SITE CHARACTERIZATION

PHASE VI DATA SUMMARY REPORT

WORK ASSIGNMENT C007540-5.1

MEEKER AVENUE PLUME TRACKDOWN
GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA

SITE NO. 224121
KINGS (C), NY

Prepared for:
NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
625 Broadway, Albany, New York

Joseph Martens, Commissioner

DIVISION OF ENVIRONMENTAL REMEDIATION
REMEDIAL BUREAU B

URS Corporation
77 Goodell Street
Buffalo, New York 14203

April 2012
SITE CHARACTERIZATION
MEEKER AVENUE PLUME TRACKDOWN
PHASE VI
SITE ID NO. 224121
GREENPOINT/EAST WILLIAMSBURG INDUSTRIAL AREA
BROOKLYN, NEW YORK

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
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REMEDIAL BUREAU B
WORK ASSIGNMENT NO. C007540-5.1

PREPARED BY:

URS CORPORATION
77 GODELL STREET
BUFFALO, NEW YORK 14203

APRIL 2012
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<td>AARCO</td>
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<td>amsl</td>
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<td>AST</td>
<td>above ground storage tank</td>
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<td>biochemical oxidant demand</td>
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<td>DCA</td>
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<td>dichloroethene, aka dichloroethylene</td>
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<tr>
<td>MTBE</td>
<td>Methyl tert-butyl ether</td>
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<td>NAPL</td>
<td>non-aqueous phase liquid</td>
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<td>NAVD</td>
<td>North American Vertical Datum</td>
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<td>OD</td>
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<td>Off-Site System</td>
<td>Off-Site Free Product Recovery System</td>
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<tr>
<td>PCB</td>
<td>polychlorinated biphenyl</td>
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<tr>
<td>PCE</td>
<td>perchloroethene, aka tetrachloroethene or tetrachloroethylene or perchloroethylene</td>
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<tr>
<td>PEST/PCB</td>
<td>pesticides/polychlorinated biphenyl</td>
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<tr>
<td>ppbv</td>
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<tr>
<td>SVOC</td>
<td>semi-volatile organic compound</td>
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**LIST OF ACRONYMS AND ABBREVIATIONS**  
*(Continued)*

<table>
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<tr>
<th>Acronym</th>
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<td>TAGM</td>
<td>Technical and Administrative Guidance Memorandums</td>
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<td>TAL</td>
<td>target analyte list</td>
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<td>1,1,1-TCA</td>
<td>1,1,1-trichloroethane</td>
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<td>TCE</td>
<td>trichloroethene, aka trichloroethylene</td>
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<td>3rd Rock</td>
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<td>TIC</td>
<td>tentatively identified compound</td>
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<td>Technical and Operational Guidance Series</td>
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<td>total petroleum hydrocarbons</td>
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<td>total suspended solids</td>
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<tr>
<td>µg/kg</td>
<td>micrograms per kilogram (parts per billion)</td>
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<td>µg/L</td>
<td>micrograms per liter (parts per billion)</td>
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<tr>
<td>µg/m³</td>
<td>micrograms per cubic meter</td>
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<td>USCG</td>
<td>United States Coast Guard</td>
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<td>USCS</td>
<td>Unified Soil Classification System</td>
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<td>URS Corporation - New York</td>
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<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
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<td>Watts Architecture and Engineering, Inc.</td>
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1.0 INTRODUCTION

This Site Characterization (SC) Phase VI Report has been prepared to summarize the field activities and analytical results associated with the sixth round of SC field activities performed at the Meeker Avenue Plume Trackdown Site (Site ID No. 224121) in the Greenpoint/East Williamsburg Industrial Area section of Brooklyn, New York. The work for the Phase VI investigation and a future Phase VII investigation was issued to URS Corporation - New York (URS) as Work Assignment (WA) No. C007540-5 in July 2011, and amended in November 2011 to WA C007540-5.1 due to a change in the drilling subcontractor, budget, and schedule. This report presents data and information gathered prior to and during the Phase VI field investigation, which was conducted from August 2, 2011 through October 28, 2011 and November 15, 2011 through January 13, 2012.

1.1 Site Background

The Meeker Avenue Plume Trackdown Site is located in the Greenpoint/East Williamsburg Industrial Area section of the Borough of Brooklyn, New York (Figure 1-1). Geographical, site use, and background information is provided in the following sections.

1.1.1 Site Location and Description

The Meeker Avenue Plume Trackdown Site investigation area (Figure 1-2) is located in a region of historic petroleum refining and storage operations that occupied a significant portion of the Greenpoint area. By 1870 over 50 refineries were located along the banks of Newtown Creek. Currently, bulk oil storage terminals exist north of the site, including the British Petroleum (BP) Terminal, and the ExxonMobil Brooklyn Terminal (ExxonMobil). The former Paragon Oil facility was located along the northeastern portion of the site along Newtown Creek, north of Bridgewater Street, between Meeker Avenue and Apollo Street. Peerless Importers, Incorporated (Inc.), is currently located on a portion of the former Paragon Oil facility along Newtown Creek.

In September 1978, the United States Coast Guard (USCG) noted the signs of an oil spill entering Newtown Creek from the northeastern end of Meeker Avenue. A subsequent investigation concluded that the area of the spill under the Greenpoint/East Williamsburg Industrial Area was in excess of 52 acres and the total spill volume, as estimated in 1979, was approximately 17 million
gallons of petroleum products (Roux, October 14, 2005). The current BP property was determined to be the source of the petroleum free product plume. Investigation and remediation activities were conducted by Roux Associates, Inc. (Roux) on behalf of ExxonMobil from 1990 to the present and have further defined the extent of the Off-Site Plume. The Off-Site Plume area consists of the area underlain by the petroleum-free product plume that is not on the BP Terminal or the Peerless Importers, Inc. properties. Currently, the extent of the Off-Site Plume area is less than what it was in 1990 due to the operation of the Off-Site Free Product Recovery System (Off-Site System). The Off-Site System has recovered over 6,000,000 gallons of free product since it became operational in 1995 (Roux, August 12, 2011).

The original Meeker Avenue Plume Trackdown site investigation area was bounded by the former ExxonMobil Brooklyn Refinery/current BP Terminal to the north (Norman Avenue/Bridgewater Street), Newtown Creek to the east, Lombardy Street to the south, and Kingsland Avenue to the west. During the first phase of fieldwork (May 7 through July 10, 2007), the southern boundary of the site investigation area along Lombardy Street between Porter and Morgan Avenues was extended three blocks south to Richardson Street. During the second phase of fieldwork (November 5 through December 27, 2007), the southern boundary of the site investigation area along Richardson Street between Vandervoort and Morgan Avenues was extended one block south to Frost Street. During the third phase of fieldwork (May 5 through July 24, 2008), the southern boundary was additionally extended one block south to Withers Street between Vandervoort and Morgan Avenues. In addition, the boundary in the northwestern corner of the site investigation area was extended west from Kingsland Avenue between Norman and Nassau Avenues to Monitor Street. A review of historical data during the fourth phase of fieldwork (November 3 through December 8, 2008) indicated that several additional potential sources of contamination may exist north of Norman Avenue, between Kingsland Avenue and Monitor Street. Therefore, the boundary in the northwestern corner of the site investigation area was extended approximately 1 block north of Norman Avenue, between Kingsland Avenue and Monitor Street.

The site boundary was once again expanded for the Phase VI field activities due to data obtained during the Groundwater Split Sampling Event which was performed in November 2009 (URS, February 2010). The data indicated the presence of a potential source of chlorinated solvents including tetrachloroethene (PCE) and trichloroethene (TCE) in groundwater originating to the west-
southwest of the investigation area. The southwest corner of the site investigation area was extended west to Kingsland Avenue and south to Frost Street.

Land use within the Meeker Avenue Plume Trackdown site investigation area is a mixture of residential and manufacturing, including both commercial and industrial facilities. The areas located north of Nassau Avenue, east of Van Dam Street, and south of Meeker Avenue are primarily used for manufacturing purposes. Residential areas are located in both the northwestern portion of the site (extending from Van Dam Street between Nassau and Meeker Avenues, to the western site boundary) and within the southern portion of the site (along Beadel Street from Morgan to Porter Avenues, along Vandervoort Avenue from Lombardy Street to Division Place, and along Kingsland Avenue from Meeker Avenue to Frost Street).

Based on the results of several investigations conducted in the area (see Section 1.1.2 for more details), chlorinated solvents such as PCE and TCE were found in soil vapor, soil, and groundwater in areas outside the historic petroleum spill. As these chemicals are not related to petroleum, the New York State Department of Environmental Conservation (NYSDEC) initiated this investigation in order to determine the source(s) of this contamination.

1.1.2 Previous Investigations

Impact Environmental Consulting, Inc. - March 1998

In March 1998, Impact Environmental Consulting, Inc. (Impact Environmental) conducted a Phase I Environmental Site Assessment (ESA) at 46-60 Anthony Street/95 Lombardy Street for ACME Architectural Products Inc., of Brooklyn, New York (ACME) (Impact Environmental, March 30, 1998a). A copy of the Phase I ESA may be found in PDF format on a compact disc which is included in Appendix A of the Phase IV Data Summary Report (URS, May 2009). The property historically had been utilized for iron working, metal shearing and finishing operations. At the time of the ESA, operations at the property included office space and operational space. The operational space was utilized for the machining, finishing, and storage of materials and products used in the manufacture of doors and knock down frames. The ESA identified a number of potential contamination sources that existed on the property due to current and/or past site activities. Numerous floor drains were identified throughout the building and their outfall locations were unknown. It was
suspected that some drains may have discharged directly to on-site soils. Several underground storage tanks (USTs) and aboveground storage tanks (ASTs) were identified and had been used for fuel oil storage and storage of degreasing products, respectively. It was noted that at the time of the ESA the facility was using a phosphate wash and rinse as a degreaser. During a personal interview, it was revealed that any regulated waste (i.e., waste paint, waste oil, waste degreaser and waste water precipitate) generated at the property was stored in the yard at 72 Anthony Street prior to disposal.

Impact Environmental Consulting, Inc. - March 1998

In March 1998, Impact Environmental conducted a Phase I ESA at 72 Anthony Street for ACME (Impact Environmental, March 30, 1998b). A copy of the Phase I ESA may be found in PDF format on a compact disc which is included in Appendix A of the Phase IV Data Summary Report (URS, May 2009). The property historically had been utilized as a brass foundry and civilian observation patrol. Operations on the property at the time of the ESA included office space and operational space. The operational space was utilized for the grinding, sanding and finishing of steel doors. The investigation identified a number of potential contamination sources that existed on the property due to current and/or past site activities. Numerous floor drains were identified throughout the building and their outfall locations were unknown. It is suspected that some drains may have discharged directly to on-site soils. One UST and one AST dip tank existed and were used for fuel oil storage and storage of degreasing products, respectively. It was noted that at the time of the ESA, the facility was using a phosphate wash and rinse as a degreaser. It was also noted that the floor of the room containing the AST dip tank was impacted by the release of degreasers from the dip tank. In addition, significant storage of portable chemical containers was observed in the building. A paint room was identified in the center of the building, as was an associated paint storage room. The floor of the paint room was significantly stained by painting operations. Floor drains were observed in the paint storage room. A chemical storage area existed outside and to the east of the building and a bermed, concrete storage pad was also observed. Numerous chemical containers were noted outside the building and consisted of 55-gallon drums and smaller containers of primers, cutting oils, hydraulic oils, waste water, xylene, waste paints, adhesives, waste degreasers, steam cleaners and waste oil contaminated absorbents. However, most of the drums were located outside the bermed, concrete storage pad and were uncovered or missing screw caps. Two dry wells were identified along
the south side of the building. In addition, during a personal interview it was revealed that the property previously maintained two dip tanks for degreasing. It was noted that a Phase I ESA was previously performed on the property in June 1995 by Conestoga-Rovers & Associates (CRA). The CRA Phase I revealed that 1,1,1-trichloroethane (1,1,1-TCA) was formerly utilized in the dip tanks and that a floor drain was observed under one of the dip tanks.

**Impact Environmental Consulting, Inc. - June 1998**

In June 1998, Impact Environmental conducted a Phase II ESA at 46-60 Anthony Street/ 95 Lombardy Street for ACME. A copy of the Phase II ESA may be found in PDF format on a compact disc which is included in Appendix A of the Phase IV Data Summary Report (URS, May 2009). The scope of the Phase II ESA was based on the recommendations of the Phase I ESA and included a remote survey [i.e., ground penetrating radar (GPR)] of a floor drain located in the northeast portion of the building and the collection of a sample from 0-2 feet below ground surface (bgs) below the floor drain. The remote survey conducted confirmed that the floor drain directly discharged to the subsurface soils. A soil sample collected from the 0-2 foot interval below the floor drain contained the VOCs, PCE and TCE, at 1,190 and 99.2 μg/kg respectively. In addition, the semi-volatile organic compounds (SVOCs) di-n-butylphthalate, pyrene and bis (2-Ethylhexyl) phthalate were detected at 4,460, 539 and 1,690 μg/kg respectively. Metals which included arsenic (4.93 μg/kg), barium (114 μg/kg), cadmium (6.53 μg/kg), chromium (123 μg/kg), lead (906 μg/kg) and mercury (0.045 μg/kg) were also detected. Cadmium, chromium and lead exceeded their respective criteria found in the Technical and Administrative Guidance Memorandum (TAGM) #4046, *Determination of Soil Cleanup Objectives and Cleanup Levels* (NYSDEC, January 24, 1994). The Phase II ESA concluded that on-site operations had impacted the environmental quality beneath the property and recommended that corrective actions were required to mitigate the contaminated soil associated with the floor drain.

**Environmental Planning and Management, Inc. – September 2005**

In September 2005, Environmental Planning and Management, Inc., (EPM) completed an investigation for the New York State Department of Transportation (NYSDOT) in connection with the Kosciuszko Bridge Project (EPM, January 2006). The investigation included the collection and analysis of soil and groundwater samples. PCE was detected at 7,760 micro grams per kilogram.
In the 0-4 feet bgs sample from boring SB-29 (southeastern corner at the intersection of Gardner Avenue and Thomas Street), PCE was also detected at 89.9, 569, and 1,060 micrograms per liter (μg/L) in ExxonMobil groundwater monitoring wells MW-018 (eastern side of Vandervoort Avenue between Anthony and Cherry Streets), MW-023 (southwestern corner at the intersection of Gardner Avenue and Thomas Street), and MW-030 (eastern side of Varick Avenue between Anthony and Cherry Streets), respectively.

**Roux Associates – September 2005**

In September 2005, Roux Associates, on behalf of ExxonMobil, sampled soil vapor at 23 temporary locations in and around the perimeter of the Off-Site Plume area (Roux, October 14, 2005). The soil vapor samples collected in September 2005 indicated the presence of PCE at 10,200 micrograms per cubic meter (µg/m$^3$) at the monitoring point located on the southwestern corner of the Vandervoort Avenue and Anthony Street intersection, and 7,050 µg/m$^3$ at the monitoring point on the western side of Morgan Avenue between Nassau and Norman Avenues. Much lower concentrations of PCE were detected throughout the remainder of and around the perimeter of the Off-Site Plume area. In addition, TCE was detected at 4,500 µg/m$^3$ at the monitoring point located on the western side of Apollo Street between Nassau Avenue and Meeker Avenue, and 151,000 µg/m$^3$ at the monitoring point on the western side of Morgan Avenue between Nassau Avenue and Norman Avenue. Much lower concentrations of TCE were detected throughout the remainder of and around the perimeter of the Off-Site Plume area. It was determined that the chlorinated solvents detected (i.e., PCE and TCE) were from a different source than the petroleum-free product plume.

**Roux Associates – September 2006**

Between June and September 2006, Roux Associates performed an additional soil vapor investigation in and around the perimeter of the Off-Site Plume area (Roux, November 10, 2006). A total of 50 permanent soil vapor monitoring points were installed. This included 20 nested monitoring points (one shallow and one deep) in the commercial/industrial area and 10 deep monitoring points in the residential area. Elevated concentrations of PCE were detected at 1,300 µg/m$^3$ at the monitoring point located at the northwestern corner of the intersection of Morgan and Nassau Avenues, and 930 µg/m$^3$ at the monitoring point on the western side of Van Dam Street between Nassau and Meeker Ave.
Avenues. Elevated concentrations of TCE were detected at 8,200 µg/m³ at the monitoring point on the eastern side of Apollo Street between Bridgewater Street and Nassau Avenue, and 700 µg/m³ at the monitoring point on the northwestern corner of the intersection of Morgan and Nassau Avenues.

1.2 **Findings of Previous Phases of Site Investigation Fieldwork**

Prior to the SC Phase VI fieldwork, URS has conducted five phases of site investigation fieldwork and two limited groundwater sampling events at the Meeker Avenue Plume Trackdown site. Plate 1 shows all monitoring well locations installed and sampled by URS, direct-push groundwater sample boring locations, direct push soil sample boring locations, membrane interface probe (MIP) boring locations, and ExxonMobil monitoring wells sampled by URS. Plate 2 shows all soil vapor implant locations installed and sampled by URS and ExxonMobil soil vapor implant locations sampled by URS. The following sections discuss the findings from the Phase I, Phase II, Phase III, Phase IV and Phase V site investigations, along with the results of groundwater split samples from seven wells for compound-specific stable isotope analysis (CSIA) of cis-1,2-dichloroethene (cis-1,2-DCE), PCE and TCE, and a limited groundwater sampling event conducted in 2009. The reports in their entirety are included on a separate CD accompanying this report.

1.2.1 **Summary of Phase I Findings**

The Phase I field investigation was conducted from May 7 through July 10, 2007. The field activities of Phase I were primarily focused on locations that were identified as potential historic users of PCE and/or TCE during the historical information review. A complete description of the field investigation and results may be found in the Phase I Data Summary Report (URS, October 2007).

Based upon the results of the Phase I field investigation, the following conclusions were made:

- Soil-gas samples from both north and south of Meeker Avenue indicated that PCE and TCE have impacted soil-gas quality, as shown on Figures 1-3 and 1-4. Elevated soil-gas concentrations appear to be associated near locations that potentially have used PCE and TCE (i.e., a former metal working facility, a research lab, two former dry cleaners, and a dye works).
A soil sample from the 5-6 feet bgs interval from monitoring well location DEC-016 that is located adjacent to a former brass foundry was the only sample that exceeded TAGM 4046 criteria, with 220 milligrams per kilogram (mg/kg) of PCE.

Groundwater samples from both north and south of Meeker Avenue indicated that groundwater has been impacted above Class GA groundwater standards for both PCE and TCE, as shown on Figures 1-5 and 1-6. Elevated groundwater concentrations appear to be associated near locations that potentially have used PCE and TCE (i.e., two former dry cleaners, a former dry cleaners/dye works, a drum recycling facility, a research lab, a former brass foundry, two metal working facilities, and a former soap manufacturer).

1.2.2 Summary of Phase II Findings

The Phase II field investigation was conducted from November 5 through December 27, 2007. The field activities of Phase II were primarily focused on investigating and delineating the extent of impacted soil-gas, soils and/or groundwater at locations where elevated concentrations of PCE and/or TCE were encountered during the Phase I field investigation. A complete description of the field investigation and results may be found in the Phase II Data Summary Report (URS, April 2008).

Based upon the results of the Phase II field investigation, the following conclusions were made:

- There appear to be areas of elevated soil-gas concentrations within the site boundary, as shown on Figures 1-7 and 1-8. The horizontal extent of impacted soil-gas was not fully determined at three of the five areas. The impacted soil-gas plumes in the area south of Meeker Avenue appear to have coalesced.

- Analytical results from soil samples indicated that a shallow source of impacted soil exists in the vicinity of the northeastern corner of the building located at 72 Anthony Street. Soil samples from boring SB-08 confirmed the presence of PCE in shallow soils at a concentration that exceeded TAGM 4046 criteria. Soil boring SB-08 is located within 20 feet of monitoring
well DEC-016. The results of the sample from SB-08 confirm the results of soil samples taken from DEC-016 during the Phase I field investigation.

- There appear to be potential source areas within the site boundary where dissolved phase chlorinated solvents have adversely impacted the shallow groundwater, as shown on Figures 1-9 and 1-10. The horizontal extent of impacted shallow groundwater was not fully determined at four of the five potential source areas. The potential impact of dissolved phase chlorinated solvents to deeper groundwater was not investigated at the five potential sources during Phase II fieldwork.

1.2.3 **Summary of Phase III Findings**

The Phase III field investigation was conducted from May 5 through July 24, 2008. The purpose of the Phase III fieldwork was to fill any data gaps identified in the Phase II Final Data Summary Report concerning the horizontal extent of impacted soil-gas at three of the five areas identified; determine if impacted soils existed at one potential source area; the horizontal extent of impacted shallow groundwater at four of the five potential sources; and to assess the vertical extent of impacted groundwater at each of the five potential sources. In addition, the NYSDEC directed URS to assess and delineate any chlorinated solvent impacts to soil and groundwater in the vicinity of the EPM soil boring located at the southeastern intersection of Gardner Avenue and Thomas Street (see Section 1.1.2). A complete description of the field investigation and results may be found in the Phase III Data Summary Report (URS, October 2008).

Based upon the results of the three phases of the field investigation, the following conclusions were made:

- The five areas of elevated soil-gas concentrations identified within the site boundary during Phase II field investigation were further delineated during Phase III, as shown on Figures 1-11 and 1-12. The horizontal extent of impacted soil-gas was not fully delineated at two of the five areas.
Soil borings performed in the vicinity of the EPM soil boring located at the southeastern intersection of Gardner Avenue and Thomas Street did not indicate the presence of chlorinated solvent impacted soils in this area.

A Dense Non-Aqueous Phase Liquid (DNAPL) containing 700,000 mg/kg (i.e., 70%) PCE was identified in monitoring well DEC-024D.

The results of groundwater samples collected during Phase III has allowed URS and the NYSDEC to identify four sources of dissolved phase chlorinated solvents in the shallow groundwater, as shown on Figures 1-13 and 1-14. In addition, there are potentially two other sources, but insufficient information was gathered to positively identify these locations as sources without additional investigation. The horizontal extent of impacted shallow groundwater was not fully determined at the two potential source areas. The potential impact of dissolved phase chlorinated solvents to deeper groundwater was investigated at all four source areas and two potential source areas. Data indicates that deeper groundwater was impacted at all four source areas and both potential source areas. The vertical extent of impacted groundwater was not fully determined at the four source areas and the two potential source areas.

1.2.3.1 Phase III Source Characterization

Using data obtained during the three Phases of the investigation [i.e., historical information (e.g., Sanborn maps, EDR reports, and business directories) soil-gas data, soil data, and groundwater data], four sources and two potential sources of PCE and/or TCE contamination were identified within the study area. The description and location of the four sources and two potential sources are discussed below.

1.2.3.1.1 Sources

- The former Spic and Span Cleaners and Dyers, Inc. [aka Eastern District Dye Works (1916 Sanborn) and Norman Cleaners and Dyers Inc. (1942 Sanborn)], located at 315 Kingsland Avenue (Brooklyn Tax District, Block 02657, Lot 0009) was identified as a source of
groundwater contamination. Based on Sanborn map data, this facility was located at the above address from the early 1900s until the mid-1960s. DNAPL containing 70% PCE was identified in monitoring well DEC-024D. DEC-024D is located on Kingsland Avenue adjacent to the southeastern corner of the former facility.

- The former and current metal works located at 95 Lombardy (Brooklyn Tax District, Block 02819, Lot 0008) was identified as a source of groundwater contamination. Based on Sanborn map data, the facility has been utilized from the 1930s to the present as a metal fabricator and painting facility. ACME is listed in the EDR report as a generator of F001 waste (spent halogenated solvents used in degreasing) for this facility. Monitoring wells DEC-005 and DEC-005D are located on the western side of the building on Vandervoort Avenue. Groundwater samples from these wells indicate significant TCE contamination and the potential presence of DNAPL given the increasing TCE concentrations with depth.

- A former brass foundry located at 72 Anthony Street (Brooklyn Tax District, Block 02820, Lot 0005) was identified as a source of soil and groundwater contamination. Based on Sanborn map data, the facility was utilized as a brass foundry from the mid 1960s to approximately 1993. ACME is listed in the EDR report as a generator of F001 waste (spent halogenated solvents used in degreasing) for this facility. Soil samples from DEC-016 and SB-08, located at the northeastern corner of the facility along Anthony Street, indicate shallow PCE contaminated soils are located adjacent to this facility. Monitoring wells DEC-016 and DEC-016D are located on the Anthony Street (north) side of the facility. Groundwater samples from these wells indicate significant PCE and TCE contamination.

- The former Klink Cosmo Cleaners, located at 364 Richardson Street (Tax District of Brooklyn, Block 02860, Lot 0001) was identified as a source of groundwater contamination. The facility is shown on Sanborn Maps to be a clothing warehouse from the mid 1950s until sometime after 1995. Klink Cosmo Cleaners is listed in the EDR report as a generator of F002 waste (spent halogenated solvents) for this facility. Monitoring wells DEC-031 and DEC-031D are located on the southwestern corner of Vandervoort Avenue and Richardson Street (northeast building corner). Soil-gas and groundwater samples indicate significant PCE and TCE contamination at the northeastern corner of the building.
1.2.3.1.2 Potential Sources

- The facility that contained a former soap manufacturer and lacquer storage, located at 171 Lombardy Street (Brooklyn Tax District, Block 02821, Lot 0001), is a potential source of groundwater contamination. Based on Sanborn map data, the facility was utilized during the 1930s for lacquer storage and as a manufacturer of powdered soap from the early 1950s to 1989. Monitoring wells DEC-018 and DEC-018D are located on the Varick Avenue or western side of the building, near Lombardy Street. Groundwater samples from these wells indicate significant PCE and TCE contamination. The PCE and TCE contamination in the shallow groundwater zone is centered on DEC-018, suggesting the contamination is near its source.

- The former Curtis Electro N.Y., Inc. facility located at 126 Cherry Street (Brooklyn Tax District, Block 02814, Lot 0010), is a potential source of groundwater contamination. Based on Sanborn map data, the facility was utilized as a light fixture manufacturer from the mid 1960s until sometime after 1995. Monitoring wells DEC-049 and DEC-049D are located adjacent to the facility on the corner of Stewart Avenue and Cherry Street. Groundwater samples from these wells indicate significant PCE and TCE contamination that increase with depth.

1.2.4 Summary of Phase IV Findings

The Phase IV field investigation was conducted from November 3 through December 8, 2008. The purpose of the Phase IV fieldwork was to assist in determining: the horizontal extent of the dissolved phase plume originating from near DEC-018/018D; if the impacted groundwater found at well pair DEC-049/049D is associated with the dissolved phase plume originating from near DEC-018/018D; the impact of dissolved phase chlorinated solvents to deeper groundwater; and the horizontal extent of impacted deep groundwater. The investigation area for Phase IV was limited to the area south of Meeker Avenue, in the area located east of, but not including DEC-016/016D and DEC-040 (i.e., between Porter and Varick Avenues) to the eastern boundary of the site investigation area (i.e., Newtown Creek). In addition, the NYSDEC directed URS to obtain and review additional Sanborn maps for the area bound by Meserole Avenue to the north, Sutton Avenue to the east, Nassau
Avenue to the south and Humboldt Street to the west. The purpose of the review of the additional Sanborn maps was to confirm the report of a dry cleaner north of Norman Avenue and west of Kingsland Avenue. A complete description of the field investigation and results may be found in the Phase IV Data Summary Report (URS, May 2009).

Based upon the results of the four phases of the field investigation, the following conclusions were made:

- Data collected at four Membrane Interface Probe (MIP) boring locations indicated that dissolved phase chlorinated solvents have impacted shallow and deep groundwater moving beneath the City of New York Department of Sanitation (DSNY) property located at the southeastern corner of the intersection of Varick Avenue and Cherry Street. Based on this data, it has been determined that the concentrations of PCE and TCE detected in DEC-049 and DEC-049D during Phase III groundwater sampling are more likely related to the impacted groundwater originating from near DEC-018/DEC-018D. No separate source of PCE and/or TCE exists near DEC-049 and DEC-049D as had been previously hypothesized.

- The soil data collected during Phase IV fieldwork is similar to that found during previous phases of fieldwork (i.e., Phase I, II and III) in the area south of Meeker Avenue.

- The results of the groundwater sample collected during Phase IV has allowed URS and the NYSDEC to identify the area in the immediate vicinity of DEC-018 as a potential source of PCE and TCE in the shallow groundwater (Figures 1-15 and 1-17). The horizontal extent of PCE and TCE in the shallow groundwater has been delineated to the west, north, and east. PCE and TCE concentrations decrease by up to four orders of magnitude in wells downgradient and side gradient from DEC-018. PCE and TCE degradation products have typically been found at the highest concentrations in shallow groundwater wells located closest to the Off-Site Plume area boundary. This is most likely caused by the degradation of the non-chlorinated hydrocarbons associated with the Off-Site Plume, which has produced an oxygen-deficient environment. The southern/southeastern extent of PCE and TCE in the shallow groundwater has not been delineated.
It has been found that deep groundwater, centered on MW-097/MW-097D, has been significantly impacted by both PCE and TCE (Figures 1-16 and 1-18). Concentrations decrease by one to two orders of magnitude moving to the east and south away from the well. The horizontal extent of PCE and TCE in deep groundwater has not fully been determined. Data gaps exist to the north and west of MW-097/MW-097D. The horizontal extent of the PCE impacted deep groundwater occupies a larger footprint than the horizontal extent of PCE in the shallow groundwater. This suggests that multiple shallow sources are contributing to the PCE and TCE, which have been found in the deep groundwater zone. The full vertical extent of impacted groundwater has not been determined.

The former Curtis Electro N.Y., Inc. facility, which was located at 126-140 Cherry Street (Tax District of Brooklyn, Block 02814, Lot 0010), is no longer considered a potential source of groundwater contamination. Based upon data obtained during the Phase IV investigation, it has been determined the concentrations of PCE and TCE that were detected previously in DEC-049 and DEC-049D, which are adjacent to the former Curtis Electro N.Y., Inc. facility, are likely related to the impacted groundwater originating from near DEC-018/DEC-018D (i.e., further upgradient). No separate source of PCE and/or TCE exists near DEC-049 and DEC-049D as had been previously hypothesized.

1.2.4.1 **Phase IV Source Characterization**

Using data obtained during the four Phases of the investigation performed by URS, it has been determined that there are four sources and seven potential sources of PCE and TCE contamination within the study area. Additional information gathered from the FOIL requests, a review of certificates of occupancy, and a review of additional reports has been incorporated in the descriptions of each source and potential source.

1.2.4.1.1 **Sources**

No additional sources were identified based on the Phase IV fieldwork. However, the four source areas identified during Phase III were listed as NYSDEC Class 2 Inactive Hazardous Waste
Disposal Sites in January 2009. The source areas and their NYSDEC Site ID Numbers are listed below.

- An identified source of groundwater contamination is the building housing the former Spic and Span Cleaners and Dyers, Inc. [a.k.a. Eastern District Dye Works (1916 Sanborn) and Norman Cleaners and Dyers Inc. (1942 Sanborn)], located at 260 Norman Avenue/315-325 Kingsland Avenue (Tax District of Brooklyn, Block 02657, Lot 0009) and 307-313 Kingsland Avenue (Tax District of Brooklyn, Block 02657, Lot 0015). The site is listed as the Former Spic and Span Cleaners and Dyers, Inc. (Spic and Span Site), NYSDEC Site Number 224129.

- A source of groundwater contamination is the former Klink Cosmo Cleaners (Klink Cosmo Site), which was located at 364 Richardson Street (Tax District of Brooklyn, Block 02860, Lot 0001). The site is listed as the Former Klink Cosmo Cleaners (Klink Cosmo Site), NYSDEC Site Number 224130.

- A source of groundwater contamination is a former and current metal works, operated by ACME Architectural Products, Inc., located at 95 Lombardy Street (Tax District of Brooklyn, Block 02819, Lot 0008) and 46-60 Anthony Street (Tax District of Brooklyn, Block 02819, Lot 0011). The site is listed as the ACME Steel/Metal Works Site, NYSDEC Site Number 224131.

- A source of soil and groundwater contamination is a former brass foundry and a stainless steel door finishing facility operated by ACME Architectural Products, Inc., located at 72 Anthony Street (Tax District of Brooklyn, Block 02820, Lot 0005) and 90 Anthony Street (Tax District of Brooklyn, Block 02820, Lot 0001). The site is listed as the ACME Steel/Brass Foundry Site, NYSDEC Site Number 224132.

1.2.4.1.2 Potential Sources

A total of seven new additional potential source areas were identified within the study area. Additional information needs to be gathered to determine if any of these areas are responsible for, or
are contributing to, the presence of PCE and/or TCE in the environment. A brief description of each potential source is given below.

- The facility that was and is currently occupied by a laundry, a dyer, and dry cleaners, located at 355 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0078), 337-353 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0079), 262-268 Monitor Street (Brooklyn Tax District, Block 02608, Lot 0082), and 252 Monitor Street (Brooklyn Tax District, Block 02608, Lot 0099) may be a potential source of PCE and/or TCE. The facility was utilized as a laundry, dyers and dry cleaners from approximately 1965 to present based on Sanborn Map data.

- The facility that was occupied by a laundry located at 242 Monitor Street/253A-257 Norman Avenue (Brooklyn Tax District, Block 02608, Lot 0095) may be a potential source of PCE and/or TCE. The facility was utilized as a laundry from approximately 1933 to 1951 based on Sanborn Map data and a review of certificates of occupancy.

- The facility that was occupied by the former Rose & Co. Dye Works, located at 355 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0078), 347-353 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0079), 341 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0084), and 337-339 Kingsland Avenue (Brooklyn Tax District, Block 02608, Lot 0084) may be a potential source of PCE and/or TCE. The facility was utilized as a laundry and dry cleaners from approximately 1944 to 1986 based on Sanborn Map data and a review of certificates of occupancy. The Sanborn maps identified six underground tanks, listed for use as benzene tanks from 1942-1965 and then as solvent tanks from 1965-present, on Block 02608 Lots 0084 and 0085.

- The facility that is occupied by a current metal works, located at 96-102 Anthony Street/157-163 Lombardy Street (Brooklyn Tax District, Block 02820, Lot 0028) may be a potential source or a contributing source to the presence of PCE and/or TCE in the environment. The facility started metal working in 1977 based on a review of certificates of occupancy.

- The facility that is occupied by a current metal works, located at 104-110 Anthony Street/169 Lombardy Street/503-519 Varick Avenue (Brooklyn Tax District, Block 02820, Lot 0021)
may be a potential source or a contributing source to the presence of PCE and/or TCE in the environment. The facility adjoins 157 Lombardy Street to the east.

- The facility that was occupied by a former soap manufacturer and lacquer storage, located at 171-179 Lombardy Street/496-508 Varick Avenue (Brooklyn Tax District, Block 02821, Lot 0001) appears to be a potential source of groundwater contamination. Based on Sanborn Map data, the facility was utilized during the 1930s for lacquer storage, and as a manufacturer of powdered soap from the early 1950s to 1989. Monitoring wells DEC-018 and DEC-018D are located on the Varick Avenue or west side of the building, near Lombardy Street. Groundwater samples from these wells indicate significant PCE and TCE contamination in shallow groundwater.

- The facility that was occupied by a former metal works, located at 122-132 Anthony Street/181-193 Lombardy Street (Brooklyn Tax District, Block 02821, Lot 0011) may be a potential source or a contributing source to the presence of PCE and/or TCE in the environment. The facility started metal working in 1953 based on a review of certificates of occupancy.

1.2.5 **Summary of Phase V Findings**

The Phase V field investigation was conducted from June 15 through July 13, 2009. The investigation area for Phase V was limited to the area located north of Nassau Avenue and south of Meserole Avenue between Sutton Street to the east and Monitor Street to the west. The purpose of the Phase V fieldwork was to assist in determining: 1) the horizontal extent of the dissolved phase plume originating from near the Spic and Span Site (DEC-024/024D); 2) if there were additional potential sources of PCE and TCE impacting shallow groundwater to the north of the Spic and Span Site; 3) the horizontal extent of impacted deep groundwater, if present; 4) if the clayey silt unit that was encountered in well DEC-024D is present at other well locations in the area; 5) the depth and areal extent of the clayey silt unit, if encountered; and 5) if DNAPL is present at the top of the clayey silt unit at locations other than DEC-024D. Using data obtained during the five Phases of the investigation performed by URS, it has been determined that there are four sources and seven potential sources of PCE and TCE contamination within the overall study area. A complete description of the
field investigation and results may be found in the Phase V Data Summary Report (URS, October 2009).

Based upon the results obtained during Phases I, II, III, and V, the following conclusions were provided in the Phase V Report.

- In the area north of Meeker Avenue, soil has been impacted by chlorinated solvents and petroleum related compounds. DNAPL containing 73% PCE was identified in monitoring well DEC-024D at a depth similar to the depth of the soil sample from DEC-024DR. Because the soil sample was collected below the water table in a zone with decreasing permeability, the impacted soil in the vicinity of DEC-024DR may be the result of lateral spreading of DNAPL. The horizontal extent of PCE impacted soil was not determined since PCE was found in only one location at significant concentrations. LNAPL was found in DEC-034 and DEC-054. Petroleum related compounds had impacted soil at DEC-034, DEC-053, and DEC-054.

- Figures 1-19 and 1-21 present PCE and TCE concentrations for shallow overburden groundwater; Figures 1-20 and 1-22 present PCE and TCE isoconcentration contours for deep overburden groundwater. Groundwater north of Meeker Avenue has been impacted by dissolved phase chlorinated solvents. The area in the immediate vicinity of DEC-024/DEC-024D/DEC-024DR was identified as a source of PCE and TCE in shallow groundwater based on the presence of DNAPL in DEC-024DR.

1.2.5.1 Sources

No additional sources were identified based on the Phase V fieldwork.

1.2.5.2 Potential Sources

No additional potential sources were identified based on the Phase V fieldwork.
1.2.6 Groundwater Split Sampling and Compound-Specific Stable Isotope Analysis

In September, 2009, URS obtained split samples from eight groundwater monitoring wells (DEC-004, DEC-005, DEC-008, DEC-016, DEC-017, DEC-018, DEC-022, MW-18) being sampled by J.C. Broderick & Associates, Inc. (JCB) personnel on behalf of ACME. These monitoring wells were from the vicinity of the identified ACME Steel source areas. Groundwater samples were analyzed for compound-specific isotope analysis (CSIA) of cis-1,2-dichloroethene (cis-1,2-DCE), PCE and TCE. A complete description of the field investigation and results may be found in the Groundwater Split Sampling Letter Report (URS, February 2010).

Based upon the results obtained during the groundwater split sampling event, the following conclusions were provided in the Groundwater Split Sampling Letter Report.

- DEC-016 and DEC-017 seem to be affected by the same source.
- While DEC-018 is strongly affected by the same source that impacts DEC-016 and DEC-017, it is likely that it is also affected by a second source of a particularly light TCE.
- DEC-004 and DEC-005 are affected by separate sources.
- DEC-022 seems to be affected by the same source which has impacted DEC-016 and DEC-017.
- DEC-008 appears to be affected by a separate source and not that affected by the sources impacting any other wells.

1.2.6.1 Sources

No additional sources were identified based on the CSIA sampling results.
1.2.6.2 **Potential Sources**

CSIA sampling results have indicated the presence of a potential unidentified source of TCE located to the southwest of DEC-004 based on the presence of a heavier carbon isotope found in the TCE in DEC-004 compared to that in DEC-005. The shallow groundwater flow has been shown to be to the east from DEC-004 towards DEC-005. Additionally, shallow monitoring wells were recommended to be installed to the southwest of DEC-004 to determine if there is an upgradient source of the TCE that has been detected in DEC-004.

1.2.7 **2009 Groundwater Sampling Event**

From November 3 through November 9, 2009, URS personnel collected groundwater samples from the 20 monitoring wells located south of the Brooklyn Queens Expressway (BQE) in the vicinity of the Former Klink Cosmo Cleaners. A complete description of the field investigation and results may be found in the November 2009 Groundwater Sampling Event Letter Report (URS, January 2010).

Based upon the results obtained during the groundwater sampling event the following conclusions were provided in the November 2009 Groundwater Sampling Letter Report.

- PCE was detected in 19 of the 20 groundwater samples collected, with 17 locations at concentrations exceeding groundwater criteria. Figure 1-23 depicts isoconcentration contours for PCE in the shallow groundwater and includes the locations of the sources and potential sources in the Former Klink Cosmo Cleaners area.

- TCE was detected in 16 of the 20 groundwater samples collected, with 10 locations at concentrations exceeding groundwater criteria. Figure 1-24 depicts isoconcentration contours for TCE in the shallow groundwater and includes the locations of sources and potential sources.
1.2.8 **Spic and Span Remedial Investigation Results**

URS prepared a Phase I Remedial Investigation Report for the former Spic and Span Cleaners site in July, 2011 (URS, July 2011) based on field investigations conducted between January and March 2011. The following is a summary of analytical results.

1.2.8.1 **Soil Gas**

- PCE was detected at concentrations ranging from non-detect to a high of 8,200,000 µg/m³ at location SG-071, which may be attributed to an apparent source area in the vicinity of location DEC-025D, and in soil samples from borings SSB-01 to SSB-10.

1.2.8.2 **Soil**

- Soil sample results were compared to unrestricted use and protection of groundwater criteria. Locations which exceeded criteria for unrestricted use also exceeded protection of groundwater criteria. PCE exceeded unrestricted and protection of groundwater criteria in previously installed borings at DEC-024DR and DEC-025D.

- DNAPL containing 73% PCE was gauged in the well adjacent to DEC-024DR (DEC-024D) at approximately 52.5-54 feet bgs. The PCE found in the soil at DEC-024DR may be the results of lateral spreading of the DNAPL due to the decrease in soil permeability at that depth.

- The PCE detection in DEC-025D appears to be a separate PCE source, as observations of PCE were at a depth immediately below the concrete sidewalk, rather than from operations at the Spic and Span site. Borings SSB-01 through SSB-10 were installed during the RI in the vicinity of DEC-025D. PCE exceeded criteria in the majority of these borings to the south of DEC-025D.

- Soil samples previously collected from DEC-034, DEC-053 and DEC-054 located north and northeast of the Spic and Span property exceeded criteria for petroleum-related compounds (acetone, benzene, isopropylbenzene and xylenes).
1.2.8.3 Non-Aqueous Phase Liquids

- During the Phase I RI in 2011, the thickness of LNAPL was observed from 0.0 to 3.99 feet in DEC-034; from 0.01 to 1.2 feet in DEC-054; and from 0.58 to 0.84 feet in DEC-053.

- During the Phase I RI in 2011, DNAPL was detected, but not in measureable quantities, in both DEC-024D and DEC-024DR.

1.2.8.4 Groundwater

- Based upon the observed concentrations of VOCs, the dissolved chlorinated solvent plume appears to originate at the Spic and Span Site, and an additional unknown apparent source is present adjacent to 300 Kingsland Avenue (building adjacent to DEC-025 and DEC-025D).

- In shallow overburden groundwater, Figure 1-25, it appears that the chlorinated solvent plume has higher concentrations of PCE immediately north and east of the Spic and Span Site, and is more discrete compared to deeper groundwater.

- In deep overburden groundwater, Figure 1-26, the complete horizontal and vertical extent of the chlorinated solvents has not been delineated.

- The dissolved chlorinated solvent plume in deep overburden groundwater appears to be impacted by both sources of PCE contamination and is spreading with groundwater flow towards the northeast, east and with a southerly component, and also via downward migration to deeper geologic zones.

1.2.8.5 Sources

No additional sources were identified during the Phase I RI field investigation.
1.2.8.6 Potential Sources

A potential source of shallow PCE soil contamination was identified in the vicinity of DEC-025 and DEC-025D. Additional information needs to be gathered to determine the horizontal and vertical extent of the shallow PCE contaminated soil identified in the vicinity of DEC-025 and DEC-025D. A brief description of the potential source is given below.

- The facility that contained a former warehouse, located at 300 Kingsland Avenue (Brooklyn Tax District, Block 02821, Lot 0001) is a potential source of soil and groundwater contamination. Based on Sanborn map data, the facility had been utilized from 1905 to at least 1942 for sorting and storage, as a wholesale grocery warehouse from 1965 to 1987 and as a warehouse from 1988 to present. A shallow source of soil contamination (i.e., PCE) was found while clearing the boring locations for DEC-025D for utilities. PCE was detected in the soil at DEC-025D in the 0 to 1.5 foot and 1.5 to 2.0 foot bgs interval at 140 and 1,300 mg/kg, respectively.

1.2.9 Klink Cosmo Remedial Investigation Results

URS prepared a Phase I Remedial Investigation Report for the former Klink Cosmo Cleaners site in December, 2011 (URS, December 2011) based on field investigations conducted between May and July 2011. The following is a summary of analytical results.

1.2.9.1 Soil Gas

- PCE was detected in all 30 sampling locations, at concentrations ranging from 35 µg/m³ to a maximum of 48,200,000 µg/m³ at location SG-060. PCE concentrations of 13,100,000; 282,000; and 176,000 µg/m³ were detected at locations SG-049, SG-084, and SG-058 respectively.

- Concentrations of TCE were generally detected at lower concentrations at locations where PCE was detected. The two locations with the highest PCE concentrations also have the highest TCE concentrations. Location SG-060 had TCE a concentration of 220,000 µg/m³ and location SG-049 had a TCE concentration of 230,000 µg/m³.
The areal extent of PCE and TCE impacted soil gas appears to be larger than that found during previous investigations. The concentrations tended to be higher than those detected in previously sampled locations by up to three orders of magnitude.

1.2.9.2 Soil

- Soil sample results were compared to unrestricted use, residential, restricted residential and protection of groundwater criteria. PCE and its daughter compound TCE were not found to exceed any soil criteria at any locations. Only the soil sample collected from DEC-030D exceeded criteria for any organic compounds. Di-n-butylphthalate and the pesticide Dieldrin exceeded unrestricted use criteria at this location (at 3.5-4.5 feet bgs).

1.2.9.3 Groundwater

- Figure 1-27 depicts isoconcentration contours for PCE in the shallow overburden groundwater. Figure 1-28 depicts isoconcentration contours for PCE in the deep overburden groundwater. Based upon the observed concentrations of VOCs from the latest groundwater sampling event, the dissolved chlorinated solvent plume appears to originate at the Klink Cosmo Site.

- It appears that the chlorinated solvent plumes in the shallow and deep overburden have higher concentrations of PCE immediately north and east of the Klink Cosmo site.

- PCE contamination appears to be spreading with groundwater flow towards the northeast and east, and also at a lesser extent via downward migration to deeper geologic zones. The plumes will be further defined following in the next phase of the RI.

1.2.9.4 Non-Aqueous Phase Liquids

- LNAPL found in DEC-048 was analyzed and a fuel oil was found at a concentration of 950,000 mg/kg (95%). NYSDEC Spill No. 1103190 was assigned on June 21, 2011 to the LNAPL found in this area. The specific gravity measured (0.8608), and organic compounds detected in the sample were consistent with fuel oil(s).
A comparison of the DEC-048 sample chromatogram to a general diesel/Fuel Oil No. 2 chromatogram indicates a similarity, although degradation of the product found in DEC-048 is evident.

1.2.9.5 Sources

No additional sources were identified during the Phase I RI field investigation.

1.2.9.6 Potential Sources

No additional potential sources were identified during the Phase I RI field investigation.

1.3 Site Characterization Phase VI Project Objectives and Scope

URS has divided the Meeker Plume Trackdown site into 5 areas, as per the Departments instruction, to allow for a focused effort of the SC field activities and data analysis as related to impacts from known and potential sources. Some of the area boundaries overlap due to the close proximity of the locations and the potential comingling of impacted groundwater and soil vapor plumes. Figure 1-29 presents a summary of the identified sources and potential sources within the project boundary. The boundaries of the five areas are as follows:

1. The area associated with the Spic and Span Site, NYSDEC Site Number 224129. This area consists of the area bound by Meserole Avenue to the north, Sutton Avenue to the east, Nassau Avenue to the south and Monitor Street to the west.

2. The area associated with the Klink Cosmo Site, NYSDEC Site Number 224130. This area consists of the area bound by Lombardy Street to the north, Porter Avenue to the east, Withers Street to the south and Morgan Avenue to the west.

3. The area associated with the ACME Steel/Metal Works Site, NYSDEC Site Number 224131. This area consists of the area bound by Cherry Street to the north, Porter Avenue to the east, Beadel Street to the south and Vandervoort Avenue to the west.

4. The area associated with the ACME Steel/Brass Foundry Site, NYSDEC Site Number 224132. This area consists of the area bound by Cherry Street and Meeker Avenue to the north, Beadel Street to the south and Monitor Street to the west.
Avenue to the north, Newtown Creek to the east, Lombardy and Beadel Street to the south and Morgan Avenue to the west.

5. The area associated with Potential Source Area West of Morgan Avenue (West of Morgan Avenue). This area consists of the area bound by Lombardy Street to the north, Morgan Avenue to the east, Frost Street to the south and Kingsland Avenue to the west.

1.3.1 **Purpose of Site Characterization – Phase VI**

The purpose of the SC Phase VI fieldwork was to further assist in determining:

**Spic and Span Area**

- If there are additional potential sources of PCE and TCE impacting shallow groundwater to the north of the Spic and Span Site;
- The horizontal extent of the dissolved phase plume originating from near the former Spic and Span Site;
- The horizontal impacts of PCE and TCE in deep groundwater in the area north, south and east of the former Spic and Span Site;
- If the clayey silt unit that was encountered in well DEC-024D is present at other well locations in the area;
- The potential presence of DNAPL if the clayey silt unit, as was found at DEC-024D, is encountered at other well locations in the area;

**ACME Steel Areas**

- If the there are additional potential sources contributing to the PCE and TCE impacted shallow groundwater found in the vicinity of DEC-018/018D;
- The delineation of the deeper groundwater to south and southwest of well pair DEC-018/018D;
- If PCE and TCE impacted groundwater found at DEC-018/018D is associated with an upgradient source and/or if there are any additional potential sources contributing to the impacted deep groundwater;

**Potential Source Areas West of Morgan Avenue**
- If there is a potential source area(s) of PCE and/or TCE to the west of Morgan Avenue that is impacting groundwater and/or soil gas near DEC-004;

**Overall Meeker Avenue Plume Trackdown Site**
- The depth, areal extent, and permeability of the Raritan Formation;
- The vertical extent of PCE and TCE impacted groundwater across the entire site; and
- To establish a baseline for groundwater sample results which will be used to assess the potential for natural attenuation in groundwater.

### 1.3.2 Scope of Site Characterization Phase VI Fieldwork

Tasks performed during the SC Phase VI field investigation included:
- Collection of 8 background surface soil samples from McGorlick Park, and 78 soil samples from monitoring well borings, soil gas borings, and shallow soil borings for analysis by Test America of Amherst, New York (Test America);
- Geophysical utility clearance by Radar Solutions International of Waltham, MA (RSI) at all soil gas and drilling locations;
- Manual and/or Vac-Tron® utility clearance for soil boring and monitoring well installation by Aquifer Drilling and Testing, Inc., of New Hyde Park, New York (ADT);
- Installation of 18 shallow, 9 deep, and 8 top of clay groundwater monitoring wells by ADT. A rationale for each well installed is provided by area and can be found in Tables 1-1 through 1-4;
- Advancement of 23 soil borings by ADT. A rationale for each well installed is provided by area and can be found in Tables 1-1 through 1-4;
• Installation of 10 soil vapor implants by Zebra Environmental Corporation of Lynbrook, New York (Zebra);
• Collection of Shelby tube and grab soil samples and analysis for geotechnical parameters by 3rd Rock LLC of East Aurora, New York (3rd Rock);
• Collection of 101 groundwater samples by field personnel from URS and Watts Architecture & Engineering, Inc. of Buffalo, New York (Watts) from 32 newly installed and 69 existing monitoring wells for analysis by Test America for volatile organic compounds (VOCs) and natural attenuation parameters;
• Collection of 3 ambient air samples, and 32 soil vapor samples at 28 locations, including 4 field duplicates, for analysis by Con-Test Analytical Laboratory of Longmeadow, MA (Con-Test);
• Daily pick-up of investigation derived waste for disposal by AARCO Environmental Services Corporation of Lindenhurst, New York (AARCO);
• Concrete sidewalk flag replacement by AARCO; and
• Site survey by B. Thayer Associates, Inc. of Woodbury, New York (B. Thayer).

1.4 Data Presentation

This Site Characterization Report has six sections. Section 1 includes background information and a synopsis of URS’ activities to date at this site. Section 2 includes a description of field activities that occurred during the Site Characterization Phase VI fieldwork. Section 3 includes a description of the subsurface conditions that have been found within the project boundary. Section 4 includes a description and summary of the analytical results for the soil, groundwater and soil gas samples from locations sampled during the SC Phase VI fieldwork. Section 5 consists of the conclusions and recommendations derived from the SC Phase VI field effort. Section 6 contains a list of references cited. Tables, Figures, and Appendices immediately follow the text.
2.0 FIELD ACTIVITIES

Field activities performed during Site Characterization Phase VI from August 2, 2011 through January 13, 2012 are discussed below.

2.1 Utility Clearance

Prior to site work, each subcontractor arranged for all appropriate utility clearance mark-outs. This included (but was not limited to) contacting the NYC Departments of Environmental Protection and Transportation, the Transit Authority, Consolidated Edison Company of New York, Inc. (Con Edison), Keyspan, and Verizon, in addition to using the Dig-Safely number for New York City – 811 or (800) 272-4480. In addition, URS coordinated with Con Edison for the installation of protective jackets on overhead wires near proposed boring locations. Photographs of jacketed overhead wires can be found in Appendix A.

2.2 Geophysical Survey for Utility Markouts

Between August 8 and 10, 2011, RSI mobilized a one person crew with ground penetrating radar (GPR) and electromagnetic (EM) induction equipment to the site. The purpose of the geophysical survey was to screen for and identify the presence/location of underground utilities in areas where drilling for soil gas implants, borings and monitoring well installations were proposed.

A 10-foot square reference grid was established around each soil gas implant, boring and/or monitoring well location prior to collecting the geophysical data. The size of the grid was adjusted to accommodate additional borings and avoid obstructions and utilities detected. A GSSI SIR-3000 digital radar system was used to perform the GPR survey. GPR data were acquired along lines spaced 1.0 to 2.5 feet apart. The EM induction equipment used to determine the location of buried utilities were a Ditch Witch 950 RT locating system and a McLaughlin’s Verifier G2 digital locator.

RSI marked utilities and anomalies by spray-painting the outline on the pavement as soon as they were located. A URS geologist supervised and assisted RSI. A photograph of a completed RSI utility mark out can be found in Appendix A, copies of the daily field notes are provided in Appendix B, and RSI’s report is provided in Appendix C.

2-1
2.3 Background Surface Soil Sample Collection

Surface soil samples from eight locations were collected from the zero to two-foot depth interval within the grass areas at eight locations in McGolrick Park on August 3, 2011. The purpose of the surface soil sample collection was to obtain site-specific background soil samples to assist in the characterization of site related contaminants. The eight surface soil sample locations in McGolrick Park shown are shown on Plate 1.

At each location, any vegetation and the upper two inches of soil were removed prior to sample collection. Using a decontaminated bucket auger, soils were collected to approximately 2 feet bgs and placed a decontaminated stainless steel bowl. An aliquot of soil for the VOC analysis was placed directly into the appropriate laboratory-supplied container. The remaining soil was homogenized and placed in the appropriate laboratory-supplied containers. Following the collection of each surface soil sample, the site was restored to pre-investigation conditions. The site restoration activities included backfilling each soil sample location with topsoil, application of fertilizer, and the application of grass seed. Site photographs are provided in Appendix A, and copies of the daily field notes are provided in Appendix B.

A chain-of custody (COC) form was maintained and accompanied the sample containers to Test America which is a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory. All background soil samples were analyzed for target compound list (TCL) volatile organic compounds (VOCs) plus tentatively identified compounds (TICs), TCL semivolatile organic compounds (SVOCs) plus TICs, TCL pesticides/polychlorinated biphenyls (PEST/PCBs), target analyte list (TAL) metals, hexavalent chromium (Cr+6), cyanide (CN) [i.e., Part 375 parameters] and total organic carbon (TOC).

2.4 Soil Borings and Groundwater Monitoring Well Installation

The following sections describe the soil boring and monitoring well installation program for the SC Phase VI fieldwork.
2.4.1 Pre-Boring Clearing

Prior to any intrusive activities, ADT obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. Between August 10 and 16, 2011, fourteen soil boring locations and thirty-five monitoring wells locations were cleared for utilities. In addition, on November 11 and 14, 2011, an additional 9 soil boring locations were cleared for utilities.

At each location, a two-foot by two-foot square area of the sidewalk was cut. An approximately one-foot diameter by five-foot deep hole was excavated using post-hole diggers, pry bars, and an air knife along with the Vac-Tron® unit. After a location was cleared for drilling, the hole was backfilled flush with the sidewalk using the excavated spoils (rocks and debris removed) and if necessary, temporarily patched with blacktop patch or concrete. The abandoned locations were backfilled using the excavated spoils and temporarily patched with blacktop patch or concrete. Site photographs are provided in Appendix A and copies of the daily field notes are provided in Appendix B.

2.4.2 Soil Borings

During the period of August 15 through October 5, 2011, and November 15, 2011 through January 12, 2012, ADT utilized track-mounted and truck-mount AMS Compact Roto Sonic 17-C drill rigs for the installation of 23 soil borings and 35 monitoring wells as listed in Tables 1-1 through 1-4 and as shown on Plate 1. Of the 35 monitoring wells installed during SC Phase VI, 18 were shallow overburden (water table) wells, nine were deep overburden wells, and the remaining eight were immediately above or within the top of the Raritan Formation (i.e., top of clay).

The soil borings at the shallow and deep well locations were advanced using a 4-inch ID inner sampler and a 6-inch ID outer casing with sonic drilling methods. The soil boring associated with the top of clay wells were advanced using a 6-inch ID inner sampler and an 8-inch ID outer casing with sonic drilling methods. Soil samples were collected continuously from the ground surface to the terminus of each boring. The procedure for the advancement of the borehole was to advance the inner sampler the appropriate interval (5 or 10 feet) and then advance the outer casing over the inner sampler to the desired depth. After the outer casing was advanced, the inner sampler was retrieved and the sample core collected was placed in a polyethylene sample tube. The process was repeated
until the desired depth was reached. All investigation derived waste (IDW) generated from the monitoring well installation was containerized in DOT approved 55-gallon drums and picked up by AARCO Environmental Services on a daily basis for off-site disposal at a permitted facility.

Each sample core was screened with a photoionization detector (PID). Up to five soil samples were collected from each boring; one soil sample was collected from the interval just above the water table, the second and/or additional samples were collected from the intervals exhibiting odors, staining, or elevated PID reading(s). If no odors, staining, or elevated PID readings were encountered, then only one sample from the interval just above the water table was collected. Soil borings that were not converted to monitoring wells were backfilled with bentonite chips to approximately 5 feet below ground surface (bgs), with clean well sand from 0.5-5.0 feet bgs, and with concrete in the top 0.5 feet. Site photographs are provided in Appendix A, copies of the daily field notes are provided in Appendix B, and soil boring logs are provided in Appendix D.

A COC form was maintained and accompanied the soil sample containers to Test America. A majority of the samples were analyzed for TCL VOCs as listed in Table 2-1, plus TICs following USEPA SW846 Method 8260B. At select locations, soil samples were analyzed for TCL VOCs plus TICs, TCL SVOCs plus TICs, TCL PEST/PCBs, TAL metals, Cr+6, CN and TOC.

2.4.3 Shallow and Deep Monitoring Well Construction

A total of 18 shallow and 9 deep monitoring wells were installed during the SC Phase VI fieldwork.

The 18 shallow monitoring wells were constructed with 15 feet of 2-inch ID, Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser. The total depth of the shallow monitoring wells ranged from 30.0 to 60.0 feet bgs. The screen was nominally set between 5 feet above and 10 feet below the water table at most locations. A 00 or 00N size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry was then installed around the riser to an elevation of 1-foot below grade via tremie pipe.

Well construction details for the 9 deep monitoring wells varied by location. The total depth of the deep monitoring wells ranged from 60.0 to 95.0 feet bgs. The five monitoring wells that were installed in the Spic and Span area were constructed with 10 feet of 2-inch ID, Type 304 stainless steel.
0.010-inch slot screen and Type 304 stainless steel riser. Stainless steel screen and riser were used instead of PVC in the event DNAPL was present in the deep well. PVC integrity degrades when in direct contact with chlorinated solvents. Each deep well was screened between 25 and 35 feet below the corresponding shallow well or across the clayey silt unit if it was encountered. The four monitoring wells that were installed in the ACME Steel/Brass Foundry area were constructed with Schedule 40 PVC 0.010-inch slot screen and riser. Each deep well installed in the ACME Steel/Brass Foundry area was screened between 25 and 35 feet below the corresponding shallow well. A 00 or 00N size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry was then installed around the riser to an elevation of 1-foot below grade via tremie pipe.

Each monitoring well was finished with a locking well cap, a 2-foot square concrete apron, and a flush-mounted curb box. Security bolts were installed in the well covers to minimize the potential for unauthorized well access. The concrete apron for each well pad was approximately 6 inches thick. Site photographs are provided in Appendix A, copies of the daily field notes are provided in Appendix B, and monitoring well construction logs are provided in Appendix E.

2.4.4 Top of Clay Monitoring Well Construction

Eight top of clay monitoring well locations were installed during the SC Phase VI fieldwork. Three of the 8 top of clay wells (DEC-058TC, DEC-062TC, and DEC-063TC) were installed with a permanent carbon steel surface casing due to the presence of an aquitard and the potential presence of DNAPL at their locations. Seven of the 8 top of clay wells were constructed with 4-inch ID well materials (DEC-018TC, DEC-029TC, DEC-031TC, DEC-041TC, DEC-085TC, DEC-062TC, and DEC-063TC) and one top of clay well was constructed with 2-inch ID well materials (DEC-035TC). The total depth of the top of clay monitoring wells ranged from 110.0 to 140.4 feet bgs.

At the 3 top of clay wells (DEC-058TC, DEC-062TC, and DEC-063TC) where a permanent carbon steel casing was installed, ADT utilized a track-mounted Sonic Drilling Corporation SDC390 drill rig with 12-inch ID drill casing to advance the boring to the top of the aquitard, which varied from 54.0-63.0 feet bgs. Once the top of the aquitard was reached with the 12-inch drill casing, the permanent casing, consisting of 10-inch outside diameter (OD) 8 ½-inch ID butt welded carbon steel
casing, was installed through the drill casing. Following the installation of the permanent casing, it was grouted in place with cement/bentonite grout. The cement/bentonite grout mixture used consisted of:

- **Grout Slurry Composition (Percent Weight)**
  - 1.5 to 3.0 percent - Bentonite (Quick Gel)
  - 40 to 60 percent - Cement (Portland Type I)
  - 40 to 60 percent – Water

The cement/bentonite grout was installed around the permanent casing to an elevation of 1-foot below grade via tremie pipe. Following the removal of the 12-inch drill casing, the cement/bentonite grout was allowed to cure a minimum of 48 hours before the remainder of the well boring was drilled/sampled.

At seven of the 8 top of clay wells (DEC-018TC, DEC-029TC, DEC-031TC, DEC-041TC, DEC-085TC, DEC-062TC, and DEC-063TC), a hybrid well consisting of a 10-foot screen of 4-inch ID, Type 304 stainless steel 0.010-inch slot screen with a 2-foot long sump, 10 feet of 4-inch ID, Type 304 stainless steel riser above the screen, and 4-inch ID, Schedule 40 PVC in the remainder of the well string, to the surface, was set. A 00 or 00N size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screens. A cement/bentonite slurry was then installed around the riser to an elevation of 1-foot below grade via tremie pipe.

At DEC-035TC, a hybrid well consisting of a 10-foot screen of 2-inch ID, Type 304 stainless steel 0.010-inch slot screen with a 2-foot long sump, 10 feet of 2-inch ID, Type 304 stainless steel riser above the screen and, 2-inch ID, Schedule 40 PVC the remainder of the well string, to the surface, was set. A 00 or 00N size sand pack was installed from the bottom of the well up to 2 feet above the top of the well screen. A cement/bentonite slurry was then installed around the riser to an elevation of 1-foot below grade via tremie pipe.

Each top of clay monitoring well was finished with a locking well cap, a 2-foot square concrete apron, and a flush-mounted curb box. Security bolts were installed in the well covers to minimize the potential for unauthorized well access. The concrete apron for each well pad was approximately 6 inches thick. Site photographs are provided in Appendix A, copies of the daily field notes are provided in Appendix B, and monitoring well construction logs are provided in Appendix E.
2.5 Monitoring Well Development

At least 24 hours after the monitoring wells were installed, the wells were developed by URS personnel with the pump and surge development method using a Waterra Inertial Hydrolift or Grundfos Redi-Flo2 submersible pump with dedicated/disposable high density polyethylene (HDPE) tubing and check valves. Prior to well development, a 250-foot long Solinst oil/water interface probe was used to check for the presence/ thickness of any free product. During well development, water quality parameters (pH, specific conductivity, temperature and turbidity) were measured using a Hanna 991301 Multiparameter Meter and a Lamotte 2020 turbidimeter and recorded. A monitoring well was considered developed when a minimum of 5 well volumes was removed, and water quality parameters had stabilized. Site photographs are provided in Appendix A, copies of the daily field notes are provided in Appendix B, and well development logs may be found in Appendix F.

Well development water was collected into DOT approved 55-gallon drums and picked up daily by AARCO for off-site disposal at a permitted facility.

2.6 Groundwater Level Measurements

A synoptic round of groundwater levels was collected on October 17, 2011 and used to develop groundwater contour elevation maps during the investigation so that groundwater flow directions could be determined. Monitoring wells within the area were checked for depth to groundwater and thickness of accumulated NAPL, if any. Water levels were determined using a 250-foot long Solinst oil/water interface probe. Groundwater elevations were adjusted if LNAPL was present, based upon the (laboratory) measured specific gravity of the product present in the individual monitoring well.

2.7 Aquifer Testing

Following well development, slug testing was conducted on select monitoring wells to estimate the horizontal hydraulic conductivity within the overburden. Falling head tests were performed by recording the initial water level in the well, lowering a pressure transducer/datalogger (In-situ MiniTroll) into the well, inserting a decontaminated slug to raise the water level in the well, and recording the water level over time until it returned to the original static level. Rising-head tests
were performed immediately following completion of the falling head test. With the slug already in the water column, the static water level was recorded, the slug was then removed, and water level readings were taken as the water level gradually returned to static condition. Aquifer testing data and results are provided in Appendix G.

2.8 Non-Aqueous Phase Liquid Gauging

During the SC Phase VI fieldwork, existing and newly installed monitoring wells were checked for the presence of NAPL. Both DNAPL and LNAPL were observed.

2.8.1 Dense Non-Aqueous Phase Liquid Gauging

During the SC Phase VI fieldwork multiple DNAPL checks were made of the deep wells in the vicinity of the Spic and Span Site. The DNAPL checks were made using dedicated/disposable HDPE bailers to verify the presence of DNAPL in the wells. A small amount was recovered only from DEC-024D and DEC-024DR, where DNAPL had previously been detected.

2.8.2 Light Non-Aqueous Phase Liquid Gauging

During the SC Phase VI fieldwork, on October 17, 2011, LNAPL was detected in DEC-021, DEC-024, DEC-034, and DEC-053 with a thickness of between 0.01 to 3.74 feet.

2.9 Non-Aqueous Phase Liquid Sampling

One NAPL sample was collected during the SC Phase VI fieldwork. A DNAPL sample was collected on November 9, 2011 from DEC-024DR.

2.9.1 Dense Non-Aqueous Phase Liquid Sampling

On November 9, 2011, URS purged approximately 55 gallons of water from DEC-024D and DEC-024DR using a Waterra Inertial Hydrolift pump with dedicated/disposable HDPE tubing and check valves, to facilitate the collection of a DNAPL sample. After allowing the wells to stabilize for approximately an hour, URS and Department personnel collected a DNAPL sample from DEC-
024DR using a weighted dedicated/disposable HDPE bailer with nylon rope. A minimal amount of DNAPL was found in DEC-024D following the purging and thus was not sampled.

When sampling was completed, the weighted dedicated/disposable HDPE bailer, nylon rope, PPE, and polyethylene sheet were placed into a DOT approved 55-gallon drum and picked up that day by AARCO for off-site disposal at a permitted hazardous waste facility. Site photographs are provided in Appendix A and copies of the daily field notes are provided in Appendix B. The hazardous waste manifest is provided in Appendix H.

The DNAPL sample was transported under COC via laboratory courier to Test America. The DNAPL sample was analyzed for TCL VOCs, specific gravity by American Society for Testing and Materials (ASTM) D1298, surface tension by D-971, and viscosity by D-445.

2.9.2 Light Non-Aqueous Phase Liquid Sampling

No LNAPL samples were collected during the SC Phase VI fieldwork because LNAPL was not detected in any of the new wells installed.

2.10 Groundwater Sampling

Between October 18 and October 27, 2011, URS collected groundwater samples from 101 monitoring wells (32 newly installed DEC wells and 69 existing DEC wells) plus QA/QC samples using low-flow sampling procedures. Groundwater samples were not collected from DEC-058TC, DEC-062TC, and DEC-063TC because they had not yet been installed. These wells were installed in December 2011 and January 2012 during activities conducted as part of the Phase II RI for the Spic and Span Site.

Prior to sample collection, standing water was purged from each well with a QED SamplePro Micropurge bladder pump or a Grundfos Redi-Flo2 submersible pump using dedicated/disposable bladders and HDPE tubing. At well locations where LNAPL was encountered, a groundwater sample was collected from the well by lowering a capped tremie pipe into the well to a depth at least 5 feet below the LNAPL layer. The tremie pipe was secured to limit movement and the cap was pushed out from the bottom end of the tremie pipe to allow the sample tubing to be lowered to the desired sampling depth without coming into contact with the LNAPL. The cap was attached to the tremie
pipe for retrieval. A peristaltic pump was used to purge the wells containing LNAPL. Wells were purged at a rate of 1-liter per minute or less and the purge rate was adjusted to minimize draw down. During the purging of the well, water quality parameters (pH, specific conductivity, temperature, dissolved oxygen, turbidity) were measured using a Horiba U-22 Multi-parameter Instrument with a flow-through cell and documented on a purge log. Samples were collected after the water quality parameters stabilized. Site photographs are provided in Appendix A, copies of the daily field notes are provided in Appendix B, and purge logs are provided in Appendix I. Purge water was collected into DOT approved 55-gallon drums, and was picked up daily by AARCO Environmental Services for proper disposal.

All samples were transported under COC via laboratory courier to Test America. All groundwater samples were analyzed for TCL VOCs plus TICs and natural attenuation parameters (i.e., alkalinity, chloride, nitrate, nitrite, sulfate, total iron, dissolved iron, ferrous iron (field parameter), TOC and methane/ethane/ethene). In addition, 4 groundwater samples were collected for sewer discharge indicator parameters [i.e., VOCs, SVOCs, PCBs, cadmium, copper, lead, mercury, nickel, zinc, Cr+6, pH, flashpoint, total petroleum hydrocarbons (TPH), total phenol, total suspended solids (TSS), total dissolved solids (TDS), biochemical oxygen demand (BOD), chloride, nitrate, nitrite and total kjedahl nitrogen (TKN)].

2.11 Monitoring Well Maintenance

During the SC Phase VI fieldwork, well maintenance was performed on all DEC wells. Every well cover was removed and all the bolt holes were tapped out and lubricated with an anti-seize paste. All flush-mount protective casings on DEC wells were equipped with new Penta Head tamper proof bolts. The flush-mount protective casings and well pads at DEC-016 and DEC-016D were replaced.

2.12 Soil Vapor Implant Installation

Prior to any intrusive activities, the subcontractor obtained all necessary permits (i.e., NYC DOT street opening permits) for conducting intrusive activities. Ten permanent soil vapor implants (SG-088 through SG-097) were installed on August 9 and 11, 2011 by Zebra, under the direction of a URS geologist. Locations of existing and newly installed soil vapor implants are shown on Plate 2.
All locations were installed through sidewalks. Rotary concrete drill bits were used to drill through the concrete sidewalk. A track-mounted Geoprobe® 6620 DT hydraulic direct-push unit was utilized to advance a 2-inch outside diameter (OD) by 5-foot long acetate-lined Macrocore sampler to a maximum depth of 8 feet bgs.

Each sample core was screened with a PID. Up to one soil sample was collected from each boring from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID readings were encountered, then a sample from the bottom of the boring was collected.

A 6-inch long double-woven stainless steel Geoprobe® vapor sampling implant was connected to an anchor and positioned above the silty clay layer (if present) or at the bottom of the probe hole. Polyethylene tubing (\(\frac{3}{8}\)-inch OD) was connected to the implant and was cut above the ground surface. The annular space around the implant (screen) was backfilled with #1 silica sand to 6 inches above the implant. A bentonite slurry was placed immediately above the sand for the seal, and extended to the ground surface. The implants were completed with 3-inch diameter aluminum flush-mount protective casings, secured with approximately 1 foot of concrete. Each flush mount casing cover was secured with a \(\frac{9}{16}\)-inch bolt.

All downhole equipment was decontaminated with a non-phosphate detergent and potable water between each soil vapor implant location. No IDW was generated during the soil vapor implant installation. Copies of the daily field notes are provided in Appendix B and soil vapor implant construction logs are provided in Appendix J.

All samples were transported under COC via laboratory courier to Test America. All soil samples were analyzed for TCL VOCs plus TICs.

2.13 Soil Vapor Sampling

On August 17 and 18, and on September 29, 2011, soil vapor samples were collected from 28 existing and 10 newly installed soil vapor implants plus QA/QC samples. Soil vapor samples could not be collected from existing location SG-57 due to no loss of vacuum; and from new locations SG-93 and SG-96 due to water in the implant and a failed helium test, respectively. It should be noted that SG-096 was replaced on August 19, 2011 by Zebra following multiple failed helium tests on August 2-11.
The location again failed helium testing on September 29, 2011. Soil vapor sampling locations are shown on Plate 2.

The soil vapor samples were collected in accordance with the procedures outlined in the Field Activities Plan (FAP) (URS, April 2010) using laboratory evacuated 6-liter Summa® canisters with 1 hour flow regulators provided by Con-Test. Per NYSDOH’s Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, October 2006), a helium tracer gas was utilized during the sampling of each soil vapor implant. The tracer gas was used to verify that the infiltration of outdoor (ambient) air was not occurring during sample collection. A one-quart enclosure was placed over the well head. The well tubing was run through an outlet and plumber’s putty was used to seal the interface between the tubing and the enclosure. The enclosure was then sealed at the ground surface with a polyurethane foam gasket. A tank containing ultra-high purity helium (99.999%) was connected to the side port of the enclosure and enough helium was released to displace any ambient air and to maintain a positive pressure within the enclosure. Following the application of the tracer gas, one to three volumes were purged from the soil vapor implant using a Gilian GilAir-3 air sample pump.

A Dielectric MGD-2002 helium detector was used to check for the presence of the tracer gas in the purged soil vapor; if less than 10% of the tracer gas was detected, a sample was collected. Following the collection of the soil vapor sample, the helium detector was re-connected to the tubing to check for the presence of the tracer gas in the soil vapor; if less than 10% of the tracer gas was detected, the sample was acceptable for analyses.

One outdoor (ambient) air sample was collected each day from a location upwind of the sample locations. The outdoor ambient air sample was collected by opening a summa canister fitted with a 1-hour flow controller and drawing in the ambient air. Field duplicate samples were collected using stainless steel ‘T’ fittings. Copies of the completed Summa Canister Sampling Field Data Sheets from the sampling event are provided in Appendix K. A COC form was maintained and accompanied the air and soil gas samples, which were shipped, via Federal Express, to Con-Test, a NYSDOH ELAP accredited laboratory. The soil vapor and outdoor air samples were analyzed for the TCL VOCs listed in Table 2-1, following USEPA Method TO-15.
2.14 Investigation Derived Waste Disposal

AARCO Environmental Services was contracted for the daily pick-up and disposal of all drummed IDW at a permitted disposal facility. Copies of the non-hazardous bills of lading and hazardous waste manifests are provided in Appendix H.

2.15 Monitoring Well Decommissioning

During the Phase VI fieldwork, two monitoring wells DEC-037 and a broken DEC-069 were decommissioned in accordance with NYSDEC protocol CP-43: Groundwater Monitoring Well Decommissioning Policy. The wells were grouted in place using the grout mixture found above in Section 2.4.4, via tremie pipe. The top 5.0-7.0 feet of the PVC riser was unscrewed and the flush-mounted curb boxes were removed. The sidewalk flags containing the decommissioned wells were subsequently replaced (Section 2.16). Copies of the daily field notes are provided in Appendix B and Well Decommissioning Records may be found in Appendix L.

2.16 Concrete Sidewalk Flag Replacement

AARCO was contracted for the replacement of sidewalk flags that had been drilled through during previous and current site activities. AARCO replaced a total of 2,544 square feet of sidewalk flags between November 3, 2011 and December 2, 2011. The sidewalk flags ranged in size from 5-foot by 5-foot to 12-foot by 10-foot. Prior to removal of the damaged flags, AARCO cut the perimeter of each flag to be replaced using a water-cooled pavement saw to reduce fugitive dust. The flags were demolished, removed and disposed of by AARCO. New flags were replaced in kind with the surrounding flags. Copies of the daily field notes which, include photographs of flag replacement activities, are provided in Appendix B.

2.17 Site Survey

NAIK Consulting Group originally surveyed the area, including all new monitoring wells installed and/or sampled for location and elevation in August 2007. URS surveyed additional monitoring well, soil gas and soil boring locations in March and June 2011. B. Thayer Associates surveyed additional monitoring well, soil gas and soil boring locations in November and December 2011.
2011. The survey provides 100-scale mapping and does not include elevated roadways and expressways (i.e., BQE). All surveying was performed under the supervision of a New York State licensed land surveyor. All vertical control points were referenced to the North American Vertical Datum 1988 (NAVD 1988). Horizontal datum was referenced to the North American Datum of 1983 (NAD83), New York State Plane Coordinate System, Long Island Zone. The complete site survey drawing is provided in Appendix M.
3.0 SUBSURFACE CONDITIONS

3.1 Regional Geology

The site investigation area is located within the Atlantic Coastal Plain physiographic province of New York State (Broughton, et al. 1966). The Atlantic Coastal Plain is characterized by low relief with elevations ranging from sea level to almost 400 feet above mean sea level (msl). The lithology of Brooklyn and Queens consists of Cretaceous and Pleistocene age unconsolidated deposits underlain by Precambrian crystalline bedrock. The unconsolidated deposits pinch out in northwestern Queens where bedrock outcrops, but reach a thickness of more than 1,000 feet in southeastern Queens. The unconsolidated deposits form six distinct hydrogeologic units consisting of four aquifers and two confining layers that generally dip to the south-southeast (Figure 3-1). The units in ascending order are the Lloyd aquifer (0-300 feet thick), the Raritan confining unit (0-200 feet thick), the Magothy aquifer (0-500 feet thick), the Jameco aquifer (0-200 feet thick), the Gardiners clay (0-150 feet thick), and the upper glacial aquifer (0-300 feet thick) (USGS, 1999a and b). The units pinch out to the north-northeast and may not all be found at any one location.

Based on borings performed near the site for unrelated work, the site is underlain from the surface down by upper glacial aquifer, the Raritan Formation, and crystalline bedrock (Figure 3-2). The upper glacial aquifer is of Wisconsin age and consists of a terminal moraine, a ground moraine, and glacial outwash deposits whose area is characterized as an unsorted and unstratified mixture of clay, sand, gravel and boulders. The Raritan Formation is recognized as a confining unit which has been described as light to dark grey, brown-red, pink, red and gray-white clay, silty clay and clayey to silty fine sand. Disseminated lignite and pyrite are common and calcareous concretions may be found. Prior to the SC Phase VI fieldwork, the Raritan Formation had previously been encountered in three borings performed near the site: one boring near Morgan Avenue and Meeker Avenue (-47 feet amsl); one boring under the BQE near the west bank of Newtown Creek (-48 feet amsl); and one boring near Meeker Avenue between Stewart Avenue and Gardner Avenue (-71 feet amsl). The boring near Morgan Avenue and Meeker Avenue penetrated the Raritan Formation into the underlying crystalline bedrock at a depth of -163 feet amsl.
During the SC Phase VI fieldwork, the Raritan Formation was positively encountered in all eight of the top of clay well locations at depths between 108.5 and 138.0 feet bgs (elevations of -56.95 to -121.19 feet amsl) and has been described as gray with white banding, brown, brownish gray, greenish gray, dark gray to greenish brown, fine sand and silt, clays with carbonized plant fragments, clays with varying amounts of sand to silts with varying amounts of sand and clay.

3.2 Site Geology

Due to the highly heterogeneous nature of the geology across the Meeker Avenue Plume Trackdown site, the site geology is described below in the context of the 5 site areas as described in Section 1.3. The ACME Steel/Metal Works Area and the ACME Steel/Brass Foundry Area geology will be discussed as one area since they are on adjacent blocks. Figure 3-3 presents the locations of the monitoring wells and cross sections developed during the SC Phase VI. Cross sections A-A’ through G-G’ are presented on Figures 3-4 through 3-10. Figure 3-11 depicts the elevation of the top of the Raritan Formation, which appears to dip away from a high point located at DEC-018TC toward the west-northwest.

3.2.1 Spic and Span Area

Cross sections A-A’, B-B’ and C-C’ are shown on Figures 3-4, 3-5, and 3-6, respectively and represent the cross-sections that may be found in the Spic and Span area. Based upon subsurface data obtained during this and previous investigations, the upper glacial aquifer was penetrated and the top of the Raritan Formation has been encountered at the top of clay monitoring well locations. The following textural units have been found in the upper glacial aquifer in most borings, from the surface downward: a fill unit; a sand unit or a discontinuous glacial till unit; a sand unit if the discontinuous glacial till unit was encountered at the surface; a discontinuous clayey silt unit within the sand unit; a fine sand and silt unit; a sand/ sand and gravel unit; and the Raritan silt. Due to the heterogeneous nature of the geology, some but not all of the units may or may not be present at each boring. The thickness of the upper glacial aquifer in the Spic and Span area is approximately 125.0 to more than 138.0 feet thick.
A fill unit is present, varying in thickness from approximately 0 to 9 feet, and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.). The discontinuous glacial till unit was noted at the surface in some borings and consists of a heterogeneous mixture of sand, silt, and clay and varying amounts of gravel, cobbles and boulders. An inclusive sand layer was identified within the glacial till unit in the vicinity of SSB-11 (Figure 3-5), which contained elevated concentrations of PCE and DNAPL. The bottom of the northern edge of the sand layer has vertical sand stringers present with DNAPL in them and represents a vertical migration pathway for DNAPL from the shallow zone through the glacial till unit to the lower units. The sand unit is present at the majority of boring locations and is represented by stratified sands of varying textures containing some to no fines. The discontinuous clayey silt unit has been observed as an inclusive unit within the sand unit, and has been observed in most of the borings at the site. The thickness of the clayey silt unit, where present, varies from 0.5 to over 20 feet thick. The presence of the clayey silt unit (i.e., a low permeability unit) at well location DEC-024D and DEC-024DR has resulted in the accumulation of DNAPL at the interface between the sand unit and the inclusive clayey silt unit at approximately 50 feet bgs (-29.78 feet amsl). This clayey silt unit was also identified in nearby wells (DEC-023D, DEC-024DR, DEC-035D, DEC-053D and DEC-055D) at depths ranging from 50 feet bgs (-29.84 feet amsl) at DEC-024DR to 65 feet bgs (-48.80 feet amsl) at DEC-023D. The fine sand and silt unit has been found under the sand unit and consists of inter-bedded very fine to fine sands, silt and fine sands and silt mixtures with inter-bedded, discontinuous beds of sands, silts and clays. A sand/ sand and gravel unit was identified overlaying the Raritan Formation at the four top of clay locations (DEC-035TC, DEC-058TC, DEC-062TC and DEC-063TC) in the Spic and Span area. The Raritan Formation consisted of green gray, green brown, brown, or white with brown banding, silt with some sand; clay with some sand; clay and silt; or fine sand and silt.

3.2.2 **Klink Cosmo Area**

Cross sections D-D’ and E-E’ are shown on Figures 3-7 and 3-8 respectively. Based upon subsurface data obtained during this and previous investigations, the upper glacial aquifer has been penetrated and the top of the Raritan Formation has been encountered at the top of clay locations. The following textural units have been found in the upper glacial aquifer in most borings, from the
surface downward: a fill unit; a sand unit or a discontinuous glacial till unit; a sand unit if the discontinuous glacial till unit was encountered at the surface; a discontinuous clayey silt unit within the sand unit; sand and gravel unit; and the Raritan Formation. Due to the heterogeneous nature of the geology, some but not all of the units may or may not be present at each boring. The thickness of the upper glacial aquifer in the Klink Cosmo area is approximately 108.5 to more than 113.0 feet thick. The Raritan Formation was encountered between -73.31 and -74.05 feet amsl.

A fill unit is present, varying in thickness from approximately 0 to 11 feet, and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.). Potentially former manufactured gas plant (MGP) related fill material (i.e., cinder and/or trace slag) found in DEC-14D (5-7’ bgs), DEC-043 (1-11’ bgs), SG-079 (1-2’ bgs), and SG-086 (at 1’ bgs) is present across Vandervoort Avenue in the vicinity of a former MGP facility. The discontinuous glacial till unit was noted at the surface in some borings and consists of a heterogeneous mixture of sand, silt, and clay and varying amounts of gravel, cobbles and boulders. The sand unit is present at all the boring locations and is represented by stratified sands of varying textures containing some to no fines. The discontinuous clayey silt/silt unit has been observed as an inclusive unit within the sand unit. The thickness of the clayey silt/silt unit, where present, varies from 0.5 to over 10 feet thick. A sand and gravel unit has been found to overlie the Raritan Formation at DEC-031TC. The Raritan Formation consisted of gray or dark gray, silt with some clay and fine sand stringers; clay with some sand; clay and silt; or fine sand and silt.

3.2.3 **ACME Steel/ Metal Works Area and ACME Steel/ Brass Foundry**

Cross sections D-D’, E-E’, and F-F’ are shown on Figures 3-7, 3-8, and 3-9, respectively. Based upon subsurface data obtained during this and previous investigations, the upper glacial aquifer was penetrated and the top of the Raritan Formation has been encountered at the top of clay locations. The following textural units have been found in the upper glacial aquifer in most borings in the ACME Steel areas, from the surface downward: a fill unit; a silty sand/ sandy silt unit; a sand unit if the silty sand it was encountered at the surface; a discontinuous clayey silt unit within the sand unit; and the Raritan Formation. Due to the anisotropic nature of the geology, some but not all of the units may or may not be present at each boring. The thickness of the upper glacial aquifer in the ACME
Steel Areas is approximately 110.0 to 120.0 feet thick. The Raritan Formation was encountered between -56.95 and -65.32 feet amsl.

A fill unit is present, varying in thickness from approximately 0 to 10 feet, and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.). The silty sand/sandy silt unit was noted at the surface in some borings. The sand unit is present at all the boring locations and is represented by stratified sands of varying textures containing some to no fines. The discontinuous clayey silt/silt unit has been observed as an inclusive unit within the sand unit, and has been observed in most of the borings at the site. The thickness of the clayey silt/silt unit, where present, varies from 1.0 to over 10 feet thick. The Raritan Formation consisted of gray or dark gray clay.

### 3.2.4 Potential Source Areas West of Morgan Avenue

Cross sections F-F’ and G-G’ are shown on Figures 3-9 and 3-10, respectively. Based upon subsurface data obtained during this investigation, only the upper glacial aquifer has been penetrated. The following textural units have been identified in the upper glacial aquifer in most borings in this area, from the surface downward: a fill unit; a silty sand/ sandy silt unit; a sand unit; and a discontinuous clayey silt/ silt unit within the sand unit. Due to the heterogeneous nature of the geology, some but not all of the units may be present at each boring.

A fill unit is present, varying in thickness from approximately 0 to 9 feet, and consists of a heterogeneous mixture of sand, silt, clay and varying amounts of construction and demolition debris (i.e., bricks, concrete, coal, slag, etc.). The silty sand/sandy silt unit was noted at the surface in some borings. The sand unit is present at all the boring locations and is represented by stratified sands of varying textures containing some to no fines. The discontinuous clayey silt/silt unit has been observed as an inclusive unit within the sand unit, and was identified in most of the borings at the site. The thickness of the clayey silt/silt unit, where present, varies from 1.0 to over 7.0 feet thick. At some locations (i.e., DEC-072, DEC-074, DEC-075, DEC-077 and DEC-078) a less permeable unit (clayey silt or silt unit) was found at the bottom of the boring and in these instances, the wells were set within the top foot of the unit. A thick silt unit was encountered at DEC-073 from 5.0 to 49.0 feet bgs and appears to run north/south. The thick silt unit appears to be a hydraulic barrier to the shallow
groundwater flow from wells to the west of this location (i.e., DEC-072, DEC-075, DEC-076, and DEC-077). The full vertical and horizontal extent of this silt unit is not yet known and is acting as an aquitard/aquiclue. The potentiometric surface at these four well locations is approximately 13.5 to 18.06 feet higher than the wells to the east of the silt unit.

3.3 Geotechnical Test Results

Select soil samples were analyzed by 3rd Rock for the following geotechnical analyses including: grain size distribution (ASTM D422); Atterberg Limits (ASTM D4318); USCS classification, and falling head permeability (ASTM D5084). Soil samples collected for geotechnical analysis include those from: the shallow overburden DEC-072 (30-33.5’); and from the areas of SSB-013 (9-10’, 23-25’ and 30-32’), and SSB-014 (5-10’, 23-25’ and 65-67’); and from the deep overburden DEC-059D (59.5-61’), DEC-063D (55.3-56.8’) and DEC-067D (50-60’); and from sand above the top of clay DEC-018TC (104-105’), DEC-029TC (108-113’) and DEC-031TC (105-106’); and from the top of clay DEC-018TC (115-117’), DEC-029TC (115-117’), DEC-031TC (115-117’), DEC-035TC (136-139’), and DEC-041TC (122.5-124’). Results are presented in Appendix N, summarized on Table 3-1 and presented below.

These results indicate that the top of the clay material (i.e., Raritan Formation) underlying the area at an approximate depth of 105 feet is a low permeability confining layer (average permeabilities of $10^{-6}$ cm/sec or less). The sand material found above the top of the clay has a permeability of approximately three times the clay material (i.e., $10^{-3}$ cm/sec). The majority of the overburden is sand with gravel (permeabilities $10^{-2}$ and $10^{-3}$ cm/sec) with silt and clay (e.g., clay with sand, silty sand, clayey sand) layers and lenses with relatively low permeability ($10^{-4}$ to $10^{-7}$ cm/sec) present. These layers and lenses were not observed to be laterally or vertically extensive.

3.4 Investigation Area Hydrogeology

The primary hydrogeologic unit identified beneath the investigation area is the upper glacial aquifer which is underlain by a clay unit at an approximate depth of 108 to 138 feet bgs. Perched groundwater has been found in some site borings in the Spic and Span Area, Klink Cosmo Area, and West of Morgan Avenue (DEC-003, DEC-072, DEC-075, DEC-076, and DEC-077). In these
perched groundwater areas, clayey silt units are present above the sand unit (i.e., glacial till and or clay/silt unit). The water table surface may be found between approximately 5 and 11 feet bgs depending on the well location. The water table in the northern and northeastern portions of this area has been affected by the operation of the Off-Site System operated by ExxonMobil since approximately 1995. The operation of the Off-Site System has produced localized cones of depression resulting in an inward hydraulic gradient around the perimeter of the Off-Site Plume area, which has prevented the expansion of the Off-Site Plume.

On October 17, 2011, a round of synoptic groundwater level measurements was obtained from 136 monitoring wells within the SC Phase VI investigation area. The water level measurements are provided in Table 3-2. LNAPL was measured in several monitoring wells: in DEC-021, DEC-024, DEC-034, and DEC-053 at thicknesses of 0.1, 0.01, 3.74, and 0.55 feet, respectively. Water levels were adjusted in these monitoring wells based on the sample-specific specific gravity measurements presented on Table 3-2. Specific gravity values were previously determined by URS and Roux during previous phases and site investigations. A potentiometric surface map based on the water level measurements in a perched groundwater zone found in the shallow overburden is provided in Figure 3-12. A potentiometric surface map based on the water level measurements from the shallow overburden wells, using a 2-foot contour interval, is provided in Figure 3-13. A potentiometric surface map from the deep overburden wells, using a 1-foot contour interval, is provided in Figure 3-14. An inferred potentiometric surface map for the top of Raritan Formation wells is provided in Figure 3-15 and includes the areas south of the BQE.

The groundwater flow in the shallow overburden is to the north and northeast in the Spic and Span area; to the north/northeast in the Klink Cosmo Area and West of Morgan Avenue; and to the east and north in the ACME Steel source areas. Limited groundwater elevations in the perched zone in the shallow overburden West of Morgan Avenue indicate groundwater flow towards the east. Horizontal hydraulic gradients range from 0.0 to 0.012 foot per foot (ft/ft) where the lowest horizontal gradients were identified in the area West of Morgan Avenue and Klink Cosmo area; and the steepest horizontal gradients area were identified south of the Spic and Span area (0.053 ft/ft) and east of the ACME Steel source areas (0.12 ft/ft).
The vertical hydraulic gradients in well pairs varied in direction across the SC investigation area as indicated on Table 3-3. The vertical hydraulic gradient range from -0.062 to 0.17 ft/ft with the steepest downward (positive) gradients at well pairs DEC-037, DEC-062 and DEC-070 (Spic and Span area), DEC-018 (ACME Steel source areas), and DEC-045 (Klink Cosmo area). The steepest upward (negative) gradients are at DEC-016 (ACME Steel source areas) and DEC-054 (Spic and Span area). Vertical hydraulic gradients over much of the investigation are relatively flat as evidenced by vertical gradients approaching zero (-0.002 to 0.002).

Groundwater flow in the deep overburden is relatively flat within the Klink Cosmo area and West of Morgan Avenue. Groundwater flow is to the northeast in the ACME Steel source areas. Groundwater flow is generally to the east/northeast in the Spic and Span area.

3.5 Slug Test Results

Representative slug test results are presented on Table 3-4 for the source/potential source areas.

3.6 Standards, Criteria and Guidance Values

For each medium, detected concentrations of individual contaminants were compared to applicable standards, criteria and guidance values (SCGs). The site-specific SCGs were determined for the individual media as follows:

3.6.1 Soil

Three sources of soil SCGs are considered appropriate for this site: site-specific background soil samples, NYSDEC Part 375, and NYSDEC CP-51.

Soil samples were collected from the zero to two-foot depth interval at eight locations in McGolrick Park on August 3, 2011. These samples were analyzed for TCL/TAL contaminants. Detected concentrations are considered to be representative of site-specific background soil for the Meeker Avenue Plume Trackdown site. These soil background concentrations will be included as soil SCGs on the soil analytical tables presented in Section 4.
3.6.1.1 Background Soil Analytical Results

A summary of the detected analytical results in the background soil samples compared to unrestricted and protection of groundwater SCGs is presented in Table 3-5. Table 3-5 lists the detected analytical results for background soil samples within/near residences compared to residential SCGs for RI soil samples. Results exceeding criteria are indicated with circles and/or squares on the table. Table 3-6 provides a statistical summary of the detected TCL parameters for background soil samples as follows: the number of detections; the minimum, maximum and average values; the location and depth of the maximum value, and the number of exceedances of unrestricted use criteria. The complete validated analytical results from the SC soil samples are presented in the Data Usability Summary Report (DUSR) in Appendix O, on a compact disc. One VOC, toluene, was detected below unrestricted use criteria at six of the eight sampling locations. As indicated on Table 3-5, SVOCs, including PAHs, were detected in the majority of samples. One SVOC, di-n-butylphthalate, exceeded unrestricted use criteria at one location (SS-02). The pesticides 4,4’-DDD, 4,4’-DDE, and 4,4’-DDT were detected in all samples and exceeded unrestricted use criteria at all locations. Additionally, dieldrin exceeded unrestricted use criteria at two locations; gamma-chlordane was detected at three locations below unrestricted use criteria.

Metals which exceeded unrestricted use criteria in all samples include: copper, iron, lead, and mercury. Additionally, arsenic exceeded unrestricted use criteria at five locations, and zinc exceeded unrestricted use criteria at one location.

Since the detected concentrations of di-n-butylphthalate, 4,4’-DDD, 4,4’-DDE, 4,4’-DDT, dieldrin, arsenic, copper, iron, lead, mercury, and zinc exceeded unrestricted use criteria in the background soil samples, these contaminants are considered to be present as background conditions for the site. The maximum concentration of each contaminant detected at concentrations exceeding unrestricted use criteria is included as the soil background concentration and presented on the soil analytical results tables in Section 4.
3.6.1.2 Part 375 Criteria and CP-51

Part 375 criteria are considered as SCGs for soil samples in conjunction with CP-51 criteria. CP-51 supplements Part 375 by providing criteria for contaminants previously included under TAGM 4046 where values were not included in Part 375. Hereafter, mention of Part 375 includes incorporation of CP-51 criteria values. Part 375 unrestricted use criteria are considered to assist in the development of a remedial alternative capable of achieving unrestricted future use, as required by DER-10 Section 4.4 (b) 3 ii. In addition, criteria for the Protection of Groundwater are considered as SCGs for contaminants which exceed groundwater SCGs. These are identified in Section 4.

Land use in New York City is regulated by the City’s Zoning Resolution, which has two parts: zoning text and zoning maps. The text establishes zoning districts and sets forth regulations governing their land use and development. The maps show the locations and boundaries of the zoning districts. The City is divided into three basic zoning districts: residential (R), commercial (C), and manufacturing (M). The three basic districts are further divided into a range of lower-, medium-, and higher-density residential, commercial, and manufacturing districts.

The project area falls within multiple zoning districts identified by the New York City Department of City Planning (http://www.nyc.gov/html/dcp/html/zone/zh_zmaptable.shtml) including residential, manufacturing, and industrial. The current (2011) zoning and land use of individual properties may be determined through the NYCityMap (http://gis.nyc.gov/doitt/nycitymap).

Soil samples were obtained from soil borings on properties zoned residential and/or manufacturing by the NYC Department of City Planning. The zoning classification for the location of the soil boring is a consideration in the determination of the appropriate soil SCGs. The majority of properties within the investigation area are zoned manufacturing. A few residential properties are present. Properties located in the manufacturing districts in NYC may be either industrial or commercial use. However, land uses allowed within manufacturing districts include residential use either within special mixed use districts or by special permit. Residences may be present on properties throughout the entire investigation area. Therefore, the soil SCGs considered appropriate for the site are residential criteria (as opposed to commercial or industrial criteria). Part 375 restricted
residential and residential land use soil cleanup criteria for the soil samples are used on the soil analytical data tables in Section 4.

3.6.2 Groundwater

The SCGs for groundwater are the Class GA standards and guidance values presented in NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 1998 (including subsequent revisions). These groundwater SCGs are included on the groundwater analytical tables presented in Section 4.

3.6.3 Surface Water/ Sediments

No surface water or sediment samples were collected therefore no SCGs were determined.

3.6.4 Soil Vapor

There are no criteria for soil vapor analytical data.
4.0 ANAlytical RESULTS

The following sections discuss the results of the soil, groundwater and soil gas sample analyses for the SC Phase VI fieldwork at the Meeker Avenue Plume Trackdown site. The following discussion presents analytical results site wide and by source/potential source location as described in Section 1.3. Table 4-1A through Table 4-1E identify the groundwater monitoring wells within each source/potential source area. The ACME Steel areas will be discussed as one area since the majority of the work was performed at the eastern boundary of the ACME Steel/Metal Works area and the central portion of the ACME Steel/Brass Foundry area.

4.1 Soil Analytical Results

The soil sample results were compared to appropriate Part 375 criteria identified for the soil samples discussed in Section 3.6. (Soil analytical results for site-specific soil background samples collected as part of the determination of SCGs are presented and discussed in Section 3.6.) Seventy-eight soil samples were collected during the period August 9 through October 4, 2011 and included: 10 from soil vapor implant locations; 27 from monitoring well locations; and 41 from soil boring locations (Figure 4-1). At some locations, more than one sample was collected from multiple depths. A summary of the detected analytical results in all soil samples as compared to soil background concentrations, and unrestricted and protection of groundwater SCGs is presented in Table 4-2 for VOCs and Table 4-3 for SVOCs, pesticides/PCBs and metals. A summary of the detected analytical results in all soil samples as compared to residential and restricted residential SCGs are presented in Table 4-4 for VOCs and Table 4-5 for SVOCs, pesticides/PCBs and metals. Results exceeding criteria are indicated with circles and/or squares on the tables. Table 4-6 provides a statistical summary of the detected TCL parameters for all soil samples collected by URS during the SC Phase VI as follows: the number of detections; the minimum, maximum and average values; and the location and depth of the maximum value.

The complete validated analytical results from the SC Phase VI soil samples are presented in the DUSR in Appendix O, on a compact disc. Data summary tables, Form I and Form Ie (TICs) are provided in the DUSR and include the reporting limit for each non-detected compound. Soil data
Soil samples collected from DEC-041TC, DEC-067D, DEC-068, DEC-068D, DEC-080D, MW-030D, SSB-11, SSB-12, SSB-13, SSB-15, SSB-16, SSB-18, and SSB-22 exceeded both unrestricted use and protection of groundwater criteria. Acetone exceeded these criteria at DEC-041TC (125-126 feet bgs) and DEC-068 (10-12 feet bgs). Acetone and methylene chloride exceeded these criteria at DEC-067D (13-14 feet bgs). Isopropylbenzene exceeded these criteria at SSB-12 (20-21 feet bgs). PCE exceeded these criteria at DEC-080D (5-6 feet bgs), SSB-11 (24-25 feet bgs and 53-54 feet bgs), SSB-15 (0-5 feet bgs and 16.5-17.5 feet bgs), SSB-16 (1-2 feet bgs and 26-27 feet bgs), SSB-18 (10-11 feet bgs), and SSB-22 (22.5-23.5 feet bgs). TCE exceeded these criteria at MW-030D (82-83 feet bgs) and SSB-13 (14-15 feet bgs, 19-20 feet bgs, and 24-25 feet bgs). PCE and TCE exceeded these criteria at SSB-16 (14-15 feet bgs). PCE, TCE, and cis1,2-DCE exceeded these criteria at DEC-080D (0-2 feet bgs). PCE, TCE, cis1,2-DCE, 1,1-dichloroethene, 1,1,1-trichloroethane, and 1,2,4-trichlorobenzene exceeded these criteria at SSB-11 (15-16 feet bgs). Xylenes (total) exceeded unrestricted use criteria at DEC-068D (14-15 feet bgs). The pesticides Endrin, 4,4’-DDE 4,4’-DDT, and Dieldrin exceeded unrestricted use criteria, but were lower than soil background criteria.

Soil samples collected from DEC-041TC, SSB-11, SSB-12, SSB-13, SSB-14, and SSB-15 exceeded unrestricted use criteria for metals. Chromium exceeded this criteria at DEC-041TC (125-126 feet bgs). Zinc exceeded this criteria at SSB-11 (24-25 feet bgs). Iron exceeded this criteria at SSB-12 (20-21 feet bgs), SSB-13 (24-25 feet bgs and 30-32 feet bgs), and SSB-14 (23-25 feet bgs). Calcium and iron exceeded this criteria at SSB-12 (44-45 feet bgs). Iron and vanadium exceeded this criteria at SSB-14 (14-15 feet bgs). Calcium, chromium +6, and iron exceeded this criteria at SSB-11 (46-47 feet bgs). Calcium and chromium exceeded this criteria at SSB-11 (0-5 feet bgs). Aluminum exceeded soil background concentrations in DEC-041TC (125-126 feet bgs) and SSB-15 (40-41 feet bgs), as did iron in DEC-041TC (125-126 feet bgs), SSB-11 (0-5 feet bgs, 15-16 feet bgs, and 24-25 feet bgs), SSB-12 (0-5 feet bgs and 16-17 feet bgs), SSB-13 (10-12 feet bgs and 14-15 feet bgs), SSB-14 (7-9 feet bgs), and SSB-15 (0-5 feet bgs and 40-41 feet bgs).
Soil sample results were compared to residential and restricted residential use criteria as shown on Figure 4-2. Soil samples collected from DEC-080D, SSB-11, SSB-13, and SSB-16 exceeded criteria for VOCs. PCE exceeded these criteria at DEC-080D (0-2 feet bgs and 5-6 feet bgs) and SSB-16 (1-2 feet bgs and 14-15 feet bgs). TCE exceeded these criteria at SSB-13 (19-20 feet bgs). PCE and TCE exceeded these criteria at SSB-11 (15-16 feet bgs).

The only metal which exceeded criteria for residential and restricted residential use was iron in DEC-041TC (125-126 feet bgs), SSB-11 (0-5 feet bgs, 15-16 feet bgs, 24-25 feet bgs, 46-47 feet bgs, and 53-54 feet bgs), SSB-12 (0-5 feet bgs, 16-17 feet bgs, 20-21 feet bgs, and 44-45 feet bgs), SSB-13 (10-12 feet bgs, 14-15 feet bgs, 24-25 feet bgs, and 30-32 feet bgs), SSB-14 (7-9 feet bgs, 14-15 feet bgs, and 23-25 feet bgs), and SSB-15 (0-5 feet bgs, 16.5-17.5 feet bgs, 33-34 feet bgs, and 40-41 feet bgs).

The following discussion presents soil analytical results by source/potential source location.

### 4.1.1 Spic and Span Area

Soil samples from DEC-037D, DEC-067D, DEC-068/068D, and DEC-070D are within the Spic and Span area. Only acetone in DEC-067D and DEC-068 and methylene chloride in DEC-067D exceeded unrestricted use criteria.

Soil samples were collected from SSB-11 through SSB-14, which are located along the west side of Kingsland Avenue and south side of Norman Avenue, and soil samples were collected from SSB-15 through SSB-25 located in the vicinity of DEC-025. VOCs, including PCE and its degradation products, were detected and exceeded unrestricted use criteria in SSB-11, located south of DEC-024, at several depths (5-6 feet bgs, 15-16 feet bgs, 24-25 feet bgs, and 53-54 feet bgs). The highest concentration of PCE was detected in sample SSB-11 (15-16 feet bgs). PCE was also detected above criteria in SSB-16 (14-15 feet bgs, 26-27 feet bgs) and SSB-22 (22.5-23.5 feet bgs). TCE exceeded unrestricted use criteria in SSB-13 (14-15 feet bgs, 19-20 feet bgs, 24-25 feet bgs), SSB-15 (0-5 feet bgs, 16.5-17.5 feet bgs), SSB-16 (1-2 feet bgs, 14-15 feet bgs), and SSB-18 (10-11 feet bgs). Isopropylbenzene exceeded unrestricted use criteria in SSB-12 (20-21 feet bgs).
4.1.2 Klink Cosmo Area

There were no unrestricted use criteria exceedances in the sample collected from DEC-029TC.

4.1.3 ACME Steel Areas

VOCs exceeding unrestricted use criteria include PCE, TCE, and/or cis-1,2-DCE in DEC-080/080D.

4.1.4 Potential Source Areas West of Morgan Avenue

There were no exceedances of unrestricted use criteria in samples collected from West of Morgan Avenue.

4.2 Non-Aqueous Phase Liquid

4.2.1 Dense Non-Aqueous Phase Liquid Analytical Results

DNAPL was detected in DEC-024D and DEC-024DR during the SC Phase VI field investigation. A sample was collected from DEC-024DR on November 9, 2011. Analytical results indicated the following:

- PCE was detected at 110,000,000 µg/kg (11%); TCE was detected at 220,000 µg/kg; cis-1,2-DCE was detected at 7,300 µg/kg; and 1,2,4-trichlorobenzene was detected at 9,400 µg/kg in DEC-024DR during the SC Phase VI investigation.

- Laboratory measured parameters from the DNAPL sample from DEC-024DR include: viscosity of 1.21 centipoise, surface tension of 26.4 dynes/cm, and specific gravity of 1.2942.

DNAPL samples were collected and analyzed during other SC and RI phases. Results are summarized below.
4.2.2 Light Non-Aqueous Phase Liquid Analytical Results

No LNAPL samples were collected during the SC Phase VI field investigations. However, LNAPL samples were collected and analyzed during other SC and RI phases. Results are summarized below.

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Density (g/mL)</th>
<th>Viscosity (centipoise)</th>
<th>Surface Tension (dynes/cm)</th>
<th>PCE Concentration (mg/kg)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEC-034</td>
<td>0.8218</td>
<td>2.14</td>
<td>25.3</td>
<td>1.1</td>
<td>URS/Roux split, July 9, 2009</td>
</tr>
<tr>
<td>DEC-054</td>
<td>0.8019</td>
<td>1.46</td>
<td>22.9</td>
<td>ND</td>
<td>URS/Roux split, July 1, 2009</td>
</tr>
<tr>
<td>DEC-053</td>
<td>0.7847</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>URS, March 9, 2011; gasoline and petroleum compounds</td>
</tr>
<tr>
<td>DEC-048</td>
<td>0.8608</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>URS, June 24, 2011; No. 2 fuel- 950,000 mg/kg (95%)</td>
</tr>
</tbody>
</table>
4.3 **Groundwater Analytical Results**

A summary of the detected TCL VOCs, iron, miscellaneous parameters, dissolved gases and field parameters in the 101 SC Phase VI groundwater samples plus QA/QC samples collected from monitoring wells is presented in Table 4-7. Results exceeding TOGS No. 1.1.1 Class GA groundwater criteria are indicated with a circle. Four groundwater samples were also analyzed for SVOCs, pesticides/PCBs, metals, and indicator parameters. Results are presented in Table 4-8. Table 4-9 provides a statistical summary of the detected parameters for the SC Phase VI groundwater samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the SC Phase VI groundwater samples are presented in the DUSR in Appendix O. Data summary tables, Form I and Form Ie (TICs) are provided in the DUSR and include the reporting limit for each non-detected compound.

The locations of detected compounds that have exceeded their Class GA groundwater criteria are shown on Figure 4-3. Isoconcentration contours of PCE in the SC Phase VI groundwater samples are shown on Figures 4-4 and 4-5 for shallow and deep overburden groundwater and indicate the source and potential source areas. The maximum detected PCE concentration was identified in monitoring well DEC-014R, downgradient of the Klin Cosmo site. Figure 4-6 presents PCE isoconcentration contours at the top of Raritan Formation. Figures 4-7, 4-8, and 4-9 present the isoconcentration contours for TCE in the shallow and deep overburden groundwater, and at the top of Raritan Formation, respectively. The maximum detected TCE concentration was identified in monitoring well MW-030D, within the ACME Steel Areas.

PCE degradation products were typically found at the highest concentrations in wells located in areas where non-chlorinated hydrocarbons are present (e.g., closest to the Off-Site Plume area boundary to the northeast and east of Spic and Span). The maximum concentrations of BTEX compounds were detected in DEC-053 north of the Spic and Span site. Fuel hydrocarbons serve as electron donors. Their presence, combined with low redox conditions, can allow bacteria to reductively dechlorinate chlorinated hydrocarbons. The maximum concentrations of vinyl chloride was detected in DEC-058, located immediately downgradient of the Spic and Span site, adjacent to the ExxonMobil property.
4.3.1 **Spic and Span Area**

PCE and its degradation products were detected in numerous groundwater monitoring wells in both the shallow and deep overburden groundwater. They were not detected in the upgradient top of clay monitoring well (DEC-035TC). Top of clay monitoring wells situated at DEC-058, DEC-062, and DEC-063 well clusters were not yet installed. These wells were recently sampled during activities conducted as part of the Spic and Span Phase II RI field investigation. High concentrations of PCE were detected adjacent to the Former Spic and Span Building in DEC-057 and DEC-057D at concentrations of 4,200 and 45,000 µg/L, respectively as shown on Figures 4-4 and 4-5; downgradient of the site in DEC-058 and DEC-058D, to the northeast, at concentrations of 14,000 and 40,000 µg/L, respectively; to the east in DEC-060 and DEC-060D at concentrations of 22,000 and 15,000 µg/L, respectively, and in DEC-036 and DEC-036D at concentrations of 5,000 and 2,600 µg/L, respectively; and to the southeast in DEC-061 and DEC-061D at concentrations of 1,800 and 4,600 µg/L, respectively.

TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected. Vinyl chloride was detected above criteria generally to the north and east of the site, as well as in DEC-024; the maximum vinyl chloride concentration was detected in DEC-058 immediately downgradient of the site and adjacent to the ExxonMobil property. Additionally BTEX and/or fuel-related compounds were detected in DEC-053, DEC-054, DEC-058D, and DEC-037R.

Based upon the October 2011 sampling event, the dissolved phase chlorinated solvent plume in the shallow and deep overburden groundwater is similar to the March 2011 sampling event as presented in the Phase 1 Spic and Span RI (URS, July 2011). PCE appears to have migrated downgradient of the Spic and Span property in the direction of groundwater flow, towards the northeast and east. Higher concentrations of PCE were generally detected in the deep overburden as compared to the shallow overburden (i.e., DEC-057 vs. DEC-057D, DEC-058 vs. DEC-058D and the presence of DNAPL containing 11-73% PCE in DEC-024D and DEC-024DR). In the deep overburden groundwater, migration has also occurred to the southeast, in a direction not previously observed and inconsistent with the groundwater flow direction presented on Figure 3-14. Additional deep overburden groundwater wells were installed in November-December 2011 as part of the Phase
II Spic and Span RI field investigation. Sampling of the additional deep groundwater wells was recently completed, and results should help determine the overall horizontal and vertical extent of PCE and TCE contamination in the deep overburden groundwater. The dissolved chlorinated solvent plume in the deeper groundwater appears to be impacted by both the presence of DNAPL at the Spic and Span Site (i.e., DEC-024D and DEC-024DR) and the presence of PCE soil contamination at 300 Kingsland Avenue (i.e., DEC-025 and DEC-025D). The plume is spreading with groundwater flow towards the northeast and east with a southerly component, and via downward migration to deeper geologic zones. The vertical extent of PCE and TCE impacted groundwater is not expected to migrate below the top of the Raritan Formation due to its vast areal extent and low permeability.

4.3.2 Klink Cosmo Area

PCE and its degradation products were detected in numerous groundwater monitoring wells in both the shallow and deep overburden groundwater as well as in the downgradient top of clay monitoring wells. High concentrations of PCE were detected at the site (DEC-031) in the shallow overburden groundwater (only) at a concentration of 5,800 µg/L; and downgradient of the site to the northeast (DEC-014R) at a concentration of 46,000 µg/L; (DEC-029/029D/029TC) at concentrations of 4,400, 27 and 2,800 µg/L, respectively; (DEC-007/007D) at concentrations of 1,400 and 400 µg/L, respectively, and (DEC-006D/006DD) at concentrations of 8,000 and 440 µg/L, respectively; and to the north (DEC-008) at a concentration of 3,000 µg/L, and DEC-028 at a concentration of 3,100 µg/L.

TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected. Vinyl chloride was detected above criteria only in DEC-009. Additionally BTEX and/or fuel-related compounds were generally absent within the Klink Cosmo Area.

The observed extent of PCE in the shallow and deep overburden groundwater is similar to the extent of PCE presented in the Phase 1 Klink Cosmo RI (URS. December 2011). The concentration of PCE in the shallow overburden groundwater is highest at the downgradient edge and downgradient of the Klink Cosmo property in the direction of groundwater flow towards the northeast. PCE has also migrated to the north. The downgradient edge of PCE in the shallow overburden groundwater extends into the PCE plume originating within the ACME Steel Areas. PCE has migrated vertically to the
deep overburden groundwater north and east, and downgradient of the Klink Cosmo property. PCE concentrations are lower in the deep overburden groundwater compared to the shallow overburden groundwater. However, PCE has migrated vertically downwards to the top of the Raritan Formation downgradient of the Klink Cosmo property. The horizontal extent of PCE in the groundwater found at the top of the Raritan Formation extends into the ACME Steel Areas. The chlorinated solvent plume is not expected to extend beyond the top of the Raritan Formation due to its vast areal extent and low permeability.

4.3.3 **ACME Steel Areas**

Within the ACME Steel Areas, the highest concentration of PCE was detected at DEC-040 at a concentration of 6,800 µg/L. TCE (62 µg/L) and cis-1,2-DCE (20 µg/L) were also detected in this monitoring well. PCE was detected in upgradient monitoring wells (DEC-041/041D/041TC) at concentrations of 620, 200 and 2,500 µg/L, respectively; sidegradient monitoring wells (DEC-018/018D/018TC) at concentrations of 1,800, 56, and 69 µg/L, respectively; downgradient monitoring wells to the northeast (DEC-080/080D) at concentrations of 1,600 and 16,000 µg/L, respectively; (DEC-017/017D) at concentrations of 680 and 1,300 µg/L, respectively; and (DEC-079) at a concentration of 1,500 µg/L.

TCE and/or cis-1,2-DCE were generally detected above criteria in monitoring wells where PCE was detected. An elevated concentration of TCE (29,000 µg/L in MW-030D) was detected in the deep overburden groundwater downgradient of the ACME Steel Areas. No vinyl chloride or BTEX compounds were detected in this area.

4.3.4 **Potential Source Areas West of Morgan**

PCE was detected in DEC-076 at a concentration of 30,000 µg/L and in DEC-077 at a concentration of 110 µg/L. PCE degradation product concentrations detected in this area included: TCE at concentrations of 200 and 12 µg/L in DEC-076 and DEC-077, respectively; cis-1,2-DCE at concentrations of 1,500 and 13 µg/L in DEC-076 and DEC-077, respectively; and vinyl chloride at a concentration of 4.8 µg/L in DEC-076. Additional VOCs which exceeded GA criteria in the
groundwater sample from DEC-076 include: 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, trans 1,2-DCE, benzene, and xylene.

4.4 **Baseline Groundwater Monitoring**

Groundwater analytical data has been collected within the Meeker Avenue Plume Trackdown area during previous phases of site characterization as well as during this SC Phase VI. This data includes both laboratory analytical results and field results. Existing groundwater laboratory and field analytical data will be evaluated and assessed to determine if statistical trends are observed. The October 2011 sampling results establish the baseline data for future comparison of groundwater sampling data, which will be used to evaluate the potential for natural attenuation. Parameters considered include:

- **DNAPL** – the presence of DNAPL indicates the presence of source material.
- **PCE** – the presence of PCE indicates the presence of dissolved-phase source material.
- **TCE** – the presence of TCE indicates either the degradation of PCE or the presence of dissolved-phase source material.
- **Cis-1,2-DCE** – the presence of cis-1,2-DCE indicates the degradation of TCE.
- **Vinyl Chloride** – TCE reduces to cis-1,2-DCE then to vinyl chloride. Vinyl chloride is difficult to dechlorinate further without very strong reducing conditions; it can accumulate in the aquifer.
- **Ethene** – presence in groundwater is indicative of strongly reducing conditions, and vinyl chloride reduces to ethene.
- **Ferrous iron** – iron reducing conditions are favorable to the process of reductive dechlorination. Concentrations of ferrous iron higher than 1 mg/L suggest iron reduction is occurring, and thus oxidation/reduction (redox) conditions are suitable for reductive dechlorination.
• Sulfate – Lower sulfate concentrations indicate zones of active sulfate reduction which are also favorable for dechlorination.

• Dissolved Oxygen – Dissolved oxygen is the most favored electron acceptor in biodegradation of hydrocarbons. Levels of less than 1 mg/L indicate that aerobic degradation has occurred, oxygen has been largely utilized, and a shift to anaerobic processes is taking place. Reductive dechlorination takes place under anaerobic conditions, generally when the DO levels are less than 0.5 mg/L. Typically, the anaerobic environment is created by the degradation of non-chlorinated compounds such as BTEX.

• oxidation/reduction potential (ORP) - as defined by the field measured value of Eh. Reductive dechlorination becomes possible at Eh levels of less than approximately 50 mV. The likelihood of reductive dechlorination is significant for ORP values less than -100 mV.

Similar to chloroethenes, the common chloroethanes and chloromethanes may be reduced as follows:

• Chloroethanes: 1,1,1-TCA → 1,1-DCA → chloroethane → ethane.

• Chloromethanes: carbon tetrachloride → chloroform → methylene chloride → chloromethane → methane.

Concentrations of the parameters which have been detected over the historic and current sampling events are presented by source/potential source area on Table 4-10 for the Spic and Span Area; Table 4-11 for the Klink Cosmo Area; Table 4-12 for the ACME Steel/ Metal Works; 4-13 for the ACME Steel/ Brass Foundry; and Table 4-14 for West of Morgan Avenue. Figures 4-10 through 4-16 show the concentrations of PCE for the respective source/potential source areas for selected monitoring well locations. A detailed trend analysis will be conducted as part of the Phase VII SC investigation. However, some general observations are noted below from data presented on Figures 4-10 through 4-16.
• In the shallow overburden monitoring wells which have been sampled during more than one sampling event in the Spic and Span area, PCE concentrations have increased north of the site (DEC-057) and downgradient of the site (DEC-025), decreased adjacent to the site (DEC-024), and generally remained on the same order of magnitude for the remainder of the wells.

• In the shallow overburden monitoring wells which have been sampled during more than one sampling event downgradient of the Klink Cosmo area, PCE concentrations have increased in DEC-028 and DEC-008 and decreased in DEC-031, DEC-044, and DEC-013.

• In the shallow overburden monitoring wells which have been sampled during more than one sampling event, concentrations of PCE generally decreased in most wells (except in the monitoring wells closest to ACME Steel Brass Foundry – DEC-016, DEC-022D, DEC-040, and DEC-041).

• In the shallow overburden monitoring wells which been sampled during more than one sampling event (DEC-011, DEC-010), concentrations of PCE have decreased by less than one order of magnitude West of Morgan Avenue. In DEC-004, the concentration of TCE has decreased by three orders of magnitude to non-detect during the latest round of sampling.

4.5 Soil Gas Analytical Results

The locations of the VOCs detected in soil gas during SC Phase VI including PCE and its breakdown products are shown on Figure 4-17. Isoconcentration contours of PCE and TCE in the SC Phase VI soil gas samples are shown on Figures 4-18 and 4-19, respectively. A summary of detected VOCs in soil gas collected during the SC Phase VI is presented in Table 4-15. Table 4-16 provides a statistical summary of the detected parameters for the SC Phase VI soil gas samples as follows: the number of detections; the minimum, maximum and average values; and the location of the maximum value. The complete validated analytical results from the SC Phase VI soil gas samples are presented in the DUSR in Appendix O. Data summary tables and Form I’s are provided in the DUSR and include the reporting limit for each non-detected compound.

Three ambient air samples were collected during the field investigations to represent background air conditions. VOCs detected in all three ambient air samples include 1,1,2-trichloro-
1,2,2-trifluoroethane, 2-hexanone, 4-methyl-2-pentanone, acetone, benzene, carbon tetrachloride, chloromethane, cyclohexane, dichlorodifluoromethane, ethylbenzene, methylene chloride, styrene, PCE, toluene, trichlorofluoromethane, and xylene. Concentrations of VOCs ranged from 0.018 to 480 µg/m³. Additionally, methyl acetate, methylcyclohexane and TCE were detected in two of the three ambient air samples. 1,4-dichlorobenzene, chloromethane, MEK and tetrahydrofuran were detected in one of the three ambient air samples.

PCE was detected at all of the 28 sampling locations, at concentrations ranging from 34 µg/m³ to a maximum of 130,000 µg/m³ at location SG-095. This maximum PCE soil gas concentration is adjacent to the potential source areas West of Morgan Avenue. Additional high concentrations of PCE detected away from the potential source areas West of Morgan Avenue and the Klink Cosmo site include:

- SG-056 along Division Place at 56,000 µg/m³;
- SG-054 downgradient of the potential source areas along Morgan Avenue at 13,000 µg/m³;
- SG-048 near the corner of Division Place and Vandervoort Avenue at 34,000 µg/m³;
- SG-0043 near the corner of Vandervoort Avenue and Beadel Street at 13,000 µg/m³; and
- SG-040 near the corner of Vandervoort Avenue and Lombardy Street at 17,000 µg/m³.

Concentrations of TCE were detected at all locations where PCE was detected (with the exception of SG-089), at lower concentrations; however, the maximum concentration of TCE was detected at location SG-091 (19,000 µg/m³) where the PCE concentration was 310 µg/m³. Additional high concentrations of TCE were at similar locations as high PCE concentrations and include:

- SG-040 near the corner of Vandervoort Avenue and Lombardy Street at 4,100 µg/m³;
- SG-043 near the corner of Vandervoort Avenue and Beadel Street at 2,000 µg/m³;
- SG-054 downgradient of the potential source areas along Morgan Avenue at 3,500 µg/m³;
- SG-056 along Division Place at 5,000 µg/m³; and
- SG-095 adjacent to the potential source areas west of Morgan Avenue at 8,700 µg/m³.
Additional VOCs detected include: benzene, toluene, ethylbenzene and xylene (BTEX) at all locations (with the exception of no ethylbenzene detected at SG-017), and related compounds (e.g., 1,3-dichlorobenzene), hexane-related compounds (e.g., cyclohexane, methylcyclohexane) in a majority of samples, and 1,1,1-trichloroethane in a majority of samples. These contaminants suggest possible petroleum or fuel source(s). Trichlorofluoromethane was detected in all samples.
5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based upon the results of the previous site investigations, the following conclusions are provided. Field investigations previously performed in the study area north of Meeker Avenue are Site Characterization Phases I, II, III and V, and the Spic and Span RI. Field investigations previously performed in the study area south of Meeker Avenue are Phases I, II, III and IV. Groundwater Split Sampling with CSIA analyses in September 2009, Groundwater Sampling Event in November 2009, and the Klink Cosmo RI.

5.1.1 Geology

- The potentiometric surface may be found between approximately 11 and 55 feet bgs across the Meeker Avenue Plume Trackdown Site.

- A perched shallow groundwater zone was identified in the area West of Morgan Avenue. Groundwater flow in this area is towards the east.

- The flow of the shallow overburden groundwater in the Spic and Span Area is to the north and northeast. The flow of the deep overburden groundwater in the Spic and Span Area is to the northeast.

- The flow of the shallow overburden groundwater in the Klink Cosmo Area and West of Morgan Avenue is to the north and northeast. The flow of the deep overburden groundwater in the Klink Cosmo Area is to the northeast.

- The flow of the shallow overburden groundwater in the ACME Steel Areas is to the north and northeast. The flow of the deep overburden groundwater in the ACME Steel Areas is to the north and northeast.

- Horizontal hydraulic gradients range from 0.0 to 0.053 foot per foot (ft/ft). The lowest horizontal gradient was observed West of Morgan Avenue and Klink Cosmo Area (0.0 to
0.012 ft/ft). The steepest horizontal gradients are found south of the Spic and Span Area (0.053 ft/ft) and east of the ACME Steel Areas (0.12 ft/ft).

- An inclusive sand layer containing DNAPL and high PCE concentrations was identified within the glacial till unit in the vicinity of SSB-11, which is located adjacent to the Former Spic and Span Cleaners building.

- A thick silt unit was encountered at DEC-073 from 5.0 to 49.0 feet bgs and appears to run north/south West of Morgan Avenue. The thick silt unit appears to be a hydraulic barrier to the shallow groundwater flow from wells to the west of this location (i.e., DEC-072, DEC-075, DEC-076, and DEC-077) resulting in a perched water table. The potentiometric surface at these four well locations is approximately 13.5 to 18.06 feet higher than the wells to the east of the silt unit.

- The entire thickness of the upper glacial aquifer has been penetrated throughout most of the Meeker Avenue Plume Trackdown Site and it varies from approximately 108.5 to 138 feet.

- The top of the Raritan Formation was encountered across the site. The elevation of the Raritan Formation varied at depths between -56.95 to -121.19 feet amsl and has been described as gray with white banding, brown, brownish gray, greenish gray, dark gray to greenish brown, fine sand and silt, clays with carbonized plant fragments and , clays with varying amounts of sand, to silts with varying amounts of sand and clay. The top of the Raritan Formation slopes towards the west and northwest. The Raritan Formation is a well-defined aquiclude regionally and has significant lateral extent. Permeabilities within the unit are less than 10^-6 cm/sec.

5.1.2 Soil

5.1.2.1 Spic and Span Area

VOCs, including PCE and its degradation products were detected and exceeded unrestricted use criteria in SSB-11, located south of DEC-024, and at several depths (5-6 feet bgs, 15-16 feet bgs, 24-25 feet bgs, and 53-54 feet bgs). The highest concentration of PCE detected was observed in
sample SSB-11 (15-16 feet bgs). PCE was also detected above criteria in SSB-16 (14-15 feet bgs, 26-27 feet bgs) and SSB-22 (22.5-23.5 feet bgs). TCE exceeded unrestricted use criteria in SSB-13 (14-15 feet bgs, 19-20 feet bgs, 24-25 feet bgs); SSB-15 (0-5 feet bgs, 16.5-17.5 feet bgs); SSB-16 (1-2 feet bgs, 14-15 feet bgs); and SSB-18 (10-11 feet bgs).

A shallow source of PCE and DNAPL has been identified within the inclusive sand layer in the vicinity of SSB-11, which is located along the eastern side of the Former Spic and Span Cleaners building, along Kingsland Avenue. The inclusive sand layer has been found to contain elevated concentrations of PCE and DNAPL. The bottom of the northern edge of the inclusive sand layer has vertical sand stringers present with DNAPL in them and represents a vertical pathway from the shallow zone through the glacial till unit into the lower units. DNAPL was noted in sand stringers located within the top of the clayey silt unit at SSB-30 at approximately 63 feet bgs. The northern edge of the inclusive sand layer is approximately 35 feet from DEC-024D and DEC-024DR, where DNAPL has been found at the top of the clayey silt unit. The north/south (horizontal) extent of the inclusive sand layer appears to have been delineated and a vertical profile has been established. The eastern and western extent of the impacted inclusive sand layer in the vicinity of SSB-11 has not been delineated.

An unrelated shallow source of PCE contamination was identified in the vicinity of DEC-025 and DEC-025D, which is located on the east side of Kingsland Avenue, south of the Former Spic and Span Cleaners building in front of 300 Kingsland Avenue. The highest concentration of PCE was found within the top 2.5 feet bgs, below the sidewalk (1,300 mg/kg) at DEC-025D. SSB-16, which is located approximately 10 feet south of DEC-025D, had the highest PID readings (336 to 1,528 ppm) in the upper 20 feet. Below 20 feet, PID readings in SSB-16 decreased to 0 ppm below 26.0 feet bgs. The remainder of the borings around DEC-025 and DEC-025D had significantly lower PID readings. It appears that the most PCE impacted soil is within the top 20 feet of soil, between 30 feet north and 10 feet south of DEC-025 and DEC-025D. The north/south horizontal extent of the impacted soil appears to have been delineated and a vertical profile has been established. The eastern extent of the impacted soil near DEC-025 and DEC-025D has not been delineated.
5.1.2.2 **Klink Cosmo Area**

There were no exceedances of unrestricted use or protection of groundwater criteria in soil samples from either the Klink Cosmo Area or West of Morgan Avenue. This is consistent with information from previous phases of the SC.

5.1.2.3 **ACME Steel Areas**

Soil samples from DEC-17D, DEC-041TC, DEC-079, DEC-080/080D, DEC-081, DEC-082, and MW-030D are within the ACME Steel Areas. VOCs exceeding unrestricted use criteria include PCE, TCE, and/or cis-1,2-DCE in DEC-080/080D.

Based upon the analytical results from samples collected at DEC-080 and DEC-080D, there appears to be a shallow source of impacted soil in the vicinity of the northwest corner of the building located at 514 Varick Street. PCE was detected in the soil at DEC-080D in the 0-2.0 foot and 5.0 to 6.0 foot bgs interval at 11,000 and 1,100 mg/kg, respectively. The impacted soil may be adversely impacting the groundwater in the vicinity of DEC-080 and DEC-080D. The horizontal extent of impacted soil has not fully been delineated in this area.

5.1.2.4 **Potential Source Areas West of Morgan**

There were no exceedances of unrestricted use or protection of groundwater criteria from soil samples West of Morgan Avenue.

5.1.3 **NAPL**

- DNAPL was found in DEC-024D and DEC-024DR. Analytical results indicated:
  
  o PCE was detected at 110,000,000 µg/kg (11%); TCE was detected at 220,000 µg/kg; cis-1,2-DCE was detected at 7,300 µg/kg; and 1,2,4-trichlorobenzene was detected at 9,400 µg/kg in DEC-024DR during Phase VI.
  
  o Laboratory measured parameters from the DNAPL sample from DEC-024DR include: viscosity of 1.21 centipoise, surface tension of 26.4 dynes/cm, and specific gravity of 1.2942.
- LNAPL was measured in several monitoring wells: DEC-021, DEC-024, DEC-034, and DEC-053 at thicknesses of 0.1, 0.01, 3.74, and 0.55 feet, respectively. These wells are situated in the Spic and Span Area.

5.1.4 Groundwater

5.1.4.1 Spic and Span Area

PCE and its degradation products were detected in numerous groundwater monitoring wells in both the shallow and deep overburden groundwater. The impact on deep overburden groundwater at the top of the Raritan Formation has not yet been determined. Monitoring wells DEC-058TC, DEC-062TC, and DEC-063TC were only recently sampled during activities conducted as part of the Phase II Spic and Span RI and results are pending. No chlorinated solvents were detected in upgradient top of clay monitoring well DEC-035TC. Elevated concentrations of dissolved phase PCE were detected adjacent to the Former Spic and Span Building in DEC-057 and DEC-057D at concentrations of 4,200 and 45,000 µg/L, respectively as shown on Figures 4-4 and 4-5; downgradient of the site in DEC-058 and DEC058D, to the northeast, at concentrations of 14,000 and 40,000 µg/L, respectively; to the east in DEC-060 and DEC-060D at concentrations of 22,000 and 15,000 µg/L, respectively; and in DEC-036 and DEC-036D at concentrations of 5,000 and 2,600 µg/L, respectively; and to the southeast in DEC-061 and DEC-061D at concentrations of 1,800 and 4,600 µg/L, respectively. TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected. Vinyl chloride was detected above criteria generally to the north and east of the site, as well as in DEC-024; the maximum vinyl chloride concentration was detected in DEC-058 immediately downgradient of the site adjacent to the ExxonMobil property. BTEX and/or fuel-related compounds were detected in DEC-053, DEC-054, DEC-058D, and DEC-037R.

Based upon the observed concentrations of VOCs from the latest groundwater sampling event, a dissolved chlorinated solvent plume appears to originate at the Spic and Span Site, and an additional unknown apparent source is present adjacent to 300 Kingsland Avenue. In the shallow groundwater, it appears that the chlorinated solvent plume has higher concentrations of PCE immediately north and east of the Spic and Span Site, and is more discrete compared to the deeper groundwater. In the deeper groundwater, the complete horizontal extent of the chlorinated solvents has not been
completely delineated. Additional deep monitoring wells and top of clay wells were recently installed as part of the Phase II Spic and Span RI field investigation. Analytical results are pending and results will help to determine the horizontal and vertical extent of dissolved phase groundwater contamination in the deep groundwater. The dissolved chlorinated solvent plume in the deeper groundwater appears to be impacted by both sources of PCE contamination and is spreading with groundwater flow towards the northeast and east with a southerly component, and via downward migration to deeper geologic zones. The vertical extent of PCE and TCE impacted groundwater is not expected to migrate below the top of the Raritan Formation due to its vast areal extent and low permeability.

5.1.4.2 Klink Cosmo Area

PCE and its degradation products were detected in numerous groundwater monitoring wells in both the shallow and deep overburden groundwater as well as in downgradient top of clay monitoring wells. High concentrations of PCE were detected at the site (DEC-031) in the shallow overburden groundwater at a concentration of 5,800 µg/L; and downgradient of the site to the northeast (DEC-014R) at a concentration of 46,000 µg/L; (DEC-029/029D/029TC) at concentrations of 4,400, 27 and 4,400 µg/L, respectively; (DEC-007/007D) at concentrations of 1,400 and 400 µg/L, respectively, and (DEC-006D/006DD) at concentrations of 8,000 and 440 µg/L, respectively; and to the north (DEC-008) at a concentration of 3,000 µg/L, and DEC-028 at a concentration of 3,100 µg/L. TCE and cis-1,2-DCE were generally detected above criteria where PCE was detected. Vinyl chloride was detected above criteria only in DEC-009. BTEX and/or fuel-related compounds were generally not detected within the Klink Cosmo area.

Based upon the observed concentrations of VOCs from the latest groundwater sampling event, a dissolved chlorinated solvent plume appears to originate at the Klink Cosmo Site. The horizontal extent of the chlorinated solvents has been mostly delineated. It appears that the chlorinated solvent plume in the shallow and deep overburden have higher concentrations of PCE immediately north and east of the Klink Cosmo site. The extent of PCE has a larger footprint in the shallow groundwater compared to the deep groundwater and appears to be moving to the northeast and comingles with the dissolved chlorinated solvent plume originating within the ACME Steel Areas. The vertical extent of PCE and TCE impacted groundwater was determined to extend down to the top of the Raritan
Formation. The horizontal extent of PCE impacted groundwater in the deep overburden near the top of the Raritan Formation has not fully been delineated. The impacted groundwater appears to be migrating to the northeast and extends into the ACME Steel Areas in the vicinity the intersection of Porter Avenue and Lombardy Street. The vertical extent of PCE and TCE impacted groundwater is not expected to migrate below the top of the Raritan Formation due to its vast areal extent and low permeability.

5.1.4.3 ACME Steel Areas

The highest concentration of PCE was detected at DEC-040 at a concentration of 6,800 µg/L. TCE (62 µg/L) and cis-1,2-DCE (20 µg/L) were also detected in this monitoring well. PCE was detected in upgradient monitoring wells (DEC-041/041D/041TC) at concentrations of 620, 200 and 2,500 µg/L, respectively; sidegradient monitoring wells (DEC-018/018D/018TC) at concentrations of 1,800, 56, and 69 µg/L, respectively; downgradient monitoring wells to the northeast (DEC-080/080D) at concentrations of 1,600 and 16,000 µg/L, respectively, (DEC-017/017D) at concentrations of 680 and 1,300 µg/L, respectively, and (DEC-079) at a concentration of 1,500 µg/L. TCE and/or cis-1,2-DCE were generally detected above criteria in monitoring wells where PCE was detected. An elevated concentration of TCE (29,000 µg/L in MW-030D) was detected in the deep overburden groundwater downgradient of the ACME Steel Areas. No vinyl chloride or BTEX compounds were detected in this area.

Based upon the observed concentrations of chlorinated VOCs from the latest groundwater sampling event, discrete dissolved phase chlorinated solvent plumes appear to originate in the vicinity of the ACME Steel/Brass Foundry Areas. The complete horizontal extent of the chlorinated solvents has not been fully delineated. The extent of PCE has a larger footprint in the shallow groundwater when compared to the extent of PCE in the deep groundwater. Discrete source areas appear to originate from the Former Brass Foundry location on Anthony Street in the vicinity of DEC-018, and from an apparent shallow soil source of PCE near well cluster DEC-080/DEC-080D. The detected concentration of PCE at DEC-040 is likely the result of a combination of an apparent shallow PCE source near DEC-016, and a shallow PCE plume originating from the Klink Cosmo Area. Elevated PCE concentrations appear to be centered on DEC-080D and this likely represents a discrete source.
TCE impacted groundwater appears to be centered on MW-30R and MW-30D with concentrations on an order of magnitude higher in the deep groundwater. It has yet to be determined if the TCE concentrations are attributable to degradation of PCE, the result of an upgradient source (i.e., DEC-016 and DEC-016D), a discrete source, or a combination of these scenarios. The vertical extent of PCE and TCE impacted groundwater is not expected to extend beyond the top of the Raritan Formation due to its vast areal extent and low permeability. Contamination in the deep groundwater near the top of the Raritan Formation is likely migrating with the direction of groundwater movement as depicted on Figure 3-15 (towards the north and northeast) from the Klink Cosmo Area. The overall extent of PCE in the deep groundwater above the top of the Raritan Formation is likely the result of a combination of PCE migration from the Klink Cosmo area and the ACME Steel Areas.

5.1.4.4 Potential Source Areas West of Morgan Avenue

PCE was detected in DEC-076 at a concentration of 30,000 µg/L and in DEC-077 at a concentration of 110 µg/L. PCE degradation products in these wells include: TCE at 200 and 12 µg/L, respectively; cis-1,2-DCE at 1,500 and 13 µg/L, respectively; and vinyl chloride at 4.8 µg/L in DEC-076. Additional VOCs which exceeded GA criteria in the groundwater sample from DEC-076 include: 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, trans-1,2-DCE, benzene, and xylene.

Based upon the observed concentrations of VOCs from the latest groundwater sampling event, a discrete chlorinated solvent plume appears to originate in the vicinity of DEC-076. The complete horizontal and vertical extent of the chlorinated solvents has not been delineated. PCE in DEC-076 at the observed concentrations indicates a source upgradient of the Former Aphrodite Cleaners and the Former Belmet Products. The source has not been identified with certainty.

5.1.5 Baseline Groundwater Monitoring

Groundwater analytical data has been collected within the Meeker Avenue Plume Trackdown area during previous phases of site characterization as well as during this SC Phase VI. This data includes both laboratory analytical results and field results. Existing groundwater laboratory and field analytical data will be evaluated and assessed to determine if statistical trends are observed. The
October 2011 sampling results establish the baseline data for future comparison of groundwater sampling data, which will be used to evaluate the potential for natural attenuation.

5.1.6 **Soil Gas**

A total of 28 sampling locations were completed as part of the Phase VI SC. Results are summarized by site area below.

5.1.6.1 **Spic and Span Area**

No soil vapor data was collected in the vicinity of the Spic and Span Area during the SC Phase VI field investigation.

5.1.6.2 **Klink Cosmo Area**

Soil vapor samples were collected to the north and northeast of the Klink Cosmo Area during the SC Phase VI field investigation. In general, the concentrations found within the Klink Cosmo Area showed no discernible trend compared to previously sampled locations. Concentrations at some locations were different from the last sampling events up to three orders of magnitude. This may be attributed to a significant amount of precipitation that had occurred prior to the soil vapor sampling event on August 17 and 18, 2011. For example, SG-042 was sampled in June 2011 and a PCE concentration of 803,000 µg/m$^3$ was detected. When an attempt was made to sample SG-042 on August 17, 2011, it was found to contain water. This location was re-sampled on September 29, 2011 and a concentration of 540 µg/m$^3$ was detected.

5.1.6.3 **ACME Steel Areas**

A limited number of soil vapor locations were sampled in the southeast portion of the ACME Steel/Brass Foundry Area. The concentrations found within the ACME Steel/Brass Foundry Area showed no discernible trend in previously sampled locations. At SG-022, SG-040, and SG-042, 1,1,1-trichloroethane was detected at 2,200, 42,000 and 5,000 µg/m$^3$, respectively. These locations are located southeast and south of ACME Steel/Metal Works building located at 95 Lombardy Street.
5.1.6.4 Potential Source Areas West of Morgan Avenue

Soil vapor data was collected within and to the north and northeast portion of the area West of Morgan avenue during the SC Phase VI field investigation. The detected concentrations showed no discernible trend when compared with previously sampled locations. Results from the newly installed locations indicate an elevated concentration of PCE (130,000 µg/m$^3$) at SG-95, which is located adjacent to the Former Aphrodite Cleaners. Elevated concentrations of PCE, TCE and 1,1,1-trichloroethane were found at SG-90 and SG-91 which are located downgradient of Former Aphrodite Cleaners and the Former Belmet Products. These results do not correlate with groundwater results. Additional characterization is needed in this area.

5.2 Source Characterization

5.2.1 Sources

Using data obtained during the SC Phase VI of the investigation performed by URS [i.e., historical information (e.g., Sanborn maps, EDR reports, and business directories) and soil data] two sources of PCE contamination have been identified and are shown on Plates 1 and 2. Descriptions and locations of the two sources are discussed below.

- The facility that contained a former soap manufacturer and lacquer storage, located at 171 Lombardy Street and 514 Varick Avenue (Brooklyn Tax District, Block 02821, Lot 0001) is a source of soil and groundwater contamination. Based on Sanborn map data, the facility had been utilized during the 1930s for lacquer storage and as a soap powder manufacturer from the early 1950s to 1989. A shallow source of soil contamination at DEC-080 and DEC-080D (i.e., PCE) was identified while clearing the boring locations for utilities. PCE was detected in the soil at DEC-080D in the 0 - 2.0 foot and 5.0 - 6.0 foot bgs interval at 11,000 and 1,100 mg/kg, respectively. PCE was detected in the groundwater at DEC-080 and DEC-080D at 1,600 and 16,000 µg/L, respectively.

- The facility that contained a former warehouse, located at 300 Kingsland Avenue (Brooklyn Tax District, Block 02821, Lot 0001) is a source of soil and groundwater contamination.
Based on Sanborn map data, the facility has been utilized from 1905 to at least 1942 for sorting and storage, as a wholesale grocery warehouse from 1965 to 1987, and as a warehouse from 1988 to present. An unsubstantiated claim by a local resident indicated that at one time the Former Spic and Span Cleaners at one time used it to house their delivery trucks. This claim is plausible and the facility may have been used for the sorting and storage of clothing associated with the Former Spic and Span Cleaners. A shallow source of soil contamination (i.e., PCE) was found while clearing the boring location for DEC-025D for utilities. PCE was detected in the soil at DEC-025D in the 0 - 1.5 foot and 1.5 - 2.0 foot bgs interval at 140 and 1,300 mg/kg, respectively.

5.2.2 Potential Sources

A total of eleven additional potential source areas have been identified within the study area (Plates 1 and 2). The eleven potential source areas have been identified as areas where additional information needs to be gathered to determine if any of these areas are responsible for, or are contributing to, the presence of PCE and/or TCE in the environment. In addition to dry cleaners, numerous other facilities that may have used PCE and/or TCE as degreasers or processed drums containing degreasers (e.g., metal plating operations, metal working facilities, and drum recycling/storage facilities) have been identified. No data was gathered during Phase VI that would definitively exonerate any of the potential sources. The potential sources are listed below.

- The facility that contained the former Belmet Products was located at 485 Morgan Avenue (Brooklyn Tax District, Block 02841, Lot 0020) and 43 Beadel Street (Brooklyn Tax District, Block 02834, Lot 0034). Belmet Products occupied these properties from at least 1951 to 1995 and worked with metal products. EDR listed the former Belmet Products as a F001 waste generator and also a Resource Conservation and Recovery Act (RCRA) small quantity generator (SQG). The Sanborn maps also indicate that the property at Block 02841, Lot 0020 was a carpet cleaner in 1933 and a garage in 1951. The Sanborn maps also indicate that the property at Block 02834, Lot 0034 was occupied by a gas station in 1933 and 1951.
The property at 34 Beadel Street/ 45 Division Place (Brooklyn Tax District, Block 02841, Lot 0010) and 48 Beadel Street (Brooklyn Tax District, Block 02841, Lot 0018) historically contained a warehouse and plating facility from at least 1951 to 1995.

The property at 35 Division Place (Brooklyn Tax District, Block 02841, Lot 0035) is currently, and historically has been, occupied by dry cleaning facilities (Aphrodite Cleaners, French Valet Cleaner and Naxos Cleaners). EDR listed the former French Valet Cleaners as RCRA SQG. The Sanborn maps also indicate that the property at Block 02841, Lot 0035 was also part of the metal works found at 45 Division Place (Brooklyn Tax District, Block 02841, Lot 0010) in 1951.

The property at 25 Division Place (Brooklyn Tax District, Block 02841, Lot 0001) currently house EPNER Technology Inc. (EPNER), which is a metal plating business. EDR listed EPNER as a F001 waste generator and also a RCRA large quantity generator (LQG). The Sanborn maps also indicate that the property at Block 02841, Lot 0001 has been used as a wholesale paint and hardware store in 1951 and for manufacturing (not specified) from 1965 to present.

The property at 18 Division Place (Brooklyn Tax District, Block 02849, Lot 0010) is currently occupied by Goodman Bros. Steel Drum Co. Inc. Sanborns maps indicate that the property historically has been a cooperage since 1933. EDR listed the cooperage as a F001 waste generator and also a RCRA LQG.

The property at 297 Richardson Street (Brooklyn Tax District, Block 02850, Lot 0001) currently houses Adar Medical Uniforms. Sanborns maps indicate that the property historically contained manufacturing and steel working.

The properties at 38 Division Place (Brooklyn Tax District, Block 02850, Lot 0010) and 42-50 Division Place (Brooklyn Tax District, Block 02850, Lot 0014), were formerly associated with Albert Plating Works Inc. (Albert). The property at Block 02850, Lot 0014 performed rayon dying in 1933. Albert occupied both properties from at least 1951 through 1995.

The property at 87 Debevoise Avenue (Brooklyn Tax District, Block 02858, Lot 0021) performed shellac manufacturing from at least 1933 to 1995 according to Sanborn maps.
• The property at 84 Debevoise Avenue (Brooklyn Tax District, Block 02859, Lot 0001) which currently houses ELIOU and Scopelitis Steel has records at the NYSDEC as being a RCRA waste generator. The property has been occupied since at least 1965.

• The property 310 Richardson Street (Brooklyn Tax District, Block 02859, Lot 0011) is identified on Sanborn maps as a sign manufacturer from at least 1951 to 1995.

• The property at 329 Frost Street (Brooklyn Tax District, Block 02859, Lot 0011) previously housed a drum cleaning and painting facility. Sanborn maps indicate that the property housed steel drum reconditioning and painting in 1951 and a drum cleaning and storage operations from 1965 to 1981.

5.3 Recommendations for Phase VII Fieldwork

The following recommendations are offered for consideration by the NYSDEC. The recommendations include additional Site Characterization activities.

• Thirteen shallow monitoring wells should be installed to an approximate depth of 45 feet at the locations shown on Plate 1, with the majority of these wells to be installed West of Morgan Avenue. The shallow monitoring wells should be constructed with 15 feet of 2-inch ID, Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser. The screens should be nominally set between 5 feet above and 10 feet below the water table at most locations. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry will then be installed around the riser to an elevation of 1-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing will complete each well. The rationale for the additional shallow monitoring wells is discussed in the subsection below.

• Eight deep monitoring wells should be installed to an approximate depth of 80 feet at the locations shown on Plate 1. These wells will further assist in determining the direction of groundwater flow and the impacts of PCE and TCE in the deeper groundwater. Samples will be collected continuously from the bottom of the existing borings until a confining unit is
encountered or 35 feet below the shallow monitoring well, whichever comes first. The construction material of the deep wells depends on the area that they will be installed within, and is discussed in more detail below. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screen. A bentonite slurry will then be installed around the riser to an elevation of 1-foot below grade via tremie pipe. An 8-inch diameter, flush-mount protective casing will complete each well.

- One top of clay monitoring well should be installed to an approximate depth of 105 feet at DEC-028 to assess the presence/absence of PCE due to a northerly groundwater flow direction. The construction specification of the top of clay well is discussed in more detail below. The rationale for the additional deep monitoring wells is discussed in the subsection below.

- Ten soil borings should be advanced in the vicinity of DEC-080 and DEC-080D to determine the horizontal and vertical extent of PCE impacted soils. The soil borings will be advanced until PID readings are zero or a confining/less permeable unit (i.e., clayey silt or silty clay) is encountered. All soil borings will be backfilled with bentonite chips to 4 feet bgs. Well sand will be placed from 0.5 - 4.0 feet bgs and the top 0.5 feet will be repaired as per the surrounding surface material.

- Up to two soil samples should be collected from each boring location: one soil sample from the interval just above water table; and the second sample from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading are encountered, then only one sample from the interval just above the water table should be collected, as per the FAP (URS, April 2010). All soil samples should be analyzed for TCL VOCs plus TICs by 8260B.

- At least one sample from each stratigraphic layer should be collected and analyzed from a minimum of two borings for TCL VOCs plus TICs by 8260B, TCL SVOCs plus TICs by 8270C, TCL pesticides/PCBs by 8081A/8082, herbicides by 8151A, TAL metals by 6010B/7471A, hexavalent chromium by 7196A, cyanide by 9010B/9012A, and TOC by Lloyd Khan.

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If DNAPL is encountered in any new monitoring well(s) during drilling, well development or purging, a DNAPL sample should be collected for laboratory analyses. The DNAPL sample(s) should be analyzed for TCL VOCs plus TICs by 8260B, TCL SVOCs plus TICs by 8270C, petroleum hydrocarbon scan by 8100 (modified), specific gravity by ASTM D4052, surface tension by ASTM D-971, and viscosity by ASTM D-445.

A complete round of groundwater samples should be collected from all new and existing DEC wells sampled during the SC Phase VI. All groundwater samples were analyzed for TCL VOCs plus TICs and natural attenuation parameters (i.e., alkalinity, chloride, nitrate, nitrite, sulfate, total iron, dissolved iron, ferrous iron (field parameter), TOC and methane/ethane/ethene). Prior to the start of groundwater sampling, a synoptic round of water levels should be collected from all DEC wells located within the Meeker Avenue Plume Trackdown Area.

Up to 10 additional soil vapor implants should be installed at the locations shown on Plate 2. These locations will further assist in determining the horizontal impacts of PCE and TCE in the potential source areas West of Morgan Avenue. At least one soil sample should be collected from each soil vapor implant location from the interval exhibiting odors, staining, or the highest PID reading. If no odors, staining, or elevated PID reading are encountered, then only one sample from the bottom of the location should be collected, as per the FAP. All soil samples should be analyzed for TCL VOCs plus TICs by 8260B.

A complete round of soil gas samples should be collected from all new and existing DEC soil gas implants sampled during the SC Phase VI. The soil gas samples should be analyzed for VOCs by TO-15, as per the FAP.

5.3.1 Spic and Span Area

One deep well location is recommended in the Spic and Span Area. The deep well will be constructed with 10 feet of 2-inch ID, Type 304 stainless steel 0.010-inch slot screen equipped with a 2-foot sump and Type 304 stainless steel riser. Stainless steel has been recommended due to the
possible presence of DNAPL and the incompatibility between PCE and/or TCE and PVC materials. The rationale for the deep well location in the Spic and Span Area can be found in Table 5-1.

5.3.2 **Klink Cosmo Area**

One shallow, two deep and one top of clay well are recommended in the Klink Cosmo Area. The deep monitoring wells that will be installed will be constructed using 10-foot long Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser and constructed as specified above. At the top of clay well location, a hybrid well consisting of a 10-foot screen of 4-inch ID, Type 304 stainless steel 0.010-inch slot screen with a 2-foot long sump, 10 feet of 4-inch ID, Type 304 stainless steel riser above the screen and, 4-inch ID, Schedule 40 PVC the remainder of the well string, to the surface, should be set. A 00 or 00N size sand pack will be installed from the bottom of the well up to 2 feet above the top of the well screens. A cement/bentonite slurry will then be installed around the riser to an elevation of 1-foot below grade via tremie pipe. A 12-inch diameter, flush-mount protective casing will complete the well. The rationale for the well locations in the Klink Cosmo Area can be found in Table 5-2.

5.3.3 **ACME Steel Areas**

Four shallow and four deep well are recommended in the ACME Steel Areas. The deep monitoring wells will be constructed using 10-foot long Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser as specified above. The rationale for the well locations in the ACME Steel Areas can be found in Table 5-3. It should be noted that the monitoring wells PW-1S and PW-1D will need to be completed with stick-up protective casings and bollards. In addition, 10 soil borings will be advanced in the vicinity of DEC-080 and DEC-080D to determine the horizontal and vertical extent of PCE impacted soils. The location of the soil boings will be determined in the field following consultation with the Department Project Manager.
5.3.4 Potential Source Areas West of Morgan Avenue

Eight shallow and one deep well are recommended in this area. The deep monitoring well will be constructed using 10-foot long Schedule 40 polyvinyl chloride (PVC) 0.010-inch slot screen and riser as specified above. The rationale for the well locations can be found in Table 5-4.
6.0 REFERENCES


New York State Department of Environmental Conservation (NYSDEC). January 24, 1994. Technical and Administrative Guidance Memorandum (TAGM) #4046, Determination of Soil Cleanup Objectives and Cleanup Levels. (Revised), including the STARS Memo #1 compounds as per the NYSDEC Memorandum dated December 20, 2000


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URS. December 2011. Remedial Investigation – Former Klink Cosmo Cleaners Site, Site No. 224130, Kings County, NY