor of these compounds to off-site groundwater.

- Although total BTEX and total PAHs were detected in groundwater samples collected from several downgradient wells and/or groundwater probe points, evidence of NAPL was not observed in any samples collected south of Union Boulevard. Based on this data, the Bay Shore Plume is comprised of dissolved-phase BTEX and PAH compounds downgradient of this location.

- The highest total BTEX concentrations in the off-site plume were detected in the shallow and intermediate zones of the Upper Glacial Aquifer at groundwater probes BBGP-07 and BBGP-75 located 450 and 800 feet, respectively, downgradient of the site. In addition, the highest total BTEX concentrations detected in the deep groundwater zone were also detected in groundwater samples from these probes. Unlike BTEX concentrations, some of the highest PAH concentrations detected within the Bay Shore plume were detected in the intermediate groundwater zone south of Montauk Highway, approximately 2,000 feet south of the site.

- The Bay Shore plume appears to be migrating in the direction of the natural flow of groundwater, south to southeast, extending from the Bay Shore Site to as far west as the southeast corner of the Bay Shore West Parcel: a width of approximately 500 feet. The total length of the plume is estimated to be approximately 3,400 feet with the plume discharging to Lawrence Creek, a tidally influenced surface water body located south of Montauk Highway. The discharge of the plume to Lawrence Creek is consistent with the findings of the Suffolk County Department of Health Services (SCDHS) Lawrence Creek Investigation discussed in the April 2002 RI report.

- Historical trends of total BTEX/PAH concentrations in groundwater in monitoring well clusters GM-03 and GM-05 indicate that over time, total BTEX/PAH concentrations have remained in a steady state at low levels in the middle portion of the plume (GM-03) and total BTEX have shown a net decrease to trace levels in the downgradient portions of the plume (GM-05). However, it is noted that concentrations of total PAHs in the downgradient portion of the plume have fluctuated sporadically since the initial monitoring of GM-05.

- BTEX and PAHs were detected in the deep groundwater zone of the Upper Glacial aquifer. However, the Upper Magothy formation consists primarily of low permeable clays. Due to the low permeable nature of this material, vertical migration of the Bay Shore Plume is restricted, and impact to the Magothy aquifer underlying the Upper Glacial aquifer is not expected. This is supported by the fact that BTEX and PAHs were found to be nondetectable in the most recent samples collected from BBMW-05D2 screened below the low permeable clay of the Magothy formation.

- The elevated concentrations of carbon dioxide and the almost complete absence of dissolved oxygen within the defined plume strongly support the conclusion that microbial respiration is occurring within the plume. Furthermore, it is likely that the BTEX and PAHs are being used as organic substrates by the microbes and are being metabolized.

Qualitative Human Exposure Assessment

- Current off-site residents living downgradient (generally due south) of the Bay Shore Site may be exposed to chemicals volatilizing out of the groundwater plumes passing underneath residential structures. Additionally, these residents may potentially be exposed to site-related chemicals in groundwater if they are using groundwater for domestic purposes. Relevant potential exposure pathways for such use of groundwater include ingestion, dermal contact, inhalation of volatiles while showering (if a private well is used as the source of the bathing water), and for irrigation purposes. Results of the indoor air sampling, and the well and basement survey (as summarized in **Section 2.5** of **Appendix F**) have identified a very small number of properties at which the potential for indoor air exposure exists. The owners of these properties have been notified. Based on information collected to date, no active private wells have been identified within the confines of the Bay Shore Plume, i.e., within the limits of the plume as defined in the Remedial Investigation.

5.5 O-Co-Nee Pond (Operable Unit 3)

Groundwater

- The Brightwaters Yard plume consists of dissolved-phase BTEX and PAH compounds originating from a source area located in the southwest corner of the site. This source area is associated with a petroleum-based MGP feedstock historically stored at the Brightwaters Yard. The plume has been determined to be approximately 200 feet wide at the site boundary and approximately 1,400 feet long. KeySpan began actively treating the plume with an oxygen injection technology starting in September of 2000. As part of this remedial technology, a line of oxygen injection points were installed perpendicular to the plume along the southern shoulder of Union Boulevard.

- The review of quarterly BTEX and PAH groundwater data collected from monitoring wells located along the plume centerline indicates reductions in BTEX/PAH concentrations downgradient of the oxygen injection points. It is expected that these reductions will continue in the future and will propagate downgradient along with the natural flow of groundwater effectively treating the dissolved-phase plume.

Pore Water

- BTEX was detected in one of the six pore water samples that were collected and analyzed. Total BTEX was detected in sample BWPW-03 at a concentration of 177 ug/l and consisted almost entirely of benzene, which was detected at a concentration of 170 ug/l. Of the PAHs analyzed, only naphthalene was detected in pore water sample BWPW-02 at a concentration of 2 ug/l. No other PAHs were detected in any of the other pore water samples. The presence of BTEX in BWPW-03 is likely attributable to the discharge of the Brightwaters Yard plume to O-Co-Nee Pond.

Surface Water

- A total of 11 surface water samples were collected from O-Co-Nee Pond at six different locations. BTEX compounds were not detected in any of the surface water samples with the exception of xylene detected at a concentration of 1 ug/l at BWSW-01 (Bottom). PAHs were detected in two of the 11 surface water samples. Concentrations of total PAHs were 20 ug/l in sample BWSW-04 (Bottom +12 inches) and 34 ug/l in sample BWSW-05 (Bottom).

- Investigations conducted to date indicate the plume discharges to the lower portion of O-Co-Nee Pond. However, BTEX and PAHs were only detected sporadically and at trace concentrations in surface water samples collected from this area. This is attributable to:

  – mixing through dispersive forces and reduction of chemical mass through natural biodegradation processes.

  – groundwater containing BTEX and PAHs that may discharge to the pond is further diluted as the result of mixing with the surface water and other water sources discharging to the pond.

  – BTEX dissolved in surface water would have a propensity to volatilize from the water and undergo additional biological decay, resulting in further reduction of concentrations.

Surface Water Sediment

- Trace concentrations of xylene were detected in 5 of the 12 surface water sediment samples ranging from 0.002 mg/kg to 0.006 mg/kg. No other BTEX compounds were detected in any of the other surface water sediment samples. Concentrations of total PAHs, where detected in the sediment samples, ranged from 1.83 mg/kg to 56.9 mg/kg.

- The investigations conducted to date demonstrate that the Brightwaters Yard groundwater plume discharges to the lower portion of the O-Co-Nee Pond system. When comparing relative levels of contaminants in sediment samples collected from throughout the pond system, it is essential to also examine the location of the sediment and surface water samples relative to the plume discharge zone and to also compare the compounds detected in the sediment to those contained in the plume. The data shows, when examined in these contexts, that the PAH compounds detected in the headwaters of O-Co-Nee Pond are not associated with the plume. Specifically:

  – The available chemical data indicates that the suite of PAH compounds consistently detected in the Brightwaters Yard groundwater plume in the vicinity of O-Co-Nee Pond is distinctly different from the suite of PAH compounds detected in the sediment samples collected from the pond and the associated headwater areas.

  – The groundwater data collected as part of the 1997/1998 investigation of the Brightwaters Yard groundwater plume (refer to **Section 1.8** of the April 2002 RI report) indicates the plume is relatively narrow in the vicinity of Cooper Lane, being less than 80 feet wide at this location. As part of the 1997/1998 investigation, BTEX and PAHs were not detected in groundwater samples collected from groundwater probes and monitoring wells located between the defined Brightwaters Yard plume and the headwaters of O-Co-Nee Pond. Therefore, the plume does not appear to discharge to this portion of O-Co-Nee Pond. This 1997/1998 data was supported by the pore water sampling conducted as part of the supplemental investigation, where BTEX and PAHs were not detected in the headwater areas of O-Co-Nee Pond. However, pore water sample BWPW-03, collected from the lower portion of the O-Co-Nee Pond system and immediately downgradient of the projected plume path, exhibited a total BTEX concentration of 177 ug/l.

  – As the data presented on **Figure 4-39** clearly illustrates, the sediment samples exhibiting the highest total PAH concentrations, including BWSD-04 (0-0.5 feet), BWSD-05 (0.5 to 1.0 feet), BWSD-06 (0.5 to 1.0 feet) and BBSD-13 (0-0.5 feet), are all located in the headwaters area of O-Co-Nee Pond, which is not influenced by the Brightwaters Yard plume. Furthermore, the predominant PAHs detected in the sediment samples, including benzo(b)fluoranthene, fluoranthene and pyrene, are commonly associated with the incomplete combustion of fossil fuels. In addition, BTEX and PAH compounds are also commonly found in a wide range of products, including petroleum products such as gasoline and home heating oil.

Several petroleum spills have been documented by the NYSDEC as occurring within the vicinity of O-Co-Nee Pond. Therefore, it is reasonable to conclude that, aside from the Brightwaters Yard plume, there are other sources of these compounds in the vicinity of the pond.

In summary, the PAHs observed in the O-Co-Nee Pond system sediments cannot be attributed to the Brightwaters Yard plume because sediment samples exhibiting PAHs were not located in the area of O-Co-Nee Pond in which the Brightwaters Yard plume discharges and the PAHs detected are not consistent with those detected in the plume. Due to the ubiquitous presence of PAHs and BTEX in developed environments, a source other than the plume is plausible. That PAHs were not detected in all sediment samples does not negate this hypothesis.

Qualitative Human Exposure Assessment

- Potentially complete exposure pathways associated with O-Co-Nee Pond for off-site residents include ingestion and dermal contact with sediment and surface water. Additionally, the consumption of fish and crabs from O-Co-Nee Pond may occur. Potential exposure to site-related chemicals due to the consumption of fish and crabs from this surface water body is expected to be minimal because BTEX and PAHs generally were not detected or were detected at relatively low concentrations and the chemicals present in the surface water and sediment samples do not tend to bioconcentrate.

5.6 Watchogue Creek/Crum's Brook (Operable Unit 4)

Former Cesspool Area

- BTEX compounds were detected in subsurface soil with total BTEX concentrations of up to 8.4 mg/kg detected approximately 80 feet downgradient of the former Cesspool. The maximum total BTEX concentration observed during the initial field program of 9.6 mg/kg was also located downgradient of the former Cesspool. Consistent with the findings of the initial field program, BTEX compounds were only detected at concentrations greater than 1.0 mg/kg in shallow subsurface soil at depths no greater than 10 feet bgs. Below this depth, BTEX concentrations were found to be nondetectable or at trace concentrations not exceeding 0.05 mg/kg. The maximum total PAH concentrations detected in subsurface soil were observed in shallow subsurface soil within the vicinity of the former Knickerbocker Ice Company facility with total PAH concentrations of up to 1,354.1 mg/kg. Petroleum fingerprint analysis indicates that the hydrocarbons present in this area were most characteristic of diesel fuel and motor oil.

- BTEX and PAH groundwater data is generally consistent with soil data with the highest BTEX and PAH concentrations observed within the former Cesspool and immediately downgradient of this area in shallow groundwater. The maximum total BTEX and total PAH concentrations observed in this area were 911.0 ug/l and 3,015 ug/l, respectively. While the data does identify groundwater containing BTEX and PAH compounds immediately downgradient of the former Cesspool, concentrations decrease rapidly with increasing depth at most downgradient sample locations.

Former Pond Area and Watchogue Creek/Crum's Brook Headwaters

- Three soil borings were advanced in the former pond area in order to delineate the areal extent of BTEX/PAHs identified in this area as part of the initial field program. Total BTEX and PAHs did not exceed 0.25 mg/kg at all sample intervals selected for analysis. Based on this data as well as the extensive data collected as part of the initial field program, the highest BTEX and PAH concentrations in subsurface soil appear to be present in stream and pond sediments associated with the former pond area. These sediments are currently overlain by several feet of sand that was apparently used to fill in the pond. The sand used to backfill this area was found to exhibit little to no BTEX and PAHs.

- BTEX concentrations were below detection limits in 13 of the 15 groundwater samples. The remaining two samples exhibited total BTEX concentrations ranging from 5 ug/l to 16 ug/l. PAH compounds were detected in six of the 15 samples. Total PAH concentrations ranged from 22 ug/l to 740 ug/l. Based on these results, subsurface soil within the former pond appears to be a minor source of BTEX and PAH compounds to groundwater.

Qualitative Human Exposure Assessment

- Potential exposures along Watchogue Creek/Crum's Brook include the following populations: residents living in the vicinity of the former pond area and trespassers along Watchogue Creek south of Union Boulevard. Potential exposure media for these off-site residents and trespassers include surface soil (via ingestion, dermal contact, and inhalation) and potential exposure to surface water and sediment via ingestion and dermal contact. As part of an interim remedial measure (IRM), Watchogue Creek south of Union Boulevard has undergone restoration efforts, including the removal of shallow sediments and channel realignment.

- Under future land use conditions, off-site construction worker exposure to portions of Watchogue Creek/Crum's Brook may be possible. Potential exposure media and pathways for the off-site construction worker include surface soil (via ingestion and dermal contact), subsurface soil (via ingestion and dermal contact) and groundwater (via dermal contact).

Fish and Wildlife Resources Impact Analysis

- For purposes of the Fish and Wildlife Resources Impact Analysis (FWRIA) and consistent with NYSDEC guidance, the site and surrounding areas are considered as a whole given the transient nature of wildlife. Consequently, this section summarizes the general findings of the FWRIA and is not OU-specific. Following the Appendix 1C Decision Key in the NYSDEC's FWRIA document, a FWRIA was deemed required. The analysis focuses on risks associated with site-related chemicals detected in soil, surface water, sediment and groundwater. The complete FWRIA can be found in **Appendix F**.

- The site reconnaissance conducted as part of this analysis indicates that the site and surrounding area are poor quality environmental resources, due to the limited presence of vegetation. The site is partially covered with buildings, blue stone and asphalt. Wildlife species typically present are adapted to an urban setting. Due to the size of the vegetated areas, only a few individual animals will be present. Remediation is suggested to at least abate entry of the Bay Shore plume into Lawrence Creek and to prevent entry of the Brightwaters plume into O-Co-Nee Pond. Interim Remedial Measures (IRMs) that address the Brightwaters plume already are underway and remedial actions currently are being developed to address the Bay Shore plume.

5.7 Private Well and Basement Survey (Operable Units 2 and 3)

Indoor Air

- Air sampling was conducted at 16 off-site locations during the remedial investigation. At one location, two rounds of sampling were conducted and at another location, three rounds of sampling were conducted. A total of 67 samples were collected and each sample was analyzed for 61 volatile organic compounds. The majority of the volatile organic compounds for which analysis was performed were not detected. The majority of those compounds that were detected were detected at concentrations within the range of background levels as reported by the New York State Department of Health (NYSDOH) and those compounds detected above NYSDOH background levels are generally those not typically associated with MGP impacts. Additionally, naphthalene, the compound most commonly associated with potential MGP impacts, was not detected in any of the samples. The analytical results obtained were reviewed by the NYSDOH and the detected compounds were found to be at acceptable levels.

- NYSDOH background levels do not exist for some of the detected compounds. Detected concentrations of these compounds are orders of magnitude below occupational standards. Consequently, available indoor air data suggest that the inhalation of vapors derived from site-related chemicals is not an exposure pathway of concern.

- Additionally, a basement survey was performed of properties within, between and in the immediate vicinity of the two groundwater plumes, as defined in the Remedial Investigation. Results of 145 questionnaires completed thus far indicate that an odor of potential concern, i.e., an odor that is characterized as "gasoline," "oil," or "driveway sealer," is present at eight properties when the basement is wet. KeySpan has offered to follow-up with the eight homeowners who indicated the presence of an odor of potential concern. Due to the lack of precipitation in recent months, the basements at the properties were dry until recently. KeySpan has told property owners to contact the company if they experience the odor again, at which point KeySpan will schedule a property visit to determine whether further testing is warranted. Thus far, indoor air sampling has been performed at three properties. Additionally, a "gasoline" odor at one property has definitively been attributed to a neighbor's gasoline tank. This survey information, coupled with results of the indoor air sampling performed to date, indicates that potential exposures to site-related chemicals via inhalation of indoor air in the vicinity of the site are minimal.

Private Well Water

- Seventeen of the 145 survey respondents reported the presence of a groundwater well on their property. KeySpan attempted to schedule visits for each of these. As a result, visits were conducted at 11 properties. The presence of a well could not be confirmed at 2 of the 11 properties due to access issues. At five properties, it was confirmed that a well is not present; one respondent who initially indicated the presence of a well later stated that the property does not have a well; and repeated attempts to arrange a site visit with four of the property owners have been unsuccessful. One respondent indicated that they have a well, but it is not functional.

  The presence of a well was confirmed at four properties: one of these wells is in active use for irrigation purposes and three wells were confirmed to be inactive (i.e., not in use) for a period of several years. KeySpan attempted to sample all four wells. However, samples could only be collected from two of the four wells. One of the wells sampled was the active irrigation well located along Lanier Lane between O-Co-Nee Pond and the Bay Shore plume approximately 1,400 feet south of the site. The other well sampled was an inactive well located inside the approximate boundaries of the Brightwaters Yard plume approximately 950 feet south of the Brightwaters Yard. The other two wells could not be sampled due to access issues (i.e., piping setup).

  Analytical results indicated that, with the exception of methyl tert-butyl ether, a common gasoline additive, no VOCs or SVOCs were detected in the sample collected from the active irrigation well. Several VOCs and SVOCs, including naphthalene, were detected in the inactive well. This well is not currently used as a source of water for any purpose and the pump is currently inoperable.

- In summary, results of the well survey indicate that 144 of the 145 survey respondents do not use a groundwater well for domestic purposes (i.e., irrigation of gardens, cooking, bathing). Consequently, exposure to potentially site-related constituents that may be present in groundwater does not occur for these individuals (that is, domestic use of groundwater is an incomplete exposure pathway). As described above, a private well is used for irrigation purposes at one property.

6.0 CONCEPTUAL SUMMARY

6.1 Introduction

This section presents a conceptual model that describes the evolution of current environmental conditions at and immediately adjacent to the site. The model is based on historical site information along with the qualitative and quantitative results of the various site assessments and investigations. The model was developed to provide an integrated summary of the key processes that have occurred (or are occurring) resulting in the existing conditions at the site and the affected off-site areas. In brief, the model addresses potential on-site source areas at each operable unit comprising the site along with the key fate and transport mechanisms that are responsible for the migration of MGP-related materials and chemicals from the source areas and its distribution in the environment.

As discussed in **Section 1.5**, the former MGP and affected off-site areas have been classified into four operable units, designated Operable Unit 1 (OU-1) through Operable Unit 4 (OU-4). This organization into operable units is necessary, as the potential source areas and associated fate and transport processes that have resulted in the distribution of MGP residuals in the environment were distinct for each operable unit. In keeping with this premise, individual conceptual models are presented below for each operable unit. In addition, historical background of the site is summarized below in order to provide an overview of the activities that were performed during operation of the former MGP. The regional hydrogeologic settings for each operable unit are similar, and accordingly, descriptions of the key local and regional hydrogeologic characteristics are provided in **Section 6.2** following the historical overview.

The former Bay Shore MGP site operated between 1889 and approximately 1973 and entailed the handling, storage and management of feedstocks for gas production as well as intermediate byproducts generated as a result of the gas production process. During the life of the plant, gas was manufactured from various solid and liquid fuel feedstocks such as coke, coal and oil. In 1918, the plant began operating using the carbureted water gas (CWG) process. The plant was later converted to operate using the oil-gas process. Manufacturing operations were conducted on the Bay Shore property, while the Brightwaters Yard property was used to support gas manufacturing and distribution. After gas production ceased sometime in the early 1970s, the gas plant structures remained on site until demolition of the plant in 1973.

From at least 1925 to the early 1970s, the Brightwaters Yard Site (OU-3) served as a storage facility for feedstock materials and commercial byproducts used and generated at the Bay Shore MGP. From approximately 1963 to 1977, a 1-million gallon aboveground storage tank was located in the southwest corner of the Brightwaters Yard site. The tank was used to store a light petroleum distillate, similar to kerosene and referred to as H-fuel. In addition, piping associated with the tank as well as drip oil tanks were located in this portion of the site.

The gas produced at the Bay Shore site was transferred from the Generator House, run through scrubbers and separators to concentrate the gas, remove and collect economically important intermediate chemicals that were produced, such as naphthalene, and to remove unwanted impurities such as sulfur and cyanide. Leaks and/or spills from piping, storage and/or treatment structures during the transfer and distribution processes of feedstocks and MGP residuals resulted in these materials impacting subsurface soil and groundwater in the vicinity of the former structures and downgradient from the site.

A portion of the wastewater generated at the former MGP was treated at an on-site wastewater treatment facility. Subsequent to treatment, treated wastewater was transported via underground piping to a cesspool located east of the site. The so-called former Cesspool was located in the vicinity of the former headwater pond for Watchogue Creek/Crum's Brook (OU-4).

6.2 Hydrogeologic Setting

Geology in the vicinity of the site consists of four primary stratigraphic units, which are the fill unit, a recent (post-glacial) silt/clay unit, glacial outwash deposits and the Magothy formation.

The fill material encountered throughout the site is highly variable in character and thickness and consists of brown to black sands and gravels with varying amounts of glass, brick, coal, ash, clinker and wood. The fill material extends throughout the southern two-thirds of the Bay Shore Site with the thickest component located along the southernmost portion of the parcel. The fill material within the southern portion of the site contains extensive amounts of construction/demolition (C&D) material, such as brick, metal piping, concrete block and wood. Based on the nature of the C&D material, it is likely that it originated as a result of the demolition of the MGP facility which occurred in 1973. Furthermore, test pits completed within the Bay Shore site indicated the presence of foundations and other subsurface structures remaining on this portion of the former MGP site. The locations of these structures appear to be consistent with available historic drawings.

The recent (post-glacial) silt/clay unit was detected at the Bay Shore Site and Bay Shore West Parcel as discontinuous lenses at or near the water table. Due to its discontinuous nature, this strata does not appear to be an effective confining unit in this portion of the former MGP site. However, the recent silt/clay unit appears to be fairly continuous in the Brightwaters Yard within the vicinity of the former H-fuel tank described above. As a result, this strata does behave as a partial confining unit in this portion of the former MGP site.

Consistent with regional geology, a continuous sequence of glacial outwash sand and gravel exists throughout the site and surrounding areas. The glacial outwash deposits comprise the entire Upper Glacial aquifer. Within the site, the upper surface of the outwash deposits is located immediately below the surficial topsoil layer in areas where the fill and recent silt/clay units are absent. The medium to coarse sands encountered throughout the site, as well as areas to the south, are typical of glacial outwash deposits which comprise the Upper Glacial aquifer within southern Suffolk County. These relatively coarse sediments contain low total organic carbon (TOC) and exhibit excellent water transmitting properties, with horizontal hydraulic conductivities ranging from 147 feet per day to 270 feet per day. The average TOC in sediments at the site is approximately 1 percent. The fraction of organic carbon is the dominant characteristic of an aquifer affecting the capacity to adsorb organic chemicals, such as BTEX and low molecular weight PAHs. The combined effects of high groundwater flow rates and low TOC allow organic chemicals to migrate through the Upper Glacial aquifer with little attenuation due to adsorption by organic carbon.

The glacial outwash deposits rest on top of the low permeable Magothy formation which consists of a fine sand, silt and clay varying from light gray to black in color and ranging from hard to slightly plastic in texture. The Magothy formation beneath the site has an average vertical permeability of only 1.74×10^{-5} cm/second or 0.05 feet/day. Therefore, the upper portion of the Magothy formation acts as an effective confining unit limiting the vertical migration of any chemical constituents beyond the glacial outwash deposits.

Based on the hydraulic gradient as determined using measured water table elevations and hydraulic conductivity described above, groundwater flows at a rate of approximately 2.3 ft/day. Consequently, there is little lateral dispersion of the dissolved BTEX and PAHs in the off-site Bay Shore plume (OU-2).

6.3 Fate and Transport of Nonaqueous Phase Liquids

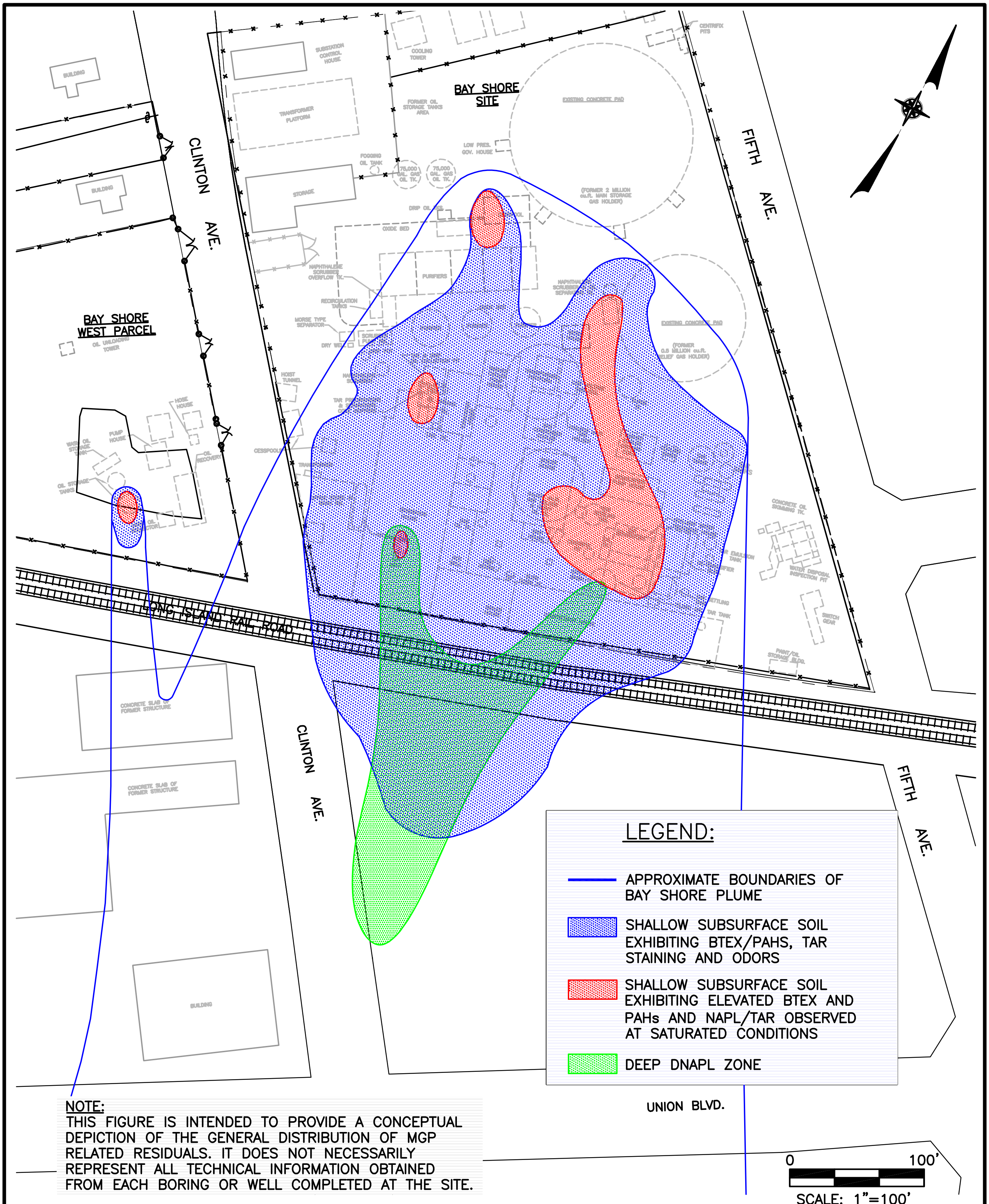
Low viscosity tar and oil that may have been discharged by the former MGP site would have behaved as nonaqueous phase liquids (NAPL) migrating vertically through the soil column under the force of gravity until contacting the water table approximately 6 to 8 feet below grade. Due to the transmissive nature of the glacial outwash sands and gravels underlying the site, migration of NAPL would have been relatively rapid. As it migrated downward through the soil, a portion of the NAPL would have become trapped in pore spaces in response to capillary forces creating a zone of immobile residual NAPL within the vadose zone. If the NAPL was able to penetrate the water table, the NAPL would also migrate horizontally in a downgradient direction under the influence of groundwater flow.

Any NAPL which is less dense than water, commonly referred to as light nonaqueous phase liquids or LNAPL, would have spread laterally on the shallow water table after it migrates vertically and infuses groundwater. The NAPL would become further immobilized in soil pores as the water table naturally fluctuates in the vertical direction in response to changes in groundwater recharge rates. This would have created a vertical zone of residual LNAPL, typically referred to as a "smear zone." Tars or oils which are more dense than water, referred to as dense nonaqueous phase liquid or DNAPL, would continue to migrate through the soil column until either the volume required to sustain gravity-driven migration was inadequate due to solubilization or loss of mass as the result of the DNAPL being trapped in pore spaces, or an impermeable unit was encountered.

6.4 Bay Shore Site, Bay Shore West Parcel and Bay Shore Plume (Operable Units 1 and 2)

Areas of subsurface soil exhibiting evidence of NAPL, were encountered primarily in close proximity to former MGP structures located at the Bay Shore Site. Where observed, saturated NAPL/tar in subsurface soil in the central third of the site is generally limited to approximately 20 to 30 feet below ground surface (bgs). The occurrence of saturated NAPL/tar in soil at depths greater than 30 feet bgs is generally limited to the southern third of the site and immediately adjacent downgradient areas. **Figure 6-1** provides the approximate locations of each on-site area containing NAPL/tar at saturated levels along with the estimated extent of soil exhibiting tar staining and odors.

The observed distribution of NAPL/tar in subsurface soil indicates a southerly migration of this material from on-site source areas primarily located in the southernmost third of the site to downgradient areas. NAPL/tar migration appears to be predominantly horizontal in nature at and below the water table. However, in the vicinity of the southern property boundary, a downward vertical migration component appears to be present. As a result, there appears to be a deeper NAPL/tar zone or DNAPL zone located above the Glacial/Magothy formation interface. As illustrated by **Figure 6-1**, this deeper DNAPL zone appears to originate from former MGP structures located in the southern third of the site and extends approximately 250 feet south of the site. LNAPL was not observed within shallow monitoring wells or test pits completed within the Bay Shore site. In addition, LNAPL was not observed in shallow monitoring wells located immediately downgradient of the site.



BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

Dvirka and Bartilucci
CONSULTING ENGINEERS
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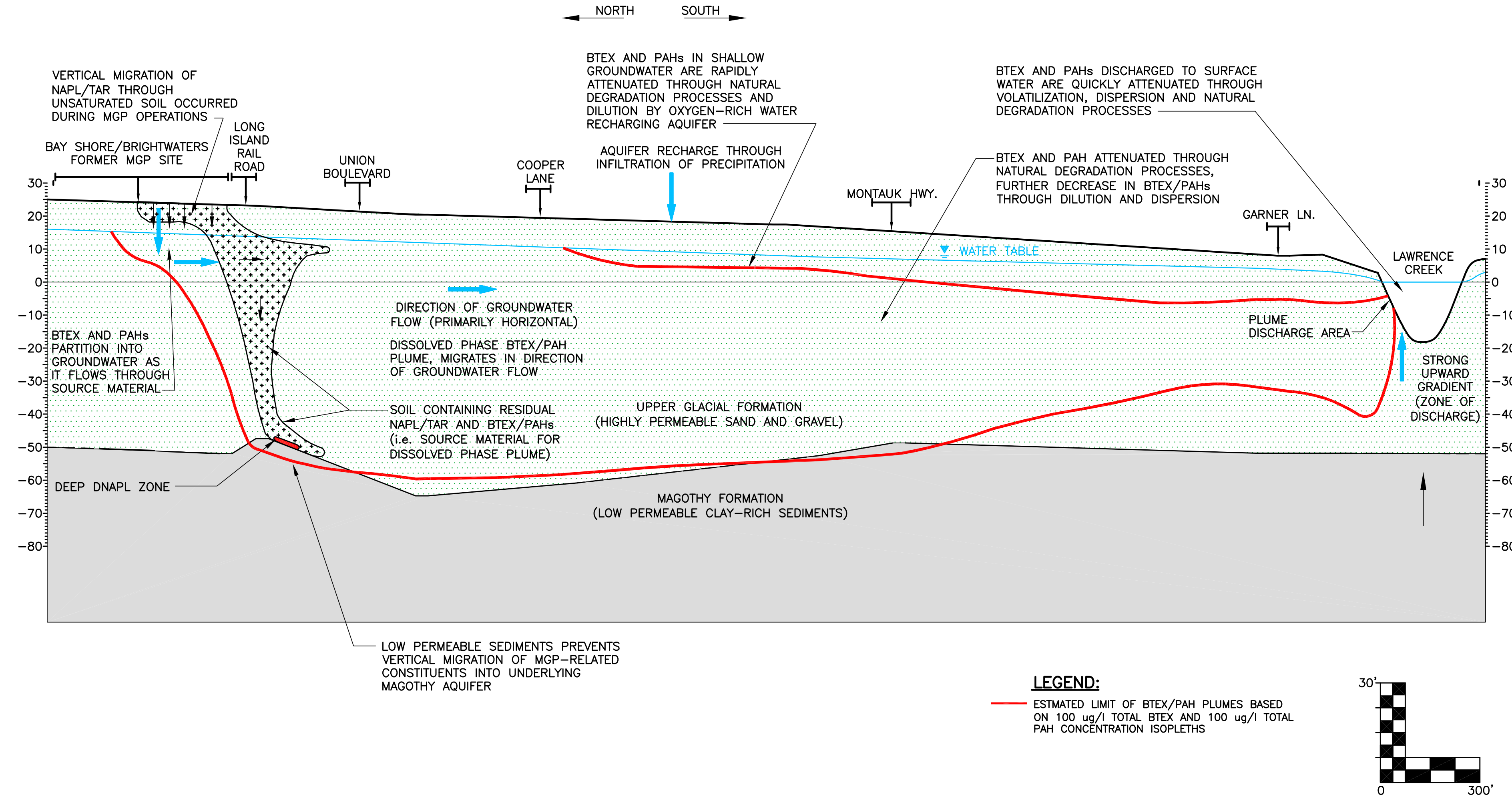
CONCEPTUAL MODEL OF BTEX AND PAH SOURCE AREAS LOCATED AT THE BAY SHORE SITE, BAY SHORE WEST PARCEL AND ADJACENT OFF-SITE AREAS

FIGURE 6-1

As shown on **Figure 6-1**, the Bay Shore West Parcel contains a relatively small area of subsurface soil containing elevated BTEX located in the vicinity of the two former Oil Storage Tanks. Based on analytical data and field observations, which are discussed under **Section 4.2.2**, this area of elevated BTEX is found to be relatively shallow in depth with the highest concentrations being present at or near the water table which is characteristic of an LNAPL smear zone. Analysis of an oil sample collected from an abandoned pipe recovered from the Bay Shore West Parcel indicated this material was less dense than water further supporting the concept that the BTEX present in subsurface soil at the Bay Shore West Parcel was likely attributed to a spill or leak of an LNAPL during the operation of the former MGP.

A schematic cross section that transects the site in a north-south direction and extends downgradient along the approximate centerline of the Bay Shore plume south to Lawrence Creek is provided on **Figure 6-2**. Consistent with the areal distribution of soil containing MGP residuals shown on **Figure 6-1**, **Figure 6-2** indicates that the majority of residual NAPL and soil containing BTEX and PAHs is limited to the source areas and areas where NAPL has migrated along and in the vicinity of the water table. **Figure 6-2** also shows that NAPL and affected soils in the deep portions of the glacial outwash deposits are limited to the adjacent off-site area immediately south of the site. The vertical migration of NAPL beyond the glacial outwash sediments is limited by the underlying low-permeability silt and clay that comprises the Upper Magothy formation.

Once the NAPL enters the subsurface soil, the more soluble components of the mixture are susceptible to dissolution through direct infiltration of precipitation, as well as groundwater flowing through the soil that contains the residual NAPL. As discussed above and in **Section 3.0**, groundwater in the Upper Glacial aquifer flows at the relatively high rate of 2.3 feet/day and the glacial outwash deposits are relatively poor in organic carbon content. Due to these conditions, the relatively soluble compounds, such as BTEX and low molecular weight PAHs, which leach from the NAPL and become dissolved in groundwater will tend to stay in solution and migrate at rates that are similar to the natural flow rate of groundwater. In contrast, the high molecular weight PAHs which have lower aqueous solubilities and higher potentials to adsorb to organic carbon in the aquifer matrix have a tendency to remain within the immobile NAPL present in the



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BAY SHORE/BRIGHTWATERS FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
BAY SHORE, NEW YORK

FATE AND TRANSPORT CONCEPTUAL MODEL OF BTEX AND PAHs IN SUBSURFACE ENVIRONMENT THROUGH BAY SHORE PLUME CENTERLINE

FIGURE 6-2

\\N4\cadwork\1620B12B\SECTIONS\1620-E.dwg, 01/06/03 09:54:33 AM, CScharkopf soil, become sorbed onto soil and/or migrate a limited distance from this source. This is supported by the groundwater data which indicates on-site groundwater collected from areas which contained NAPL exhibit elevated levels of BTEX and both low and high molecular weight PAHs. Immediately downgradient of the site, the same high molecular weight PAHs were only sporadically detected in groundwater and at lower concentrations.

During migration in the Bay Shore plume, the dissolved BTEX and to a lesser degree, PAHs, have been degraded through both aerobic and anaerobic biodegradation processes. Evidence of these processes include elevated carbon dioxide, depleted dissolved oxygen concentrations and elevated concentrations of anaerobic byproducts such as reduced iron, reduced manganese and ammonia. **Figure 6-2** also illustrates that the plume is located several feet below the water table downgradient of Cooper Lane. The lack of BTEX and PAHs present in this portion of the plume is likely attributed to the relatively rapid attenuation of BTEX/PAHs through the introduction of oxygen-rich water recharging the aquifer at the water table throughout the length of the plume.

As shown on **Figure 6-2**, the Bay Shore plume is migrating in the direction of the natural flow of groundwater (south to southeast), extending from the Bay Shore Site to as far west as the southeast corner of the Bay Shore West Parcel: a width of approximately 500 feet. The total length of the plume is estimated to be approximately 3,400 feet with the plume discharging to Lawrence Creek, a tidally influenced surface water body located south of Montauk Highway. Groundwater flow in the downgradient portion of the plume transitions from a predominantly horizontal to a more vertical flow regime south of Montauk Highway. The vertical component of flow increases until groundwater discharges into the tidal portion of Lawrence Creek. While the plume discharges to a relatively narrow zone of Lawrence Creek, surface water sampling conducted within this discharge zone found relatively low concentrations of BTEX and PAHs within surface water. The lack of BTEX and PAHs in surface water within the discharge zone is likely attributable to the following fate and transport factors:

- Groundwater containing BTEX and PAHs is rapidly diluted as the result of mixing with surface water and other water sources which also discharge to the creek.

- BTEX dissolved in surface water will have the propensity to volatilize from the water and undergo biological decay. Studies have shown that BTEX compounds readily degrade through natural processes within surface water.

6.5 Brightwaters Yard Site Groundwater Plume (Operable Unit 3)

As discussed in **Section 6.2**, the Brightwaters Yard site is underlain by fill, the recent (post-glacial) silt/clay unit and the transmissive glacial outwash sediments. Investigations conducted to date have identified a BTEX/PAH source area within the southwestern portion of the site which is associated with the former storage of H-fuel discussed under **Section 6.1**. This BTEX/PAH source area is estimated to be approximately 30,000 square feet in area and is approximately 14 feet thick. The density of H-fuel was likely less than that of water and, accordingly, would have spread laterally along the water table surface as a LNAPL as described under **Section 6.3**. As the result of the natural vertical fluctuation of the water table, the LNAPL would tend to distribute within soil pores over a "smear zone" bounded by the historic high and historic low water table elevations. Due to the position of the recent silt-clay unit and the degree of the water table fluctuation, NAPL will have a propensity to become trapped in more permeable sands and peat deposits interbedded within this unit creating isolated zones of bulk NAPL within the smear zone. However, the majority of the NAPL will likely remain in a residual and immobilized state within the pores of the soil as the result of capillary forces. These factors significantly limit the ability to physically remove the trapped LNAPL. Despite these conditions, KeySpan has had some success in recovering NAPL from the source area. This recovery effort was followed up by treating the source area with an in-situ chemical oxidation remedial technology.

Over time the more soluble components, that include BTEX and low molecular weight PAHs such as naphthalene, have leached from the H-fuel source area and into the shallow groundwater. As a result, the Brightwaters Yard plume consists of dissolve-phase BTEX and PAH compounds originating from a source area located in the southwest corner of the site and has migrated to the south along with the natural flow of groundwater. The plume has been determined to be approximately 200 feet wide and 1,400 feet long.

As the dissolved BTEX and PAHs migrate downgradient, they are being attenuated through biodegradation, as indicated by increases in carbon dioxide and depletion of dissolved oxygen in the Brightwaters Yard plume. Beginning in September of 2000, KeySpan began actively treating the plume with an oxygen injection technology. The oxygen amendments were implemented to accelerate naturally occurring aerobic biodegradation of BTEX and low molecular weight PAHs in the plume. The effectiveness of the natural biodegradation (i.e., prior to the oxygen injection) and the oxygen-enhanced biodegradation is clearly demonstrated by the continued decreases in concentrations of BTEX and PAHs in the Brightwaters Yard plume. The decreased concentrations of these comparatively soluble components also demonstrate the ongoing mass removal of dissolved chemicals.

The groundwater in the Brightwaters Yard plume ultimately discharges to the north end of O-Co-Nee Pond. However, analysis of surface water and sediment samples collected from the pond indicate little if any impact associated with the Brightwaters Yard plume. The lack of BTEX and PAHs in the surface water of O-Co-Nee Pond is likely attributable to the same fate and transport factors attenuating these compounds in Lawrence Creek as described under **Section 6.4**.

6.6 Watchogue Creek/Crum's Brook (Operable Unit 4)

A former industrial Cesspool located at the headwaters of Watchogue Creek was the historical discharge point for treated wastewater generated at the former Bay Shore MGP site. Wastewater discharged to the creek flowed south to a small pond area, which was subsequently backfilled. Currently, the creek headwaters start immediately south of the LIRR property, located approximately 500 feet east of the former MGP site. The creek flows south under Union Boulevard, eventually discharging to the Great South Bay. Investigations conducted to date indicate soil, groundwater and surface water sediments exhibit detectable levels of BTEX and PAHs. In general, BTEX and PAH concentrations decrease rapidly with increasing depth. However, at several soil borings completed in the vicinity of the former Cesspool, the detectable concentrations of PAHs persisted at depths well below the water table. In these soil borings, field observations of recovered soil included staining, sporadic blebs of NAPL and/or hydrocarbon and naphthalene odors. Additionally, groundwater samples collected in the vicinity of the borings that exhibited these conditions also contained detectable concentrations of BTEX and/or PAHs.

Water discharged to the former Cesspool from the former Bay Shore MGP historically may have contained NAPL and dissolved BTEX and PAHs. The dissolved chemicals would likely have readily leached into and become diluted to reduced concentrations by groundwater and migrated away. Any MGP-related NAPL that was discharged to the former Cesspool remained in the immediate vicinity and acted as a secondary source for dissolved BTEX and PAHs.

As indicated by subsurface soil data, BTEX compounds were only detected at low concentrations in subsurface soil below a depth of 10 feet, whereas PAHs were detected to a depth of up to 30 feet below grade. This is consistent with the vertical migration of NAPL that may have been discharged to the former Cesspool from the former MGP. The absence of BTEX in the subsurface soil deeper than 10 feet bgs indicates that the NAPL may have had a different chemical make-up from the NAPL typically encountered at the former MGP site or was extensively weathered. The NAPL impacted sediments within, beneath and immediately surrounding the former Cesspool are currently acting as a local source of groundwater impacts. The concentrations of BTEX and PAHs decrease rapidly downgradient from the former Cesspool. During the period of its operation, water from the former Cesspool migrated downgradient to the former Watchogue Creek headwaters pond area where it locally impacted sediments in the pond producing what is now a minor low-concentration secondary source area for BTEX and PAHs to groundwater.

6.7 Remedial Action Plan

KeySpan and the NYSDEC are developing a Remedial Action Plan (RAP) to address the environmental implications associated with the Bay Shore/Brightwaters former MGP site. That Plan will include a number of remedial measures, both within the site boundaries and in the community, to eliminate, reduce or contain sources of the MGP-related contaminants that are found in the defined groundwater plumes in the community and to eliminate or limit the pathways through which residents, workers and other members of the public could be exposed to the contaminants associated with the former MGP operations. The Plan will include several remedial measures, designed to protect public health and the environment.

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